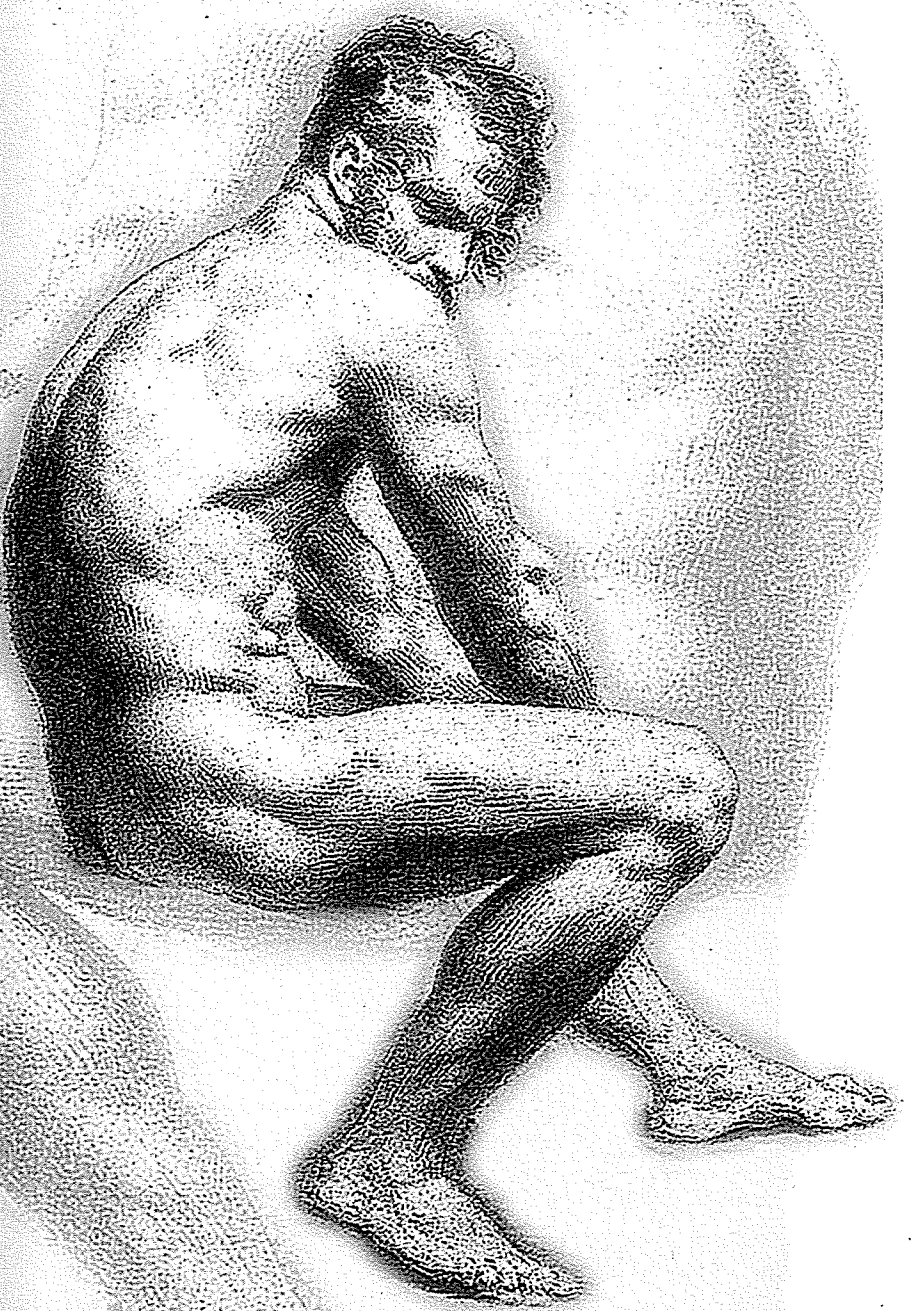
INTERNATIONAL CONGRESS ON SPINAL SURGERY

METU-ANKARA / TURKEY



METU

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program & abstract book

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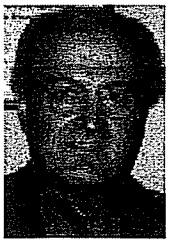

PRESIDENTS MESSAGE

I wish to welcome you to the land that has a history as old as the first human settlement. You are now on the land where Troy met Greek, Homer wrote the Iliad and Odysseus, Phrygian people invented money, Hattie's grew their civilization as big as ancient Egypt, and Mesopotamian people invented the letters and trade with Hattie's. You are at the land where Asia and Europe meets; Alexander the great went to East and Mongolians to the West; Civilizations, hundreds of them grew and disappeared; Religions who found life first on earth; Turks and Ottomans who ruled this part of the world for more than 1000 years. You will find the first clues of science from Stone Age to Avicenna and signs of education of East which once deeply influenced West.

Not only science but affections grow as experiences are shared. In the name of the organizing committee and myself, I wish to thank all attendees who came to this congress to share their experience, thoughts and ideas on spinal surgery. We do appreciate the time and effort you made to be here. We do also know that establishing and improving experience is a difficult and long lasting event. Experience, however, needs to be shared whether it is successful or not.

There is a Chinese saying that if you think the coming year you may grow good rice but if you think of the coming 50 years you only than may educate your people.

Your contribution to this congress is of huge value as cultivating experienced and well educated spinal surgeons is our ultimate aim. The world is getting smaller with the developments in technology. Computers and their infinite network at our hands make access to scientific information more easily than ever. Exchange of information, sharing comments and experiences may shape our near future. In the foreseeable future even surgical skills may be transferable by computers. Thus, one should keep in mind that science, education and surgery can only be close to perfect by understanding each other. Human relations face to face and hand by hand shall make our dream come through. That is what makes international meetings so valuable.

The president of Middle East Technical University provided us this congress venue and technical equipment. The campus of this university is open for our use throughout this congress.

The organizing committee arranged 18 lectures and 2 panels for this congress. Let me remind you that lectures start as early as 07:30 AM each morning. There will be 60 oral and 60 poster presentations under the titles of Basic Science, Trauma, Deformity, Tumors and Infections, Degenerative Spine and Miscellaneous. Best clinical, basic, podium and poster presentations will be awarded. An internet café shall be available and this is going to be the only section of the congress venue where smoking is allowed. The commercial part of the congress constitutes of exhibitions and workshops. I also wish to thank our technical exhibiters who financially supported this congress.

I am thankful to our lecturers who come from various cities of Turkey and distant countries. Dr. Akalan, Dr. Alanay, Dr. Alıcı, Dr. Aydınlı, Dr. Benli, Dr. Domaniç, Dr. Fuji, Dr. Gülşen, Dr. Hamzaoğlu, Dr. Lenke, Dr. Leong, Dr. Öner, Dr. Raushning, Dr. Şar, Dr. Webb, Dr. Yonenobu and Dr. Zeller and Dr. Batterjee.

I also wish to thank to Dr. Acaroğlu and Dr. Korkusuz who have been working for two years to make this congress possible for their invaluable efforts. Other hard workers were Ms. Banu Akman and her team from Astral Tourism who successfully dealed with every detail of this congress, without their expert help, this meeting would not have possibly existed.

I hope you will enjoy the scientific and social part of the congress and feel the kindness, sincerity, and hospitality of the people of this country.

With my sincere regards,

Tarık Yazar MD
Congress President

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* On behalf of the Ankara Group of the Turkish Society of Spinal Surgery

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GENERAL INFORMATION

Registration

All delegates must register to the congress. The working hours of the registration desk is given below.

04 September 2002	Wednesday	13:00 – 18:30
05 September 2002	Thursday	07:00 – 18:30
06 September 2002	Friday	07:00 – 18:30
07 September 2002	Saturday	07:00 – 18:30

The registration fee includes:

Participants

- ✓ registration to the congress
- ✓ congress kit
- ✓ congress certificate
- ✓ coffee-breaks
- ✓ welcome reception
- ✓ gala dinner

Accompanying Persons

- ✓ welcome reception
- ✓ gala dinner

Name Badges

Participants and Accompanying Persons must wear their congress badges throughout the meeting to gain the admission to conference venue, scientific sessions, and social program. The color codes of the badges are:

Participants	Red
Exhibitors	Green
Congress Staff	Purple

Posters

The posters will be on display in the Poster Hall throughout the meeting, September 4 – 7. The place for each poster will be indicated in advance and the poster presenters should fix their presentations with assistance of the congress staff in charge. The schedule cards are attached to each poster board indicating the poster presenter's preferred date and time for discussion.

Language

The official language of the congress is English. Simultaneous translation from Turkish to English and English to Turkish will be provided during all sessions in the Main Hall (Kemal Kurdaş)

Commercial Exhibition

The trade exhibition takes place in the main foyer. The exhibition is open every day from 07:30 to 18:30.

Certificates of Attendance

The certificates will be available at the registration kit. The certificates will be signed by the President and the General Secretary of the Meeting.

Smoking

This congress promotes a smoke free environment. Smoking is prohibited in the congress venue. The internet café is going to be the only section of the congress venue where smoking is allowed.

Cellular Phones

Please kindly refrain from leaving your cellular phones active in the congress session rooms, because of the electronic interference between cellular phones and audiovisual systems.

Hospitality Desk

The Hospitality desk is situated next to the Registration Desk in the entrance of conference venue, METU – Cultural & Convention Center. The desk will be open from 07:00 until 18:30 every day. Inquiries concerning the reservations for the sightseeing tours, post-congress tours, reconfirmation of the tickets and departure airport transfers, may be made at this desk.

Transportation Arrangements

Transportation is provided between the Hotel Dedeman, Hilton Hotel, Hotel Bilkent and the congress venue, and will be available from 07:00 each morning till the end of the social program.

For your departure airport transfers please contact the Astral Congress Organization - Hospitality Desk.

Lost and Found

Please enquire at the hospitality desk for any items lost whilst at the congress.

Social Program

Invitations are for social events are distributed at the time of registration. Invitations are per one person only and should be presented at official social events, without which admittance may be denied.

Wednesday; September 4, 2002

19:00 – 20:00	Opening Ceremony
20:00 – 24:00	Welcome Reception (casual dressing)

Thursday; September 5, 2002

12:30 – 13:00	Opening of the Kayahan Keskinok Painting Exhibition Wine & Cheese Party
20:00 – 22:00	The Youth Guitar Orchestra Concert – tickets will be available in the Hospitality Desk

Friday; September 6, 2002

16:00 – 18:30	Social Activities Ankara Sightseeing and Shopping Tour Program Paintball Tournament Open Tennis Tournament Archery Tournament
20:00 – 24:00	Gala Dinner (official dressing)

Saturday; September 7, 2002

16:00 – 16:30	Closing Ceremony
18:00 – 19:30	Turkish Bath Tour

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PROGRAM AT A GLANCE

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(Pediatric Deformity)</td><td rowspan="7">'Spinal
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SCIENTIFIC PROGRAM

Wednesday; September 4, 2002

TRAUMA COURSE (Thoracolumbar Burst Fractures)

14:15 – 14:30	**TC-1**	Biomechanics of Thoracolumbar Burst Fractures *Feza KORKUSUZ*
14:30 – 14:45	**TC-2**	Classification of Thoracolumbar Burst Fractures *Mehmet ALTINMAKAS*
15:00 – 15:15	**TC-3**	Conservative Treatment of Thoracolumbar Burst Fractures *Ali BİÇİMOĞLU*
15:15 – 15:30	**TC-4**	Posterior Instrumentation in Thoracolumbar Fractures *F. Cumhur ÖNER*
15:30 – 15:45	**TC-5**	Anterior Instrumentation in Thoracolumbar Burst Fractures *Serdar AKALIN*
15:45 – 16:00	**TC-6**	Combined Anterior-Posterior Surgery in Thoracolumbar Fractures *Mark WEIDENBAUM*
16:00 – 16:15	**TC-7**	Spinal Cord Injury in Thoracolumbar Burst Fractures *Murat HANCI*
16:15 – 16:30	**TC-8**	Complications of Surgery in Thoracolumbar Burst Fractures *Nejdet ALTUN*
16:30 – 17:30	**Case Discussions** Moderator: *Mark WEIDENBAUM*	
19:00 – 20:00	**OPENING CEREMONY**	
20:00 – 24:00	**WELCOME RECEPTION**	

Thursday; September 5, 2002

Moderator: *Mahir GÜLŞEN*

07:30 – 08:00 **IL-1** Cervical Spondylothic Myelopathy. Its Clinical Manifestations and Spinal Cord Pathology
Kazuo YONENOBU

08:00 – 08:30 **IL-2** Choice of Surgical Treatment for Multisegmental Cervical Spondylothic Myelopathy
Kazuo YONENOBU

Moderator: *Haluk BERK*

08:30 – 09:00 **IL-3** Stabilization of the Cervical Spine Using the Alligator Plate System
Takeshi FUJI

09:00 – 09:30 **IL-4** Traumatic Atlanto-Axial Instability Treated by Magerl Technique ---Transarticular Screw Fixation---
Takeshi FUJI

Moderator: *Tarik YAZAR*

09:30 – 10:00 **GL** Pathoanatomy and Pathophysiology of Low Back Pain
Wolfgang RAUSCHNING

10:00 – 10:30 **COFFEE BREAK**

Moderator: *Kazuo YONENOBU, Necdet ALTUN*

10:30 – 10:35 **BS-01** Measurement of Sagittal Inclination of the Lumbar Vertebrae at Pone Position
A. Esat KITER, Fahir DEMİRKAN, B. Alper KILIÇ, Gürkan ERKULA, Ertan ER

10:35 – 10:40 **BS-02** The Use of Demineralized Bone Matrix with Autogenous Bone Graft, or Allogenic Bone Graft for Posterolateral Lumbar Intertransvers Spine Fusion
Şevki KABAK, Volkan KAYAR, Mehmet HALICI, Mahmut ARGUN, Sami ENGİN

10:40 – 10:45 DISCUSSION

10:45 – 10:50 **BS-03** Experimental Spinal Fusion with Bioabsorbable Rods
Murat BEZER

10:50 – 10:55 **BS-04** Comparison of Short Segment Pedicle Instrumentation with Supplemental Hook Fixation (Under axial compression): A biomechanical Study on Calf Spine
Kıvanç MURATLI, Haluk BERK

10:55 – 11:00 DISCUSSION

11:00 – 11:05 **BS-05** In Vitro Biomechanical Evaluation of A New Rod-Screw Implant System for the Posterior Occipito-Cervical Instrumentation
Balkan ÇAKIR, H-J WILKE, L.CLAES, W. PUHL, M. RICHTER

11:05 – 11:10 **BS-06** Preliminary Results for Axial Low Back Pain Treated With Coblation: A Comparison of Patients With and Without a Central Focal Protrusion
Curtis W. SLIPMAN, Atul L. BHAT, Russell V. GILCHRIST, Zacharia ISAAC, Anthony LEE, Cyndi GARVAN, Larry CHOU, David A. LENROW, Edward J. VRESILOVIC JR

11:10 – 11:15 DISCUSSION

11:15 – 11:20 **BS-07** Disc Temperature Measurements During Nucleplasty and Idet Procedures
Duran N. YETKİNLER, William H. NAU, Lori L. BRANDT, Chris DIEDERICH

Abbreviations

GL: Presidental Guest Lecture
PN-PD: Panel-Pediatric Deformity
BS: Basic Science
D: Deformity
DS: Degenerative Spine
TC: Trauma Course
PN-AD: Panel-Adult Deformity
IL: Instructional Lecture
T: Trauma
TI: Tumors/Infection
M: Miscellaneous
SRAS: Spinal Rehabilitation in Athletes' Symposium

11:20 – 11:25 **BS-08** The Effect of Radiofrequency Energy on Dural Tissue: Histomorphologic Analysis
Michael VIVES, Richard MANOS, Philip YUAN, Christopher KAUFFMAN, Steven GARFIN, Duran N. YETKİNLER

11:25 – 11:30 DISCUSSION

Moderator: *F.Cumhur ÖNER*

11:30 – 11:35 **T-01** The Outcome of Surgery of Acute Vertebral Fractures of the Thoracic and Lumbar Spine
JJ VERLAAN, C.H. DIEKERHOF, F.C. ÖNER, W.J.A. DHERT, A.J. VERBOUT

11:35 – 11:40 **T-02** Results of Conservative Treatment in Thoracolumbar Vertebral Fractures
Erden ERTÜER, Mehmet TEZER, İrfan ÖZTÜRK, Ünal KUZGUN

11:40 – 11:45 DISCUSSION

11:45 – 11:50 **T-03** Vertebroplasty with the Use of Hydroxiapatite Cylindrical Sticks in Treating Painful Thoracolumbar Osteoporotic Collapse
Tomoaki TOYONE, Tadashi TANAKA, Daisuke KATO, Ryutaku KANEYAMA

11:50 – 11:55 **T-04** The Course of Non-Surgical Management of Burst Fractures with Intact Posterior Ligamentous Complex (PLC): An MRI Study
Ahmet ALANAY, Egemen TURHAN, Emre ACAROĞLU, Muharrem YAZICI, Ayşenur CİLA, Adil SURAT

11:55 – 12:00 DISCUSSION

12:00 – 12:05 **T-05** Lumbar Vertebral Transverse Processes Fractures: Are They Really Innocent ?
Bülent DAĞLAR, Bülent Adil TAŞBAŞ, Kenan BAYRAKÇI, Güzelali ÖZDEMİR, Uğur GÜNEL

12:05 – 12:10 **T-06** Comparison of The Results of Anterior Screw-Plate Instrumentation and Anterior Dual-rod Screw Instrumentation in The Treatment of Thoracolumbar Burst Fractures
Serdar AKALIN, İ.Teoman BENLİ, Gökhan TEMELLİ, Mehmet ÇITAK, Mahmut KIŞ

12:10 – 12:15 DISCUSSION

12:15 – 12:20 **T-07** Evaluation of Spinal Canal Compression and Remodeling and The Effect of Posterior Instrumentation and Fusion in Thoracolumbar Burst Fractures
Serdar AKALIN,Özgur KARAKAŞ, İ.Teoman BENLİ, Evrim DUMAN, Mahmut KIŞ, Erbil AYDIN

12:20 – 12:25 **T-08** Effect of The Different Instrumentation Techniques in Protecting The Surgical Correction of The Unstable Thoracolumbar Vertebral Fractures
Erhan SERİN, Lokman KARAKURT, Erhan YILMAZ, Oktay BELHAN

12:25 – 12:30 DISCUSSION

12:30 – 13:30 **LUNCH – BREAK**

Moderator: *Emin ALICI*

13:30 – 14:00 **IL-5** Brief History of Spinal Surgery in Turkey
Tarık YAZAR

Panel Chairman: *John LEONG*

14:00 – 14:20 **PN-AD-1** An Overview of Adult Spinal Deformity
Larry LENKE

14:20 – 14:40 **PN-AD-2** Degenerative Scoliosis
Ünsal DOMANİÇ

14:20 – 14:40 **PN-AD-3** Surgical Treatment of Sagittal Deformity in Ankylosing Spondylitis
John LEONG

15:00 – 16:00 DISCUSSION

16:00 – 18:30 **WORKSHOPS**

HALL A MOSS-Miami Workshop – Johnson & Johnson DePuy AcroMed
Azmi HAMZAOĞLU

HALL C Ege Group
X-Ray Free Skeleton Diagnostic System Workhop

HALL D Stryker Xia Polyaxial System
P.I.J.M. WUISMAN

HALL E VBR: Vertebral Body Replacement - System and Technique
Ulrich GmbH & Co. KG

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M: Miscellaneous
SRAS: Spinal Rehabilitation in Athletes' Symposium

Friday; September 6, 2002

Moderator: *Ünsal DOMANİÇ*

07:30 – 08:00 **IL-6** New Classification System in Ais; Impact on Surgery
Larry LENKE

08:00 – 08:30 **IL-7** Cervical Trauma
Cüneyt ŞAR

Moderator: *Ufuk AYDINLI*

08:30 – 09:00 **IL-8** The Role of MRI in the Classification of Thoracolumbar Spine Injuries
F.Cumhur ÖNER

09:00 – 09:30 **IL-9** Lower Lumbar Burst Fractures
Ufuk AYDINLI

09:30 – 10:00 **IL-10** Vertebroplasty
Ahmet ALANAY

10:00 – 10:30 **COFFEE BREAK**

Moderator: *Lawrence LENKE, Mehmet ALTINMAKAS*

10:30 – 10:35 **D-01** The Residual Rotation and Tilt of the Lowest Instrumented Level (LIV) in Posterior Instrumentation for Adolescent Idiopathic Scoliosis (AIS). Are They Really Important?
Emre ACAROĞLU, Vedat DEVİREN, Ahmet ALANAY, Akın ÇİL, Akın ÜZÜMCÜGİL, Muharrem YAZICI, Adil SURAT

10:35 – 10:40 **D-02** Scoliosis Screening with Evaluation of Joint Laxity. The Relation Between Trunk Rotation and Joint Laxity
A. Esat KITER, Gürkan ERKULA, B. Alper KILIÇ, Ertan ER

10:40 – 10:45 DISCUSSION

10:45 – 10:50 **D-03** Reliability of The Superficial Abdominal Reflexes in Spinal Examination
A. Esat KITER, Gürkan ERKULA, Ertan ER, Haluk BERK

10:50 – 10:55 **D-04** Correction of Adolescent Idiopathic Scoliosis Using Thoracic Pedicle Screw Fixation versus Traditional Hook Contructs: A Single Surgeon Retrospective Review
Steven K. STORER, Michael G. VITALE, Darria E. LONG, Julie C. CHOE, Joshua E. HYMAN, Francis Y. LEE, David P. ROYE Jr.

10:55 – 11:00 DISCUSSION

11:00 – 11:05 **D-05** Pediatric Spine Deformity: Assessing Patient Outcomes and Quality of Life
Michael G. VITALE, Douglas E. LEVY, Julie C. CHOE, Annetine C. GELIJNS, Alan J. MOSKOWITZ, Joshua E. HYMAN, Francis Y. LEE, David P. ROYE JR.

11:05 – 11:10 **D-06** Effect of Bracing on The Quality of Life of Adolescents with Idiopathic Scoliosis
Obinwanne F. UGWONALI, Guillem LOMAS, Julie C. CHOE, Joshua E. HYMAN, Francis Y. LEE, Michael G. VITALE, David P. ROYE JR.

11:10 – 11:15 DISCUSSION

11:15 – 11:20 **D-07** The effect of Apical Vertebral Instrumentation in Surgical Treatment of King Type II Curves
Ömer AKÇALI, Can KOŞAY, Emin ALICI

11:20 – 11:25 **D-08** Assessment of Curve Flexibility in Adolescent Idiopathic Scoliosis .
F.Erkal BİLEN, Ufuk TALU, Mehmet TEZER, Cüneyt MİRZANLI, Ünsal DOMANİÇ, Azmi HAMZAOĞLU

11:25 – 11:30 DISCUSSION

Moderator: *Adil SURAT, Emre ACAROĞLU*

11:30 – 11:35 **D-09** Evaluation of Titanium Mesh Cages Used for Anterior Column Support Following Corpectomy in the Thoracic and Lumbar (T1-S1) Region with Minimum Two-Year Follow-up
Oğuz KARAEMİNOĞULLARI, Mürsel DEBRE, F.Erkal BİLEN, Ufuk TALU, Ünsal DOMANİÇ, Azmi HAMZAOĞLU

11:35 – 11:40 **D-10** Thoracic Adolescent Idiopatchic Scoliosis: Correction with Translation Using Polyaxial Reduction Screws
Cüneyt ŞAR, Önder KILIÇOĞLU

11:40 – 11:45 DISCUSSION

11:45 – 11:50 **D-11** Does Fulcrum Bending Predict Postoperative Correction in Adolescent Idiopathic Scoliosis King-Moe Type III Curves?
Haluk BERK,İlker ÖZDEN, Cem Ozan ARDIÇ, Ömer AKÇALI

11:50 – 11:55 **D-12** Gait Analysis Before and After Posterior Fusion in Unbalanced Adolescent Idiopathic Scoliosis
A.Şükrü SOLAK, Behzat KENTEL

11:55 – 12:00 DISCUSSION

12:00 – 12:05 **D-13** Combined Anterior-Posterior Arthrodesis For Adult Lumbar and Thoraco-Lumbar Scoliosis
Vedat DEVİREN, Sigurd BERVEN, Serena HU, David BRADFORD

12:05 – 12:10 **D-14** Treatment of Thorocolumbar Scoliosis with Anterior Instrumentation; Adults vs. Adolescent
Vedat DEVİREN, Sigurd BERVEN, Serena HU, David BRADFORD

12:10 – 12:15 DISCUSSION

12:15 – 12:20 **D-15** Trunk Balance Analysis of Late Onset Idiopathic Scoliosis Patients Treated with TSRH Instrumentation
İ.Teoman BENLİ, Mahmut KIŞ, Mehmet ÇITAK, Serdar AKALIN

12:20 – 12:25 **D-16** Neural Axis Abnormalities Determined by MRI in The Patients with Type III Idiopathic Scoliosis
İ.Teoman BENLİ, Evrim DUMAN, Levent GÜRSES, Baki HEKİMOGLU

12:25 – 12:30 DISCUSSION

12:30 – 13:30 **LUNCH BREAK**

Moderator: *Emre ACAROĞLU*

13:30 – 14:00 **IL-11** Tuberculosis Spondylitis
İ. Teoman BENLİ

14:00 – 14:30 **IL-12** Tuberculosis of the Spine and its Sequelae
John LEONG

Moderator: *Reinhard ZELLER, Teoman BENLİ*

14:30 – 14:35 **D-17** Anterior Fusion and Instrumentation in the Treatment of Congenital Spinal Deformities
Mahir GÜLŞEN, Cenk ÖZKAN

14:35 – 14:40 **D-18** Pain in Patients with Scoliosis and Syringomyelia
Remzi A. ÖZERDEMOĞLU, Ensor E. TRANSFELDT, Francis DENIS

14:40 – 14:45 DISCUSSION

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14:45 – 14:50 **D-19** The Efficacy of Convex Hemiepiphysiodesis in Patients with Iatrogenic Posterior Element Deficiency due to Diastematomyelia Excision
Akın ÜZÜMCÜGİL, Muharrem YAZICI, Ahmet ALANAY, Emre ACAROĞLU, Pınar OZIŞIK, Nejat AKALAN, Adil SURAT

14:50 – 14:55 **D-20** Analysis of Upper and Lower Thoracic Kyphosis in Healthy Individuals
Remzi Arif ÖZERDEMOĞLU, Ufuk AYDINLI, Salim ERSÖZLÜ, Aytun TEMİZ, Çağatay ÖZTÜRK

14:55 – 15:00 DISCUSSION

Moderator: *Takeshi FUJI, Tarik YAZAR*

15:00 – 15:05 **TI-01** Combined Anterior-Posterior Surgical Treatment for Adult Thoracolumbar Pott's Disease
Mehmet TEZER, Erden ERTÜRER, Cüneyt ERKEN, Irfan ÖZTÜRK, Ünal KUZGUN

15:05 – 15:10 **TI-02** Risk Factors of Postoperative Deep Wound Infections in Spinal Instrumentation, Analysis of 869 Cases
Cem Ozan ARDIÇ, Can KOŞAY, Ömer AKÇALI, R.Haluk BERK, Emin ALICI

15:10 – 15:15 DISCUSSION

15:15 – 15:20 **TI-03** - Withdrawn -

15:20 – 15:25 **TI-04** Surgical Outcome of Primary Benign and Malignant Spinal Tumors
İ.Teoman BENLİ, Serdar AKALIN, Mahmut KIŞ, Şükrü SOLAK, Erbil AYDIN, Evrim DUMAN

15:25 – 15:30 DISCUSSION

15:30 – 15:35 **TI-05** Treatment of Vertebral Body Replacement with Expandable Titanium Cages
Benjamin ULMAR, Balkan ÇAKIR, Markus RICHTER

15:35 – 15:40 **TI-06** Surgical Approach in T4n0m0 (Vertebral Involvement) Lung Cancer
Ufuk AYDINLI, Cengiz GEBİTEKİN, Sami BAYRAM, Salim ERSÖZLÜ, Çağatay ÖZTÜRK

15:40 – 15:45 DISCUSSION

15:45 – 15:50 **TI-07** Surgical Outcome of Metastatic Spinal Tumors
İ.Teoman BENLİ, Mahmut KIŞ, Serdar AKALIN, Mehmet ÇITAK, Şükrü SOLAK, Erbil AYDIN

15:50 – 15:55 **TI-08** Failures in Oncologic Surgery of the Spine: Causes and Treatment
S.BORIANI, S.BANDIERA, A.GASBARRINI, F.De IURE

15:55 – 16:00 DISCUSSION

16:00 – 18:30 **SOCIAL ACTIVITIES**

19:00 – 20:00 **BUSINESS MEETING**

20:00 – 24:00 **GALA DINNER**

Saturday; September 7, 2002

Moderator: *Feza KORKUSUZ*

07:30 – 08:00 **IL-13** Problems and Complications Recorded with Clinical Trial of 40 Patients Implanted with Prosthetic Disc Nucleus Two Years Follow Up
Khalid A. BATTERJEE

08:00 – 08:30 **IL-14** Lumbar Disc Herniation
Mahir GÜLŞEN

Moderator: *Ufuk AYDINLI*

08:30 – 09:00 **IL-15** Spinal Stenosis - Mechanics
Tarık YAZAR

09:00 – 09:30 **IL-16** Spondylolisthesis
Emin ALICI

09:30 – 10:00 **IL-17** Conservative Treatment of Pediatric Deformity
Reinhard ZELLER

10:00 – 10:30 COFFEE BREAK

Moderator: *John LEONG, Ahmet ALANAY*

10:30 – 10:35 **DS-01** - Withdrawn -

10:35 – 10:40 **DS-02** The Effect of Continuous Early Childhood Back Stretching in Preventing Adulthood Low Back Pain. A New Theory
Dr. Mohammed CHAARANI

10:40 – 10:45 DISCUSSION

10:45 – 10:50 **DS-03** The Endoscopic Microdiscectomy
A. GASBARRINI, A. MARESCA, L. MIRABILE, S. BANDIERA, F. De IURE, S. BORISANI

10:50 – 10:55 **DS-04** Comparative Study of Endoscopic and Conventional Discectomy for Lumbar Disc Herniation
Tomoaki TOYONE, Tadashi TANAKA, Daisuke KATO, Ryutaku KANEYAMA

10:55 – 11:00 DISCUSSION

11:00 – 11:05 **DS-05** Surgical Treatment of Multiple Level Cervical Disc Disease
Kemal YÜCESOY, Ercan ÖZER, H.Sinan YILMAZ, Pınar YAZICI, Semih PETEKKAYA, M.Nuri ARDA

11:05 – 11:10 **DS-06** A New Spacer for Expansive Open-Door Laminoplasty
Takashi YAMAZAKI

11:10 – 11:15 DISCUSSION

11:15 – 11:20 **DS-07** Results of Surgical Treatment for Degenerative Lumbar Spinal Stenosis
Mehmet TEZER, Cüneyt MİRZANLI, F.Erkal BİLEN, Oğuz KARAEMİNOĞULLARI, Ufuk TALU, Azmi HAMZAOĞLU

11:20 – 11:25 **DS-08** Results of Surgical Treatment For Degenerative Cervical Myelopathy
Şevki KABAK, F.Erkal BİLEN, Mehmet TEZER, Mürsel DEBRE, Ufuk TALU, Azmi HAMZAOĞLU

11:25 – 11:30 DISCUSSION

11:30 – 11:35 **DS-09** Transpedicular Decancellation Osteotomy in The Treatment of Peridural Fibrosis
Murat BEZER, Osman GÜVEN, Kemal GÖKKUŞ

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11:35 – 11:40 **DS-10** The Influence of Vertebral Instability on Peridural Circulation Impairment and Concomittant Peridural Fibrosis Formation
Murat BEZER, Osman GÜVEN, Kemal GÖKKUŞ, Umut AKGÜN

11:40 – 11:45 DISCUSSION

Moderator: *Derya DİNÇER, Feza KORKUSUZ*

11:45 – 11:50 **M-01** The Retrodiaphragmatic Spinal Approach; Leaving The Thoracic Cavity Intact
Sorin Daniel IORDACHE, Ohana NISSIM, Mercado EIAL, Soudry MICHAEL

11:50 – 11:55 **M-02** - Withdrawn -

11:55 – 12:00 DISCUSSION

12:00 – 12:05 **M-03** An Analysis of All Spinal Fusions in The State of California from 1995 to 1999
Mark A. VITALE, Raymond R. ARONS, Joshua E. HYMAN, David L. SKAGGS, Michael G. VITALE

12:05 – 12:10 **M-04** Correlation Between Pain, Pelvic Lateral Shift and Positive Walk Test in Sacroiliac Joint Dysfunction
Filiz CAN, Zafer ERDEN, Gürsoy COŞKUN, Irem DÜZGÜN, Ahmet ALANAY

12:10 – 12:15 DISCUSSION

12:15 – 12:20 **M-05** Clinical Follow-up of A New Implant System for Posterior Cervical Spine Insturmentation
Balkan ÇAKIR, Marcus RICHTER

12:20 – 12:25 **M-06** A Comparison of MCKenzie's Manual Therapy Approach and Traditional Physiotherapy in Patients with Acute and Subacute Back Pain
Filiz CAN, Zafer ERDEN, Gürsoy COŞKUN,İrem DÜZGÜN, Adil SURAT

12:25 – 12:30 DISCUSSION

12:30 – 13:30 **LUNCH BREAK**

Moderator: *Azmi HAMZAOGLU*

13:30 – 14:00 **IL-18** Adolescent Idiopathic Scoliosis: Anterior vs Posterior Instrumentation
John WEBB

Panel Chairman: *John WEBB*

14:00 – 14:20 **PN-PD-01** Spina Bifida
Nejat AKALAN

14:20 – 14:40 **PN-PD-02** Surgery in Pre-adolescent Idiopathic Scoliosis
John WEBB

14:40 – 15:00 **PN-PD-03** Congenital Scoliosis: Surgery?, Which Surgery?
Reinhard ZELLER

15:00 – 15:20 **PN-PD-04** Pediatric Paralytic Deformity
Azmi HAMZAOĞLU

16:00 – 16:30 **CLOSING CEREMONY**

16:30 – 18:30 **WORKSHOPS**

HALL C Solis Peek Cage (Acif) + Stabilis Cage, Alif
Dietmar SALGER

POSTER LIST

BASIC SCIENCE

BS-01 Pedicle Morphology of The Thoracolumbar Junction in a Turkish Population: A Preliminary Study
Abtullah MİLCAN, Caner ÖZER, Volkan ÖZTUNA, Metin M. ESKANDARİ, Mehmet ÇOLAK, Fehmi KUYURTAR

BS-02 Posterolateral Thoracolumbar Spinal Fusion with Composite of Allogenic Demineralized Bone Matrix(DBM) and Autologous Bone Graft
Can SOLAKOĞLU, Cemil YILDIZ, Ali ŞEHİRLİOĞLU, Mehmet ALTINMAKAS

BS-03 Fast Low-Angle Shot MR Imaging is a Useful Strategy for Diagnosis of Lumbar Disc Hernia
Norisuke SATORI, Akira TAGAYA, Ban MIHARA, Shintaro GOMI

BS-04 Endoscopically Checked Transpedicular Screw Insertion-Preliminary Report
Tarık YAZAR, Sinan BİLGİN, Ataç KARAKAŞ, Cengiz YILMAZ

BS-05 A Comparative Study of Behavioral and Immunohistochemical Changes after Spinal Cord Injury between Young and Adult Rats
Jun-Young YANG, June-Kyu LEE, Kyung-Cheon KIM

BS-06 The Changes in Expression of Tumor Necrosis Factor Receptor I after Spinal Cord Injury
Jun-Young YANG, June-Kyu LEE, Sang-Yun CHUNG, Chang-Hwa HONG

TRAUMA

T-01 One Stage Spondylodesis for The Bursting Fracture of The Thoracolumbar Spine.
-Technicalnote-
Young-baeg KIM

T-02 Late Result of the Vertebroplasty
Byungjik KIM, Jeonggook SEO, JinHwan KIM

T-03 Treatment Results of Low Lumbar Burst Fractures
Ufuk AYDINLI, Çagatay ÖZTÜRK, Remzi Özgür ÖZER

T-04 Transforaminal Decompression of Burst Fractures of Thoracolumbar Vertebrae (A New Technique)
H. KUTLU, E. MERİH, T. ŞENER, C. MİRZANLI, A.N. KARA

T-05 The Results of The Posterior Surgical Treatment of The Thoracolumbar Unstable Spine Burst Fractures
C. KILIÇKAP, R. DANIŞMAN, V. GÜRKAN, H. GÜZ, T. BERKEL

T-06 Long Segment Posterior Surgical Stabilisation of Unstable Thoracolumbar Spine Fractures
Erbil OĞUZ, Ali ŞEHİRLİOGLU, Bahadir SEYHAN, Mehmet ALTINMAKAS

T-07 Late Decompression in Posttraumatic Syringomyelia: A Case Report with Long-Term Follow up
T. YAZAR, K.C. KÖSE, O. CEBESOY, C. SOYDAN

DEFORMITY

D-01 - Withdrawn -

D-02 Manual Contouring of The Spine; A New Technique for Scoliosis Correction
Ohana NISSIM, Iordache Sorin DANIEL, Klir ISRAEL, Sheinis DIMITRY, Sasson ALBERT, Soudry MICHAEL

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D-03 Sublaminar Wires with Third Generation Spine Instrumentation For The Treatment of King Type II and Type III Adolescent idipathic Scoliosis
Asım CILIZ, Süleyman PORTAKAL, Güray ÖZKAN, Ali UTKAN, Mehmet Ali TÜMÖZ

D-04 - Withdrawn -

D-05 Posterior Instrumentation and Interbody Fusion for Post Discectomy Instabilities
Onur POLAT, Alihan DERİNCEK, Ayhan ATTAR, Kemal US

TUMORS / INFECTION

TI-01 Management of Vertebral Osteomyelitis
A. GASBARRINI, E. BERTOLDI, S. BANDIERA, L. MIRABILE, F. De IURE, S. BORIANI

TI-02 Thoraco-lumbar spine Tuberculosis: Our Experience in Posterior debridement, Reconstruction and Internal Fixation
Cezar POPESCU, Ioan POEATA, Radu SORETE, Dana TURLIUC

TI-03 Transpedicular Decancellation Osteotomy in The Treatment of Pott's Kyphosis
Murat BEZER, Osman GÜVEN, Kemal GÖKKUŞ, Umut AKGÜN

TI-04 The Surgical Treatment of Tuberculous Spondylitis and Its Consequences in Adults
Vaqif G. VERDIYEV, Rashid N. IBRAHIMOV

TI-05 Thigh Abscess as a Late Complication of Pott's Disease
Kenan BAYRAKÇI, Bülent DAĞLAR, Bülent Adil TAŞBAŞ, Mustafa ŞAHİN, Uğur GÜNEL

TI-06 A Case With Lumbosacral Tuberculosis
Meral CONGER, Mehmet TEZER, Banu KURAN

TI-07 Paravertebral Fibromatosis
Mehmet TEZER, Yavuz KABUKCUOĞLU, Cüneyt ERKEN, Ünal KUZGUN

TI-08 A Solitary Osteochondroma in the Spinous Process of the Lumbar Spine
Metin ÖZALAY, Sercan AKPINAR, Murat Ali HERSEKLİ, Gürkan ÖZKOÇ, Reha TANDOĞAN

TI-09 Osteoid Osteoma of Sacrum Mimicing Sacroileitis
Gürkan ÖZKOÇ, Metin ÖZALAY, Sercan AKPINAR, Murat Ali HERSEKLİ, N. Reha TANDOĞAN

TI-10 A Case of Chondrosarcoma Localized to The Lumbar Spine, Sacrum and Iliac Wing
Ufuk AYDINLI, Aytun TEMİZ

TI-11 Clinical Results of Total en Bloc Spondylectomy for Metastatic Vertebral Tumors in Thoracolumbar Spine
Munehisa KOIZUMI, Yurito UEDA, Etsuhiro MATSUYAMA, Mitsuo KUGAI, Takafumi YOSHIKAWA, Jin IIDA, Yoshinori TAKAKURA

TI-12 - Withdrawn -

DEGENERATIVE SPINE

DS-01 Degenerative Cervical Spondylolisthesis
Fujita KYOSUKE, Hirabayashi HISASHI, Takahashi SEIKEN

DS-02 - Withdrawn -

DS-03 - Withdrawn -

DS-04 The Determinants of Spondylolisthesis
Hayal GÜLER, Abtullah MİLCAN, Gunsah ŞAHİN, Selda BAĞİS, Canan ERDOĞAN

DS-05 Direct Repair of Lumbar Pars Interarticularis Defect
Haluk BERK, Ömer AKÇALI, Emin ALICI

DS-06 The Clinical Importance of Magnetic Resonance Imaging in Degenerative Lumbar Spine
Metin ÖZALAY, Ayşin POURBAGHER, Sercan AKPINAR, Murat Ali HERSEKLİ, Gürkan ÖZKOÇ, Reha TANDOĞAN

DS-07 - Withdrawn -

DS-08 Individual and Occupational Determinants of Low Back Pain According to Various Diagnosis of Low Back Problems
Gül BALTACI, Nevin ERGUN, Ayşenur BESLER, Volga Bayrakçı TUNAY, Magsoud EIVAZI

DS-09 Percutaneous Disc Decompression Using Nucleoplasty
Lewis SHARPS

DS-10 - Withdrawn -

DS-11 - Withdrawn -

DS-12 Nucleoplasty: A Novel Approach to Percutaneous Disc Decompression
Robin D. MCMAHON, Duran N. YETKİNLER, Norman R. SANDERS

DS-13 Long Term Results of Wide Laminectomy for Lumbar Spinal Canal Stenosis without Fusion
Atsushi IWATA, Masahiko MATSUSAKI, Kohei TAKATA, Mitsuo OCHI, Tadahiko YOTSUMOTO

DS-14 Bed Rest Prevents Collapse of The Lumbar Vertebral Body in Case of Postoperative Sinking of Titanium Threaded Fusion Cage
Kosuke KURIBAYASI

DS-15 Longitudinal Length of the Spinal Cord after ,Cervical Laminoplasty
Toru YOKOYAMA, Akihiro OKADA, Takashi TOMITA, Kazunari TAKEUCHI

MISCELLANEOUS

M-01 Surgery for Patients with Bow Hunter's Stroke: Usefulness of Intraoperative Head Rotation
Michihiro KOHNO, Hiromu SEGAWA, Keiji SANO

M-02 Spondylolysis of Lumbar Spine in Athletes: Comparison of two Different Nonoperative Treatments
Gül BALTACI, Nevin ERGUN

M-03 Accidental Peroperative Lumbar Durotomy - Forty Dural Tears out of 842 Operations
François DUBUC

M-04 Intraspinal Metallosis as a Cause Late Period Paraparesis Secondary to Posterior Spinal Instrumentation
Mehmet TEZER, Ünal KUZGUN

M-05 The Effects of Haemostatic Agents on Graft Donor Site
Erol YALNIZ, Selçuk ERCAN, Misel KOKINO

M-06 Different Continuous Total Intravenous Anesthesia Technique is Recommended for Wake-up Test (A Preliminary Study)
Rıza KURUEFE, Aysun YILMAZLAR, Berrin ÖZCAN, Ufuk AYDINLI,Çağatay ÖZTÜRK

M-07 A Change in Blood Flow of the Spinal Cord Artery Due to the Cervical Laminoplasty
Koji SATO M.D., Toshihiro ANDO, Kazuyoshi MIYASAKA, Yukihiro MATSUYAMA, Taichi TSHUJI

M-08 Interlaminar Osteotomy in Surgical Correction of The Kyphosis of Anchylosing Spodilitis(AS)
H. KUTLU, E. MERİH, F. HATİBOĞLU, K. ÇETİNER, O. ORTAL, A.N. KARA

M-09 Surgical Treatment of Cervicothoracic Pathologies
Şükrü ÇAĞLAR, Ayhan ATTAR, Ali O. TAŞCIOĞLU, Ahmet ERDOĞAN, Tarık YAZAR

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M-10 Cost and Effectiveness Analysis of Manual Therapy and Physiotherapy For Low Back and Neck Pain
Gül BALTACI, Volga Bayrakçı TUNAY, Nevin ERGUN, Ayşenur BESLER, Magsoud EIVAZI

M-11 Lumbal Spinal Stenosis: Assessment of Outcomes One-Year After Operative and Conservative Treatment: A Pilot Clinical Study
Magsoud EIVAZI, Gül BALTACI, Ali Kemal US, Nevin ERGUN

M-12 Effectiveness of Manipulative Physiotherapy for The Treatment of Whiplash Injuries
Volga Bayrakçı TUNAY, Gül BALTACI, Nevin ERGUN, Ayşenur BESLER

M-13 The Pain Intensity Level and Physical Function in Patients with Cervical Disc Herniation: Effectiveness of Manual Therapy
Volga Bayrakçı TUNAY, Gül BALTACI, Nevin ERGUN, Ümmühan Baş ARSLAN

INSTRUCTIONAL LECTURES

&

PANEL PRESENTATIONS

An Overview of Adult Spinal Deformity

Lawrence G. LENKE, MD

Institution(s):
The Jerome J. Gilden Professor of Orthopaedic Surgery, Washington University School of Medicine
Chief, Spinal Deformity Surgery, Shriners Hospital for Children – St. Louis, Missouri

INTRODUCTION

The evaluation and treatment of adult spinal deformity remains a challenging clinical entity. Many factors must be analyzed to help decide the best treatment plan for these patients ranging from conservative care with physical therapy, epidural steroid injections and lifestyle adjustments to major surgical intervention consisting of anterior and posterior spinal fusions, vertebral osteotomy or resection procedures. This manuscript will highlight the essentials of the evaluation, conservative and surgical treatment of patients will all forms of adult spinal deformity.

EVALUATION

The history of a patient presenting with adult spinal deformity must be quite detailed regarding the patient's main complaints, past treatments and future expectations. Patients usually present because of increasing axial, and less commonly appendicular pain. In addition, they may feel their deformity is progressing by the noticing loss of height, altered fitting of clothes, increasing rib or lumbar prominences, or because of comments regarding these features made by family members and/or friends. Rarely do patients present with increasing dyspnea which obviously manifests itself in a severely neglected thoracic deformity. It is extremely important to identify the primary reason(s) that the patient came to see the spinal deformity physician, as this will be extremely helpful in deciding what level of treatment is necessary to meet the patients' expectations.

There are several basic subdivisions of adult spinal deformity including whether the patient presents with a primary deformity or with a previously treated deformity. In my practice, approximately 50% of patients evaluated have a primary deformity, while 50% have had prior surgery in the past, most commonly in the distant past with first generation (i.e. Harrington rod instrumentation) implants in place. Although the presentation of these patients is somewhat different, the expectations and analyses are quite similar. It is important to try and detail exactly the type of prior surgical intervention the patient has undergone, including how many prior surgeries, type of implants placed, and source of bone graft harvest. This last point is extremely important, since the availability of autogeneous posterior iliac crest bone graft is important, not only for future bone graft harvests, but also the placement of iliac screws for additional sacropelvic fixation, which is commonly utilized for long fusions extending to the sacrum.

Additional features of the history that are important include: the patient's prior or current steroid use and anti-inflammatory and narcotic usage, etc.; past medical history including any type of cardiac or pulmonary problems; past or current use of tobacco products (lower fusion rate and higher infection rate?); and overall nutritional and exercise status. Also, it is extremely important to understand the patient's psychological and emotional status for those contemplating significant spinal reconstructions. In addition, it is necessary to identify supportive systems available to those patients planning to recover from significant spinal reconstructive surgeries.

RADIOGRAPHIC EVALUATION

The standard radiographic evaluation of patients with adult spinal deformity begins with an upright long cassette (36 inch) frontal and lateral view of the spinal column. Ideally, the entire spinal axis from the occiput to the sacrum will be visualized, but at a minimum from the C7 vertebral body to the sacrum. In addition, recent evaluation of the sacral pelvic alignment with respect to the pelvic incidence will be extremely important. Besides the obvious Cobb measurements of the major and minor curves on the coronal plane films, with the regional thoracic, thoracolumbar and lumbar sagittal angulations should be

documented. Probably the two most important radiographic measurements are the coronal vertical alignment (CVA) or coronal plumbline and the sagittal vertical alignment (SVA) or sagittal plumbline. The singular two most important features of adult spinal deformity from a radiographic, as well as clinical evaluation, remains the optimization of coronal and sagittal plane balance. Thus, all efforts should be made to fully evaluate both of these on the long cassette radiographs, which must be of good quality and sufficient detail to assess.

Additional radiographic evaluations may include short cassette detailed evaluations of the lumbosacral region, including a Ferguson view to assess the lumbosacral region especially in patients with lumbosacral spondylolithesis, which must always be checked for. Almost all patients presenting with any type of lumbar deformity will also require a lumbar MRI exam to evaluate the health of the lumbar discs as well as the presence of any spinal stenosis. In patients with severe lumbar deformity, a CT myelogram will be more helpful to totally evaluate the extent of any stenotic problem. Rarely, a technetium bone scan may be helpful in identifying areas of pseudarthrosis present in those patients who have had prior surgery, or in patients with painful facet joints in the lumbosacral region.

PHYSICAL EXAMINATION

The key elements of the physical exam include: evaluation of the skin integument of the back, especially in those patients with prior surgery (and especially with history of prior infection); overall coronal and sagittal balance standing as well as walking; range of motion of trunk, and neurologic exam to the upper and lower extremities. It is extremely important to assess the patient's overall coronal and sagittal balance while standing and walking, especially noting whether the patient flexes their knees to remain in good sagittal balance. This is a very common adaptive response for those patients with a flexible or fixed sagittal imbalance syndrome. Evaluating the patient both standing and prone on an exam table can identify postural abnormalities that are flexible and thus easily correctable versus fixed deformities that do not change from an upright to prone position. For patients with kyphotic deformities, lying them supine over a bolster for a period of time (5-10 minutes) will often identify areas of flexibility to regions of the spine thought to be somewhat 'autofused'. This same evaluation can be performed radiographically by obtaining hyperextension lateral films of the entire spinal column, if necessary, to aide in this evaluation.

A standard upper and lower extremity neurologic exam consisting of motor, sensory and reflex testing should be undertaken. It is fairly rare in patients with scoliosis deformities to have significant thoracic myelopathy, but certainly they may have lumbar stenosis and/or radiculopathy present, especially at the apex of the major curve or more commonly in the secondary fractional lumbosacral curve below. Patients with kyphotic mal-alignments can present with tenting of the spinal cord over the spinal column producing myelopathy and/or a stenosis type of pathology. Any abnormalities in the neurologic exam warrant thorough neuro-radiographic evaluation to completely understand. Discography may also play a role in the evaluation of the painful lumbosacral spine, but this is being utilized less frequently because of the excellent technology available now with the MRI evaluations.

CONSERVATIVE TREATMENTS

The hallmark conservative treatment of adult spinal deformity is observation with intermittent radiographic and clinical examinations over time. The frequency of examinations is based on the age of the patient, the degree of the deformity, and the symptomatic presentation of the patient. Usually, evaluation yearly or at 3-5 year intervals will be required. It is extremely important to have access to previous radiographs when the patient returns to recognize any progressive tendencies, including increasing osteoporosis. Progression of spinal deformity over time is one of the main indications for considering operative intervention in patients who are symptomatic or even asymptomatic. Thus, it is essential to have radiographs available for comparative purposes.

The most commonly prescribed active intervention with patients with a spinal deformity is an active and passive physical therapy program. The active component consists of muscle strengthening, flexibility, and aerobic conditioning which can be quite important not only for current but also future considerations. In addition, those patients with active musculoskeletal mechanical symptoms require passive therapy including heat; massage, ultrasounds, etc. and can be quite helpful in alleviating current symptomatologies. If musculoskeletal mechanical pain is a major component to the patient's chronic condition, assistance with a pain management service may be required, especially in those patient who are narcotic dependent.

In patients with active radiculopathy and/or stenosis, nerve root and/or steroid injections can be quite helpful in both the diagnostic and therapeutic approach to these problems. Often these will be temporizing and not curative injections. However, they do play an important role in the overall evaluation and treatment. Rarely, behavioral and/or psychological counseling will be required for patients with conservatively treated

spinal deformity problems. The psychological impact of long standing spinal deformity is not very well understood and probably is much more problematic than has been realized in the past. It is human nature not to want to be deformed or different. Spending one's life with a major deformity may, over time impart psychological ramifications that are poorly understood.

SURGICAL TREATMENT

Consideration of surgical treatment in patients with adult spinal deformity is extremely complex and challenging. There are many variables to consider including: whether the deformity is based in the coronal plane, sagittal plane or both; whether it is a primary or revision procedure; whether the deformity is flexible, fixed or a combination; the location of the major deformity (thoracic, thoracolumbar, lumbar or combined); the age and overall health of the patient; the degree of osteoporosis present; nature and degree of any type of spinal stenosis causing neurologic abnormalities present; the overall wishes and desires of the patient; and the experience and skills in the treating spinal deformity surgeon. All these conditions, as well as others must be maximally understood and evaluated when planning surgical intervention.

The hallmark treatment of patients with adult spinal deformity consists of a posterior instrumentation and fusion. With thoracic coronal plane deformities, this remains the most commonly utilized method for correction and stabilization. For the lumbar region, occasionally an isolated anterior instrumentation and fusion may be performed for major thoracolumbar or lumbar scoliosis deformities. The majority of patients with larger deformities, especially in the older age group, require circumferential procedures on the lumbar spine for realignment, stabilization and fusion. For patients with combined thoracic and lumbar deformities, a circumferential approach would be performed for the lumbar deformity but not for the thoracic deformity as it is extremely rare to do a combined anterior approach for both thoracic and lumbar deformities. Rigid stabilization with multi-segmented pedicle screws is the current instrumentation of choice. Having a variety of modular systems available, especially in complex deformities can be quite helpful to the treating surgeon. Abundant autogenous bone graft remains the gold standard for production of a solid fusion. Success in these procedures is multi-factorial and includes: rigid internal fixation, thorough decortication and fusion, and optimization of segmental, regional and global coronal and sagittal alignment.

In patients undergoing revision surgery, additional techniques may be required including: various types of osteotomies and/or resections procedures especially in patients with fixed deformities that are imbalanced. The most common adult spinal deformity procedure that we perform is extension of a previous Harrington instrumentation and fusion to the lower lumbar spine and often the sacrum. This requires anterior structural lordosing cages/grafts down to and including the lumbosacral disc, in addition to posterior instrumentation and fusion of the entire thoracic fusion mass to the lumbosacral region. Smith-Peterson (SPO) and/or pedicle subtraction osteotomies (PSO) are commonly performed to optimize sagittal as well as coronal alignment. Rigid lumbosacral fixation will also be required, especially in those patients who are imbalanced preoperatively. We prefer 4-point sacropelvic fixation with bilateral S1 and iliac screws. In addition, multi-level lumbar segmental pedicle screw fixation will optimize final rigidity and thus fusion consolidation. In our institution, the pedicle subtraction osteotomy has been a major help in realigning the deformed sagittal plane in the last decade. We have experience with well over 60 of these procedures and the 2-year follow-up results will be reported in the American Journal of Bone and Joint Surgery in the near future. The average sagittal correction was approximately 35° more lordosis at a single level and improving overall sagittal balance by 10-12 cm with the PSO.

Rarely, a vertebral column resection will be required for rigid and fixed adult deformities that are significantly imbalanced in the coronal and/or sagittal plane. One can either perform a circumferential procedure or an AL posterior procedure. Traditionally, we have preferred a circumferential procedure, which tends to be somewhat safer to the neural elements. These are significant spinal reconstructions and should be performed only by those surgeons comfortable doing complex osteotomy procedures.

CONCLUSIONS

The evaluation and treatment of adult spinal deformity continues to evolve but still remains a challenging area. Current initiation of a prospective multi-center study spearheaded by the Spinal Deformity Study Group (SDSG) in North America will hopefully provide better clinical research for both conservative and surgically treated patients. Although it is somewhat difficult, if not impossible to perform a randomized clinical study of patients with either conservative or surgically treated adult deformity, prospective evaluation of all patient presenting to spinal deformity surgeons with their deformity should provide sound scientific information to treating surgeons. Dedication and commitment to spinal deformity patients is important for the optimal evaluation and treatment of these complex spinal problems.

Surgical Treatment of Sagittal Deformity in Ankylosing Spondylitis

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Kyphosis in ankylosing spondylitis can affect the cervical spine, thoracic spine, lumbar spine, or a combination. Severe deformity is now less commonly seen, because of better medication to control symptoms, and better supervised physiotherapy to prevent stiffening in a deformed posture.

Cervical Spine

In mild or moderate cases, correction may or may be necessary, depending on the posture of the rest of the spine and remaining mobility. In severe cases, the jaw of the patient may not be opened wide enough to eat solid food. In that case, cervico-dorsal osteotomy to correct the deformity is necessary. Cervico-dorsal osteotomy is best performed under local anaesthesia, between C7 and T1. Care is taking to ensure that the C8 nerve root is not compressed during the correction. With the patient awake, any unfortunate neurological damage can be detected quickly, and avoided. A simple compression implant can be used to fix the osteotomy.

Thoracic Kyphosis

There are two main sub-types:

(a) The kyphosis only affects the thoracic spine, with retained cervical and lumbar lordosis.

(b) The thoracic kyphosis is part of a long C-type of kyphosis affecting both the thoracic and the lumbar spine.

In type (a), correction is more safely obtained by a combined anteroposterior approach. Multi-level osteotomies are performed both anteriorly and posteriorly, with compression correction using posterior instrumentation.

In type (b), it should be treated as a lumbar kyphosis.

Lumbar Kyphosis

Patients with this problem have a very tiring posture. If they stand with the hips and knees extended, forward visual field is very limited. If they bend the knees and hips to accommodate forward vision, they get tired very easily. The forward visual field is also dependent upon concomitant cervical spine kyphosis and stiffness.

Fixed flexion deformity of the hips, if significant, should be corrected by hip arthroplasty before deciding on lumbar osteotomy. The classical Smith-Peterson osteotomy of the lumbar spine involved a v-shape posterior osteotomy at one or more levels, followed by closing of the osteotomy, with concomitant opening of the anterior longitudinal ligament. This method has distinct disadvantages:

a) Lengthening of the anterior column.
b) Acute angulation at the corrective site.
c) A small but definite risk of intraoperative or early post-operative rupture of the major blood vessels.

We have described a *transpedicular decancellization osteotomy* since 1976. Removal of about 1" of posterior element at the intended level, removal of the pedicle to its base, and transpedicular decancellization of the vertebral body will result in a controlled posterior closure. The spine is shortened, and there is no acute angulation. Closure is gradual and under direct vision. Any simple posterior compression implant will be able to hold the osteotomy. If preferred, multiple fixation points over a longer length of the spine can be used to maintain the correction.

The transpedicular decancellization osteotomy works well only when the bone is very osteoporotic. In young individuals, a *transpedicular partial corpectomy* will result in a much better posterior closing effect. This is particularly true when there is absence of, or insignificant, ossification of the anterior longitudinal ligaments.

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Cervical Spondylotic Myelopathy. Its Clinical Manifestations and Spinal Cord Pathology

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Cervical spondylosis is one of the most common disorders that ail people over middle age. Problems brought by this condition have become more serious to societies where aged population is expanding. Clinical manifestations of cervical spondylosis are quite diverse and schematically these can be classified into discopathy, radiculopathy, myelopathy and miscellaneous conditions. Among them, myelopathy is relatively rare but disability of myelopathic patients is severer and permanent.

Clinical features of cervical spondylotic myelopathy (CSM) are composition of symptoms of segmental and long tract impairment. Segmental symptoms are ambiguous to radicular symptoms and thus the symptoms are sometimes regarded as radicular origin, and diagnosed to be radiculomyelopathy erroneously. In Japan we have many patients with CSM, probably due to developmental spinal canal size. Experientially, most of patients with CSM have only combination of long tract and segmental signs, and the diagnosis of CSM is easy by neurological and radiological examinations. On the other hand, we have experienced patients having muscular weakness and atrophy of the upper extremity without obvious sensory deficit of the upper extremity, that is vague to lower motor neuron diseases [2-3]. Sobue named this condition cervical spondylotic amyotrophy (CSA). Anyway, both conditions are myelopathic. What changes of the spinal cord occur in these conditions?

Since Key described encroachments on the spinal cord by ventral ridges of disc origin in 1838, the condition has been studied from various viewpoints. Although several pathological studies on the spinal cord were done, little was known about relationship between clinical manifestations and spinal cord pathology of CSM. We carried out a clinicopathological study to elucidate the relationship[1]. We found that severity of pathological changes was paralleled to severity of myelopathic symptoms, and the severity of pathological changes could be represented with a simple morphometric parameter, compression ration (=anteroposterior diameter of the spinal cord divided by transverse diameter).

Development of computed tomography (CT) allows us to observe a cross-sectional shape of the spinal cord and to measure its area. We studied relationship between a transverse area of the cord at maximally compressed level and various clinical parameters including severity of myelopathy evaluated with the scale proposed by the Japanese Orthopaedic Association (JOA score), duration of disease and surgical results [4-5] and found the transverse area at maximally compressed level significantly correlated with surgical results. Namely, the transverse area is the most significant indicator of viability of the spinal cord in CSM.

Our previous pathological study on CSM reveals that an initial change of the spinal cord is demyelination of the white matter. When demyelination of the white matter advances, the gray matter is involved and shows cystic changes. Namely, the white matter reduces the size more than the gray matter. On the other hand, severity of pathologic change is correlated with severity of myelopathy. So, positive correlation between the transverse area of the cord and the severity of myelopathy before surgery could be speculated. However, significance of the correlation was not high and a correlation between the transverse area and severity of myelopathy after surgery was statistically positive. We think that the difference of results between from the pathological study and the clinical study is due to the difference of subjects, that is, in the former study the subjects are in the end stage of CSM, while in the latter study, the subjects are in the initial or advanced stage of CSM.

With appearance of magnetic resonance imaging (MRI) following CT, we can obtain clues of internal changes of the cord as well as external forms of the cord in various sections. The most recognizable change was signal change of the cord (high in T2 weighted and low in T1 weighted image). We also investigated

relationship between the signal change of the cord and the clinical parameters that were analyzed in the CT study. We could not found significant correlation between the high signal intensity area (HSIA) and surgical results. A significant positive parameter correlated to multisegmental HSIA was muscle atrophy of the upper extremity. The HSIA represents cavity formation in the gray matter and thus in CSM that long-tract dysfunction is a main feature of disease, the HSIA cannot be an indicator of severity of myelopathy or a predictor of surgical results. When damage of the gray is extensive, usually the white matter is also damaged severely. In another word, the multisegmental HSIA indicates probable extensive damage of the white matter and thus, can be a predictor of surgical results.

Another type of myelopathy is cervical spondylotic amyotrophy (CSA). Characteristics of CSA are muscle atrophy of the upper extremity, which means predominant involvement of the gray matter. There are two types of CSA; proximal and distal types. The proximal type of CSA is characterized by weakness or atrophy of the deltoid, biceps and other shoulder girdle muscles.. The distal type represents muscle weakness and atrophy of the hand and forearm. In both types, sensory deficit of the upper extremity is usually absent or mild compared to severe motor dysfunction of the upper extremity. No sign and symptom of long-tract involvement except for exaggerated tendon reflexes is detected. Although these clinical features are delusive to lower motor neuron diseases, this should be differentiated because these are treatable surgically. Multiple-level spondylotic protrusions and developmental narrow spinal canal are believed to be etiological in the distal type, although etiology of the proximal type is still controversial.

Conclusively, clinical manifestations of CSM are diverse and some patients with CSM show signs and symptoms mimicking intrinsic neurological diseases. However, in most cases, diagnosis of CSM is feasible with careful history taking, minute neurological examination, appropriate radiological examination and wide knowledge on this condition.

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Choice of Surgical Treatment for Multisegmental Cervical Spondylotic Myelopathy.

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Recent advances in surgical techniques have expanded the field of surgical treatment for cervical spondylotic myelopathy. For single-level spondylotic myelopathy, anterior surgery has been widely accepted. However, there is little agreement as to the best approach for multisegmental spondylotic myelopathy, especially when the condition is associated with a narrow spinal canal. Some authors recommend anterior or posterior decompression exclusively for the surgical treatment of this condition. Others based their decision on various criteria including multiplicity of involvement and the anteroposterior spinal canal diameter. The validity of the opinions, however, has not been substantiated by statistical evidence. We have conducted several comparative studies of results of surgical treatment for cervical spondylotic myelopathy.

First, three surgical procedures for multisegmental cervical spondylotic myelopathy; laminectomy, anterior underbody fusion and corpectomy, were evaluated on the basis of a retrospective follow-up study (12-157 months) of 95 patients. Twenty-four patients were treated by extensive laminectomy, 50 by anterior underbody fusion by the Cloward and/or Smith-Robinson techniques, and 21 by subtotal spondylectomy and fusion. Results of subtotal spondylectomy were significantly (P less than 0.01) better when compared with those of the other two procedures. Reasons for the inferiority of laminectomy were malalignment and instability of the cervical spine and it was concluded that maintenance of cervical lordosis and stability was the key to stable surgical results after posterior decompression 1-3).

Secondary, we conducted a prospective comparative study of two procedures; subtotal corpectomy and laminoplasty, by which cervical lordotic alignment and stability was expected to be preserved 4). Forty-one patients who received subtotal corpectomy and strut grafting (SCS) and forty-two undergoing laminoplasty were followed up for at least 2 years after surgery. Regarding factors known to affect surgical prognosis (age at surgery, duration of symptoms, severity of neurologic deficit, anteroposterior canal diameter, transverse area of the cord at the site of maximum compression, number of levels involved), the two groups were statistically comparable with each other. The severity of neurologic deficits was assessed by the Japanese Orthopaedic Association scale 8). Results were evaluated in terms of postoperative score and recovery rate. The difference between the recovery rate and final score between the two groups was not statistically significant. Surgical complications were more frequent in the subtotal corpectomy and strut grafting group than in the laminoplasty group. The most frequent complications encountered in the subtotal corpectomy and strut grafting group were related to bone grafting. Spinal alignment worsened in six patients of the laminoplasty group, but none of them suffered from neurologic deterioration. Another disadvantage of subtotal corpectomy and strut grafting was the longer postoperative period of bed rest needed to secure graft stability. We concluded that laminoplasty should be the treatment of choice for multisegmental cervical spondylotic myelopathy when neurologic results, incidence of complications, and postoperative treatment are taken into consideration.

We applied this principle to myelopathy caused by soft disc herniation and analyzed surgical results 5). The results suggested that when the incidence of complications and the possibility of regression of herniated disc are taken into consideration, expansive laminoplasty can be selected for radiculomyelopathy due to cervical disc herniation.

Finally, we did a long-term follow-up study of two procedures; laminoplasty and subtotal corpectomy and compared surgical results 7). Twenty-three patients treated with subtotal corpectomy and 24 patients treated with laminoplasty were followed up for 10 to 14 years after surgery. Neurologic recovery, late deterioration, axial pain, radiographic results (degenerative changes at adjacent levels, alignment, and range of motion of the cervical spine), and surgical complications were compared between the two groups. No significant difference in neurologic recovery was found between the two groups 1 and 5 years after surgery,

or at the latest follow-up assessment. Neurologic status deteriorated in one patient of the subtotal corpectomy group because of adjacent degeneration, and in one patient of the laminoplasty group because of hyperextension injury. Axial pain was observed in 15% of the corpectomy group and in 40% of the laminoplasty group ($P < 0.05$). In the corpectomy group, listhesis exceeding 2 mm developed at 38% of the upper adjacent levels, and osteophyte formation at 54% of the lower adjacent levels. In the laminoplasty group, kyphotic deformity developed in one patient (6%) after surgery. In the corpectomy group, the mean vertebral range of motion had decreased from 39.4 degrees to 19.2 degrees (49%) by the final follow-up assessment. In the laminoplasty group, the mean vertebral range of motion had decreased from 40.2 degrees to 11.6 degrees (29%) by the final follow-up assessment. Neurologic complications related to the surgery occurred in two patients (one myelopathy from bone graft dislodgement and one C5 root palsy from bone graft fracture) of the corpectomy group and four patients (C5 root palsy) of the laminoplasty group. All of these patients recovered over time. The corpectomy group needed longer operative time ($P < 0.001$) and tended to have more blood loss ($P = 0.24$). Six patients in the corpectomy group needed posterior interspinous wiring because of pseudarthrosis. We concluded that subtotal corpectomy and laminoplasty showed an identical effect from a surgical treatment for multilevel cervical spondylotic myelopathy. These neurologic recoveries usually last more than 10 years. In the subtotal corpectomy group, the disadvantages were longer surgical time, more blood loss, and pseudarthrosis. In the laminoplasty group, axial pain occurred frequently, and the range of motion was reduced severely.

Through the studies, we found that many patients complained of neck pain after laminoplasty. Neck pain after posterior decompression had not been notified and we analyzed this nuisance complaint 6). So far, no cause of this has been clarified and no effective preventive measures have been established.

Conclusively, in most patients with multisegmental spondylotic myelopathy, stable and endurable results can be expected regardless of surgical procedures, if surgery is done properly by expert's hands. However, when invasiveness of surgery and incidence of surgical complications are taken into consideration, laminoplasty is treatment of choice, specially when a condition is associated with a narrow spinal canal, On the other hand, correction of spinal alignment cannot be expected with laminoplasty and subtotal corpectomy should be chosen for patient with kyphotic alignment.

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Stabilization of the Cervical Spine Using the Alligator Plate System

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I have designed a type of clamping plate called the "Alligator plate" for stabilization of the cervical spine and used it in some clinical cases with cervical instability. Various types of instrumentation to fix the unstable cervical spine such as screw and plate, hook, hook and rod system, subliminal wiring or simple wire suturing have been reported. Each posterior fixation method has its advantages and disadvantages. Although interspinous wiring is an easy, safe and simple technique, this method cannot promise cervical stability, especially in extension or rotation. Screw and plate is a rigid fixation and both decompression and fusion can be performed through only one approach. But lateral mass screwing or pedicle screwing require a complicated technique and has the risk of inadequate screw insertion. Subliminal wiring offers rigid fixation and it is available for occipito-cervical fusion, but this method is risky in case with cervical canal stenosis and also requires a complicated technique.

The Alligator plate was designed by myself, made by Mizuho Ikakogyo. Alligator plate has a physiological lordotic curve. The "L"-shaped cut surface gives strength in all directions and the length of the plate is adjustable by cutting. Multiple triangular spikes clamp the base of the spinous processes of the cervical spine and multiple notches outside the plate prevent the loosening of the wires, which encircle and fix the plate. Only one size of Alligator plate and some wires or suture threads are all implants needed. Alligator plate system cannot be used for postolaminectomized instability because the plate clamp the base of the spinous process. However, Alligator plate is a simple instrument and its fixing technique is easy.

Operative techniques. The Alligator plate is cut by pin cutter to fit the fusion length. A pair of wires is inserted into each interspinous space at the fusion levels and one level below. After checking the alignment of the cervical spine by a lateral radiograph, the bases of the spinous processes of the cervical spine are clamped between the multiple spikes of the Alligator plate. The wires are tightened so as to press that plate against the spinous processes using wire tightener from cranial to caudal. After alligator plate fixation, the posterior surface of the laminae and the facet joints of the fusion segments are decorticated using by an air drill. A sufficient amount of graft bone can be placed on both sides of the plate taken from the posterior part of the iliac bone because the Alligator plate does not take up space.

Clinical experiences. Fifty-one patients with cervical instability treated by posterior cervical instrumentation using the Alligator plate were radiological evaluated. There were 37 males and 14 females. The average age was 39.8 years ranged from 12 to 82 years. Follow up duration was more than one year averaged in two year and seven months. Diagnosis causing cervical instability was trauma in 30 cases, myelopathy due to kyphosis in 4, non-union after anterior fusion in 4, spinal tumor in 3, pyogenic spondylitis in 3, rheumatoid arthritis in 3, myelopathy associated with athetoid cerebral palsy in 2, kyphosis in one and destructive spondyloarthropathy associated with HD in one. Alligator plate fixation was carried out for non-union after anterior spinal fusion in 4 cases, in combination with anterior fusion in 17 and with posterior bone grafting in 30. Depending on the dynamic flexion-extension lateral radiograph and confirmation of the fusion mass in an oblique view radiograph, surgical results were evaluated as follows: Excellent: union in the alignment at the operation; good: union with minimal displacement; poor: non-union, dislodgement of the anterior grafted bone or instrumentation failure.

Results. In patients undergoing surgery for non-union after anterior spinal fusion, the results were excellent in all cases. Alligator plate fixation without bone grafting is enough for achieving the union of the non-union site. When the Alligator plate was applied in combination with anterior spinal fusion, the clinical result was excellent in 15 cases, good in 2 and poor in none. In the group with the Alligator plate applied for posterior spinal fusion with posterior bone grafting, we achieved an excellent in 27 cases, good in 1 and poor result in 2. The overall result was excellent in 46 cases, good in 3 and poor in 2.

Dislocation of the cervical spine can be treated by Alligator plate fixation with posterior bone grafting in case without disc herniation. Burst fracture of the cervical vertebral body is good indication of this method. Anterior decompression with strut bone graft in combination with posterior spinal fusion using the Alligator plate system is suitable for myelopathy associated with athetoid cerebral palsy. In case with vertebral tumor, anterior decompression and fusion can be done followed by Alligator plate fixation with bone cement. Fracture of the spinous process occurred in both poor cases due to severe osteoporosis. Ankylosis at the adjacent facets of the fusion segments was seen in two patients and wound infection occurred in another two patients as complications.

Alligator plate fixation has some disadvantages, but it is useful for cervical fixation with some features as follows: The "L"-shaped cut surface gives strength in all directions. Multiple triangular spikes clamp the base of the spinous process of the cervical spine. Multiple notches prevent the loosening of the wires. The length of the plate is adjustable by cutting. Special technique or instrument is not necessary for setting Alligator plate. This technique gives more stability in extension, flexion or rotation of the cervical spine than wire suturing method.

Traumatic Atlanto-Axial Instability Treated by Magerl Technique. --- Transarticular Screw Fixation---

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A lot of techniques for posterior fusion of the atlanto-axial joint, such as Gallie or Brooks, have been reported. Transarticular screw fixation with posterior atlanto-axial fusion is good and reliable procedure reported by Magerl in Switzerland. However, the technique seemed dangerous and difficult. We have done this method using cannulated screws under fluoroscopic control without opening the lateral joints. I will show some cases of traumatic atlanto-axial instability treated by Magerl's technique and to confirm the safety of the technique.

There are various types of traumatic atlanto-axial instability. We have experienced 6 cases of Jefferson fracture, 5 of odontoid fracture, 2 of vertebral body fracture of the axis, one of anterior atlanto-axial subluxation and one of atlanto-axial rotatory fixation. Among these cases, one case of Jefferson fracture, 3 of delayed union of the fracture of the odontoid process, one of vertebral body fracture of the axis and one of atlanto-axial rotatory fixation were treated by Magerl's technique. Bony union was achieved in all cases without any complication.

This posterior atlantoaxial transarticular screw fixation (Magerl's technique) has been reported to be biomechanical superior to posterior wiring techniques. However, in some reports, the risk of screw insertion in this technique has been pointed out. I will also demonstrate the accuracy of screw insertion during atlantoaxial transarticular screw fixation.

Fifty-six consecutive cases with atlantoaxial instability were treated by atlantoaxial transarticular screw fixation under fluoroscopic monitoring without opening the lateral atlantoaxial joint. Screw insertion of these 112 screws was assessed by CT examination. One screw could not be inserted. There were 77 screws out of 111 screws (69.4%) perforated the anterior cortex of anterior arch of the atlas. There were 106 out of 111 screws, which perforate the atlantoaxial joint. Therefore, success insertion of atlantoaxial transarticular screw fixation was 95.5%. There were 2 screws inserted at outside the joint, 2 at medial and 1 at anteroinferior of the joint.

Atlantoaxial transarticular screw insertion using image intensifier without opening the lateral atlantoaxial joint can be done accurately in most clinical cases. However, preoperative evaluation of unusual condition of screw path in CT examination and careful screw insertion to avoid disoriented perforation of the cortical bone are mandatory especially in patients with rheumatoid arthritis.

Atlantoaxial Transarticular Fixation Using Atlasclaw of Olerud Cervical

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Posterior atlantoaxial transarticular screw fixation was introduced by Magerl and Seemann. Several authors reported the advantages of this technique and the good clinical results.

Olerud Cervical is the unique cervical instrumentation developed by Dr. Sven Olerud. Especially an atlasclaw is the clawing device of the atlas.

From 1997 to 1999, there were 20 patients who underwent atlantoaxial fusion using atlasclaw of Olerud Cervical. There were 6 males and 14 females. The age at operation ranged from 14 to 71 and the follow up duration was from 12 to 37 months. Diagnoses were rheumatoid arthritis in 15 patients, os odontoideum in 4 and Down syndrome in 2.

Atlasclaw was used to grab the posterior arch of the atlas in all cases. Fixation method of the axis varied in each case. Postoperative loss of correction and bone union were evaluated.

Fixation methods of the axis are shown in the slides. Transarticular screw fixation was performed at 35 sides in 19 cases. Failure of transarticular screw insertion was seen in one os odontoideum case. The cause of the failure was inadequate reduction of posterior subluxation. Preoperative CT examination revealed the risk of the injury of vertebral artery during screw insertion, grabbing the lamina of the axis by hooks was performed at 5 sides in 4 cases.

Loss of correction after the operation was seen in one case. In that case, hooks were used to fix the axis instead of transarticular screw fixation due to high riding of the vertebral artery in both sides. Union was defined when there was no movement in flexion-extension radiograms without instrumentation failure. Union rate was 100%, but it is impossible to confirm the consolidation between the graft and the laminae because of shades of the atlasclaw.
This is a case of high riding of the vertebral artery, so we performed atlantoaxial fixation using the atlasclaws and the hooks.

Atlasclaw of Olerud Cervical is a useful instrumentation for grabbing the posterior arch of the atlas. If the atlantoaxial transarticular screw fixation is performed even in one side, rigid atlantoaxial fixation will be achieved.

In summary, twenty cases with atlantoaxial fixation using atlasclaw of Olerud Cervical were evaluated. Atlantoaxial transarticular screw fixation was performed bilaterally in 16 cases. Hook fixation of the axis was done at 5 sides in 4 cases. Bone union was achieved in all cases. Loss of correction was recognized in one case with bilateral hook fixation of the axis. Rigid fixation was achieved even in the case with unilateral transarticular screw fixation without perforation of the anterior cortex of the anterior arch of the atlas. Atlasclaw of Olerud Cervical is the useful instrumentation for atlantoaxial fixation.

Posterior lumbar interbody fusion using Lumbar Alligator Spinal System.
--- Video presentation---

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Although posterior lumbar interbody fusion (PLIF) using cages is a useful procedure, there are problems in terms of bony fusion in case with cage alone technique. The Lumbar Alligator Spinal System has been developed to serve as an auxiliary immobilization material for this procedure. The Lumbar Alligator Spinal System is composed of two plates positioned on both sides of the spinous process, and a transverse system that connects these plates.

The two plates are connected by combining on the cephalic side. The insides of the plates contain two rows of spikes that bite into the cortical bone and clamp the spinous process. Irregularities on the outsides of the plates are formed to enable the transverse system to engage with the plates and securely hold them in position. When the two plates are connected into the shape of a "V", the cephalic side is securely immobilized. The transverse system is composed of two hooks and transverse pin, which engage with the left and right plates, and a nut. There are two types of hooks consisting of a hook incorporated in the transverse pin and a hook into which the nut is inserted. The pin is inserted into the hook and passed through the hook on the opposite side. The transverse system is then completed by tightening this pin with the nut.

Surgical procedure: Check the length by aligning the plates with the surgical field. Adjust the length of the plates by cutting with a cutter. Cut the counter plate to the same length to prepare them for surgery. Make holes at the portion of the interspinous ligaments above the immobilized vertebrae, and pass the L-shaped plate between the spinous processes. Pass the counter plate through the hole in the end of the L-shaped plate and clamp the plates about the spinous process of the immobilized vertebrae with the compression pliers. Remove the plate holder, clamp the plates with different compression pliers and remove the lowermost compression pliers for initially installing the transverse system. Make a hole into the interspinous ligaments on the lowermost side and insert the hook with the pin attached into the plate. Pass the hook with the nut attached through the pin from the opposite side and securely insert into the plate. Loosely tighten the nut to temporarily fix the transverse system in position. Remove the hook holder and compression pliers. Install the transverse system between the spinous processes of the immobilized vertebrae as well using the same procedure. Apply the transverse compressor to the hooks and after temporarily loosening the nut, apply pressure to bring the two plates together, and then tighten the nut to fix in position. This is then also performed for the other transverse system to complete immobilization. When viewed from the posterior direction, the plates and transverse systems are assembled in the form of a ladder, demonstrating that the spinous process is clamped securely. When viewed from the lateral direction, the immobilized portion can be seen to be immobilizing a dynamically advantageous position relative to flexion-extension at the base of the spinous process. Cut of any portion of the pin protruding from the hook. Since this system is compact and is in contact with the row of spinous processes, the degree of impairment of the adjacent spinal muscle is low as compared with pedicle screws and other apparatuses.

As a result of adding the use of the Lumbar Alligator Spinal System, it is possible to increase immobilization strength in the directions of flexion and extension with a low degree of invasiveness as compared with pedicle screw fixation.

Brief History of Spinal Surgery in Turkey

Prof. Dr. Tarık YAZAR, MD

Institution(s):
Ankara University, School of Medicine, Ibn-i Sina Hospital, Department of Orthopaedics and Traumatology

Dr Cemil Topuzlu (1866 –1956) is probably the pioneer of modern surgery in Turkey. His contributions to Turkish spinal surgery is of utmost importance.

He not only described several general surgery procedures, but also performed many spinal operations, mainly on spinal trauma and Potts' disease. One article of his studies was published in December 31, 1897 in *la Gazette Medical D'Orient.* This study included;

Laminectomy on one patient due to vertebral column fracture

Laminectomy on one patient due to cervical Potts' disease

Laminectomy on one patient due to dorsal Potts' disease

Menard operation on one patient due to dorsolumbar Potts' disease

And Calot operation on 3 patients due to dorsolumbar Potts' disease

In the history of fusion, we see that that the first doctors performing spinal fusion were general surgeons. Orthopaedics and neurosurgeons followed general surgeons in 1960.

In Turkey the first Albee operation was performed by **Dr. Kemal Öke** on 2 cases.

Following the case of **Dr. Öke**, in 1926 **Dr. Burhaneddin Toker** presented another case.

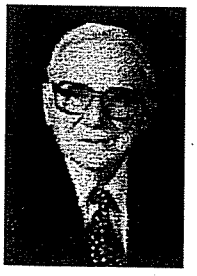
In 1942, **Dr. Sadettin Onaran** presented 9 cases of Albee operation on Potts' disease stating the efficiency of that operation.

This study of **Dr. Onaran** was the first published series of spinal fusion surgery.

After these initial studies, bone and joint diseases hospitals were established throughout the country

In the following years spinal fusion operations were performed by **Dr. Baha Özkay, Dr. Ruhi Soyer** of Baltalimanı Hospital and **Dr.Orhan Aslanoğlu** of Eğridir Hospital in 1955 who were trainees of the French school.

Spinal stenosis was first described by **Dr. Münir Ahmet Sarpyener** in 1945.



Prof. Dr. Rıdvan Ege

Prof. Dr. Rıdvan Ege and **Prof. Dr. Recai Ergüder** published the first study on discectomy at the 14th National Medical Congress in 1958.

In 1960's posterior spinal fusion became widely known. **Prof. Dr. Zeki Korkusuz** in Ankara, and concurrently others in İzmir and İstanbul, started to perform this surgery.

Prof. Dr. Zeki Korkusuz

Prof. Dr. Rıdvan Ege modified Albee operation in the same years.

In Aegean University, **Prof. Dr. Veli Lök** began to use Albee operation for Pott cases. Following posterior lumbar fusion, anterior fusion became popular as well.

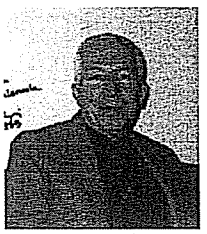
Prof. Dr. Güngör Sami Çakırgil performed anterior spinal fusion in Potts' diseases in 1964. These operations were mostly located at the thoracic and lumbar regions.

Prof. Dr. Güngör Sami Çakırgil

In 1970's, **Prof. Dr. Zeki Korkusuz** performed anterior cervical procedures.

In 1971, **Dr. Akçiçek** from Eğridir hospital presented 53 cases of vertebral osteotomies due to kyphosis.

The first anterior cervical fusion was made by **Dr. Cloward** at Hacettepe University Department of Neurosurgery in 1964.



Prof. Dr. Aykut Erbenli

Prof. Dr. Vural Bertan

Prof. Dr. H. Ziya Gökalp

Prof. Dr. Yücel Tümer

Prof.Dr.Ertan Mergen

After this first anterior cervical fusion, **Dr. Nurhan Avman** of Ankara University in 1965, **Dr. Vural Bertan** and **Dr. Aykut Erbengi** of Hacettepe University in 1967, **Dr. Hamit Ziya Gökalp** of Gülhane Military Hospital in 1968, and other institutions started to operate on the anterior cervical spine. The DDT system of Armstrong popularized in 1975 was first used in Ankara University Medical School by **Prof. Dr. Yücel Tümer** and **Prof. Dr. Ertan Mergen.**

Apart from these fusion operations, **Prof. Dr. Emin Alıcı** performed the first trans-oral fusion in 1978 and Alıcı Internal Fixation (ALIF) surgery in 1979.

Prof. Dr. Emin Alıcı

Spinal Instrumentation in Turkey

Cervical Instrumentation

Medical records on which instruments was first used in Turkey are lacking. The first instrumentation is thought to be posterior sublaminar wiring.

In 1967, **Dr. Bertan** and **Dr. Tokgözoğlu** used cervical plates for fixation in a trauma case. This study was published in 1972. Plate fixation was occasionally used in various centers, whereas, posterior wire fixation remained to be popular for many years.

Anterior cervical plates were also used for different cases in following years.

In 1980's Halifax clamps became popular for a short period. Halifax clamps for C1-C2 fusion and at other locations were used by **Dr. Zileli** in 1990. **Dr. Zileli** presented the results of his clinical study in one meeting.

Prof. Dr. Mehmet Zileli

Rundsford Loop was first used for occipitocervical fixation in 1989 in Aegean University. A similar operation was also performed by **Dr. Özer**.

Dr. Fahir Özer was the first surgeon to use lateral mass plating in posterior cervical region. He was also among the first to perform anterior screw fixation of the odontoid, posterior screw fixation for Hangman fractures and C1-C2 transarticular screw fixation.

Dr. Özer and his friends defined oblique corpectomy and fusion in cervical spondylosis in 1999.

Thoracolumbar Instrumentation

POSTERIOR SYSTEMS

The system of Harrington first introduced in 1962 has been widely used since then.

Thoracolumbar instrumentation was first used in scoliosis surgery in contrast to cervical instrumentation.

Harrington instrumentation was first used in 1968 by **Dr. Güngör Sami Çakırgil** of Ankara University, in 1969 by **Dr. Bahattin Oğuz Temoçin** of İstanbul University, and in 1972 by **Dr. Mehmet Tiner** of Ege University.

Dr. Altav presented 4 cases of Harrington application for scoliosis in 1971..

Dr. Bilsel was the first to use the Luque system in 1988.

In 1988, the CD system was first used by **Dr. Çeliker** and by **Prof. Dr. Ünsal Domaniç**. **Prof. Dr. Hamzaoğlu** was first to use the Drummond-Harri-Luque system in 1989.

Prof. Dr. Azmi Hamzaoğlu

Thoracolumbar Harrington instrumentation among Neurosurgeons was first performed by **Dr. Aydın Paşaoğlu** in 1980.

Prof.Dr.Derya Dinçer

Prof.Dr. İ. Çetin

The pedicular Schanz screw was first used in Ankara University by **Prof. Dr. İ. Çetin, Assoc. Prof. Dr. Derya Dinçer** and **Dr. Tarık Yazar** in 1987.

Dr. Alıcı performed the first transpedicular fixation operation in 1991 with the system called under his name.

The first transpedicular operation on spondylolysthesis was also performed by **Dr. Emin Alıcı**.

Although lumbar cage application was widely used by all neurosurgeons and orthopaedic surgeons initially, it was mostly commonly used by the neurosurgeons lately.

The names of first users of lumbar cages are still not known.

ANTERIOR SYSTEMS

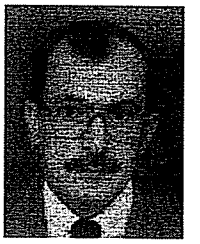
Dr. Alıcı performed anterior rigid rod fixation in 1990.

The Kaneda system was used after **Dr. Kaneda** himself gave an invited speech in one of our previous Spinal Surgery Congresses.

Dr. İlker Çetin of Ankara University was among the first to use the Kaneda system in 1992.

In Aegean Region, the first Kaneda device was implanted by **Dr. Zileli** in 1993.

The Dweyer instrument and the Webb-Morley system were used by **Dr. Güngör Sami Çakırgil** and **Dr. Mümtaz Alpaslan** in 1987. First endoscopic instrumentation was made by **Dr. Alıcı** in 1995.



Dr. Mümtaz Alpaslan

Assoc. Prof. Dr. Ahmet Alanay and **Prof. Dr. Tarık Yazar** were the first to perform vertebroplasty and kyphoplasty.

Development of Instrument Systems

Following the usage of imported spinal systems, studies on local products improved.

The first outcome was the Alıcı Spinal System (Hipokrat A.Ş.), developed by **Prof. Dr. Emin Alıcı** in 1990. Following several modifications, this system is one of the most commonly used implant by orthopedists.

In 1992, **Dr. Tarık Yazar** developed the "İbn-i Sina Spinal System" and **Dr. Mehmet Zileli** developed the "Tıpsan Spinal System".

Dr. Cengiz Türkmen's anterior fixator should also be mentioned among local products.

Dr. Özer developed a new retractor system to be used in anterior cervical discectomy and fusion.

In conclusion, general surgeons were the first spinal surgeons who performed fusion in Turkey. Orthopaedic spinal surgeons were the pursuers of general surgeons in means of performing trauma and deformity surgery of our near past.

The pioneers of cervical stabilization were mostly neurosurgeons. After 1990's, neurosurgeons were also interested in thoracolumbar stabilization.

New Classification System in Ais: Impact on Surgery

Lawrence G. LENKE, MD

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AIS CURVE CLASSIFICATION

The King classification system has remained the principle means of classifying thoracic adolescent idiopathic scoliosis (AIS). Despite marked changes in the three-dimensional preoperative assessment and the use of segmental spinal instrumentation in the last decade, this coronal plane only system has prevailed, but has shortcomings. It is not comprehensive, uniplaner, and reliability of the system is suspect. As a direct reflection of a multi-center scoliosis group (Harms Scoliosis Study Group), difficulty with reproducible idiopathic scoliosis curve classification, a new system has been developed. Six goals in formulating this surgical system were specific from the outset: 1) to be comprehensive with all types of AIS curves classified; 2) to be two-dimensional with applicability to three-dimensional assessment; 3) to be treatment based; 4) to separate out specific curve types by objective radiographic criteria; 5) to be highly reliable; 6) to be logical, easily understood, and useful to scoliosis surgeons.

There are three components to this new curve classification system: curve type, lumbar spine modifier, and a sagittal thoracic modifier. Each of these three components should be identified separately, then combined together to create the complete classification.

Classification begins by reviewing the long cassette upright PA and lateral radiographs as well as right and left side bending radiographs. The spinal columns are divided into three regions: proximal thoracic (PT), main thoracic (MT), and thoracolumbar/lumbar (TL/L). One must also keep in mind the regional apices of curve designation with a main thoracic apex being located between the body of T2 inclusive to the T11-T12 disc; thoracolumbar curves having apices from the body of T12 to the body of L1 including the T12-L1 disc; and lumbar curves having apices extending from the L1-L2 disc to the body of L4 inclusive.

CURVE TYPES 1-6

Regional curves are separated into major (largest Cobb) and minor curves. Specific objective criteria in the coronal and sagittal planes determine whether the minor curves are structural or non-structural. Structural criteria in the coronal plane include inflexibility on side bending > 25□; in the sagittal plane proximal thoracic (T1-T5) and thoracolumbar (T10-L2) kyphosis > +20□; and in the axial plane residual apical lumbar rotation on side bending > Nash-Moe grade I. Thus, each region of the spine, the PT, MT, TL/L, is either designated as structural or non-structural based on these criteria. The largest Cobb measurement is considered the major curve and thus is always structural in these operative cases. A template can thus be created whereby six curve types are designated: Type 1- Main Thoracic; Type 2 – Double Thoracic; Type 3 – Double Major; Type 4 – Triple Major; Type 5 – Thoracolumbar/ lumbar; and Type 6 – Thoracolumbar/lumbar – Main Thoracic.

These curve type designations are treatment-based, for by and large the regions of the spine that are designated structural will require instrumentation and fusion, while those non-structural regions will not. Thus, although not directly providing fusion levels, the curve type designation does implicate appropriate regions of the spine to be included in the instrumentation and fusion, and those regions, which should be left unfused.

LUMBAR SPINE MODIFIER

The lumbar spine is a mobile region of the spine and serves as the foundation of the spine and pelvis. The degree of lumbar deformity is an important determinant of spinal balance and success with scoliosis instrumentation and fusion. Therefore, we have included a lumbar spine modifier to classify the severity of the lumbar deformity in each scoliosis curve and to complement the specific curve type.

Lumbar spine modifiers, A, B, and C, are based on the relationship of the center sacral vertical line (CSVL) to the lumbar spine on long cassette upright radiographs. For the lumbar spine modifier A, the CSVL lies between the lumbar pedicles up to the stable vertebra. The curve must have thoracic apex (curve type 1-4), which excludes any thoracolumbar or lumbar curves (types 5 and 6).

For lumbar modifier B, a major thoracic curve also exists, but the CSVL falls on the apex of the lumbar spine between the medial border of the lumbar concave pedicle and the concave lateral margin of the apical vertebral body or bodies (if the apex is a disc) because of the lateral deviation from the midline of the lumbar spine.

And for the lumbar modifier C, the CSVL falls completely medial to the concave lateral aspect of the thoracolumbar/lumbar apical vertebral body or bodies (if the apex is a disc). Thus, lumbar modifier C may exist with any of the curve types 1-6 with curve types 5 and 6 always having lumbar curve modifier C because of the necessary deviation from the midline of the apex of the major thoracolumbar/lumbar curve for the curve type 5 and 6 designation.

SAGITTAL THORACIC MODIFIER (-, N, +)

Thoracic sagittal alignment is crucial in the formation of scoliosis, the preoperative assessment of surgical indications, the specific operative approach, and instrumentation techniques utilized to correct the scoliosis. Currently, instrumentation techniques are often principally guided by the thoracic sagittal profile in order to optimize sagittal alignment during concomitant scoliosis correction. For these reasons, we have devised a simple thoracic sagittal modifier to complement the six curve types and three lumbar spine modifiers presented.

The sagittal thoracic modifier is based on the upright lateral radiograph and measured from the superior endplate of T5 to the inferior endplate of T12 (T5-T12). When this measurement is <+10□, the sagittal modifier is designated as a "-" or hypokyphosis; when the measurement is between +10° to +40°, it is designated as "N" or normal kyphosis; and for measurements greater than +40°, the designation is "+" or hyperkyphosis.

COMPLETE CURVE CLASSIFICATION

Complete curve classification thus combines the specific curve type 1-6 along with the lumbar spine modifier (A, B, C) and the sagittal thoracic modifier (-, N, or +) to form the specific curve classification (for example 1A-, 1AN, 1A+, 1B-...., 6CN, 6C+). A one-page information sheet has been developed to provide all the necessary requirements for proper curve classification, and a one-page schematic highlights the coronal differences between the six curve types and the three lumbar modifiers.

IMPLICATIONS OF CLASSIFICATION ON OPERATIVE TREATMENT

One of the main goals of this new classification system was to make it treatment based. In evaluating the three components of curve type, lumbar spine modifier, sagittal thoracic modifier, the treatment based implications are highlighted.

By designating specific curve type 1-6, the regions of the spine that are structural and should be considered included in the instrumentation and fusion are quite evident. Specifically, for curve type 1 (main thoracic – MT) the MT curve will be fused; in curve type 2 (double thoracic – DT), both the PT and MT curves will be fused; and type 3 (double major – DM), the MT and TL/L curves will be fused; in type 4 (triple major – TM) all three curves, PT, MT, and TL/L will be fused; in type 5 (thoracolumbar/lumbar – TL/L), only the TL/L curve will be fused; and in type 6 (thoracolumbar/lumbar – main thoracic – TL/L-MT) both the MT and TL/L curves will be fused.

Surgical implications for the lumbar modifiers A, B, and C are also evident. For lumbar modifiers A and B, it is anticipated that the lumbar spine will not require fusion. One exception to this is if a

thoracolumbar junctional kyphosis exists in the sagittal plane (T10-L2 > +20°) requiring inclusion of this region in the instrumentation and fusion of the main thoracic curve above. Also, for those main thoracic curves that are quite large (> +75°), often the thoracolumbar/lumbar coronal plane is structural in and of itself because of the large compensatory thoracolumbar/lumbar Cobb measurement (e.g. curve types 3A and 3B, as well as 4A and 4B).

Lumbar modifier C may or may not require the lumbar curve to be included in the instrumentation and fusion of a main thoracic curve. For those with a MT 1C (main thoracic) curve, the goal is to perform a selective thoracic fusion to leave the lumbar spine mobile to accommodate and balance if possible. This is in distinction to a 3C (true double major) curve pattern where invariably the lumbar spine will be included in the instrumentation and fusion of the main thoracic region. Occasionally, there is a fine line between the 1C and 3C curve patterns, and ratio criteria of thoracic to lumbar (T:L) Cobb measurements, apical translations, and apical rotations that will be required in addition to the structural criteria as listed for this classification system. Lastly, it is important to evaluate the clinical appearance of the patient when separating out a true (3C) versus false (1C) double major curve pattern. If there is a marked discrepancy between the thoracic (greater) and lumbar (lesser) cosmetic appearance, often a selective thoracic fusion can be successfully performed. When the thoracic and lumbar cosmetic appearance is equal, this usually indicates a true double major curve pattern that will require both curves to be instrumented and fused.

For type 5 and 6 curves of the C modifier, the thoracolumbar/lumbar curve will always be included in the instrumentation and fusion. Most type 6 (TL/L – MT) curves will also require the main thoracic curve to be fused as well.

The treatment implications of the sagittal thoracic modifier are also quite important. For a hypokyphotic sagittal modifier (-), the goal of instrumentation and fusion of the thoracic region is to improve thoracic kyphosis either with posterior or more recently, anterior instrumentation techniques. For a normal (N) sagittal modifier, the goal is to maintain normalized thoracic sagittal alignment. For a hyperkyphotic (+) sagittal modifier, the goal is to reduce thoracic kyphosis into the normal range. This will usually require instrumentation and fusion from a posterior route with convex compression forces applied prior to any concave distraction forces.

Thus, all components of this triad classification system produce treatment implications of either regions of the spine to be fused, as well specific techniques to optimize coronal and sagittal curve correction and balance.

Cervical Trauma

Cüneyt Şar

Institution(s):
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Mechanism of injury:

Most cervical spine fractures can be classified on the basis of the mechanism of injury. The forces and mechanism that produce the spine fracture vary according to the level of injury. A sever flexion or extension force is responsible for occipital and atlas injuries. Axial loading is accountable for the majority of fractures of the ring of C1. Rotation and hyper flexion most often account for injury at the atlantoaxial level. Hyperextension and axial loading are believed to be the most common cause of spondylolisthesis of the axis, and further injury may be associated with a second force of anterior flexion and compression. Injuries to the lower cervical spine may occur secondary to the forces of flexion, extension, lateral rotation, axial loading, or a combination of these forces.

Patient evaluation

In the multitrauma settings, patients should be considered to have cervical spine injury until completion of the secondary physical examination and thorough radiographic assessment. Noncontiguous spinal injuries occur in % 5 to % 20 of these with spine fractures.
Palpation of the spine from the skull to the coccyx for areas of localized tenderness is extremely helpful to localize a spinal injury in a cooperative patient. Root specific muscle strength testing of the upper and lower extremities and rectal examination for tone and sensation are extremely important in determining an anatomic level of injury. Cranial nerve examination, determination of sensation and pin and light touch, and determination of deep tendon and plantar reflexes complete the spine injury assessment. The presence of sensory sparing should be documented. If present, it indicates a potentially hopeful prognosis. Absence of primitive reflexes, such as the bulbocavernosus reflex or anal wink, in the first 48 hours indicates that neurological deficit may be related to spinal shock or contusion rather than to a complete and permanent spinal cord injury.

Imaging

Lateral cervical spine radiographs are an essential part of the evaluation. Although % 70-85 of significant injuries will be detected with a lateral radiograph that allows visualization of C7, an injury at the cervicothoracic junction may escape detection. Consequently, current spine trauma protocol should require complete spine radiographs with full visualization of the body of T1. If this not possible, a swimmer's view or computed tomography scan will be required. A complete cervical spine series consist of lateral, AP and open mouth views, which will diagnose 90-95% of all cervical spine injuries. The open-mouth anteroposterior view of the spine is essential for evaluation of the upper cervical spine. The standard AP view of the cervical spine allows evaluation of lateral mass and sagittal plane fractures. Oblique views provide excellent visualization of the intervertebral foramina, pedicles and facet joints. The role of flexion-extansion lateral radiographs in an emergency setting remains controversial. They may be useful in the alert, cooperative patient without neurological deficit who complains of neck pain.
Computed tomography is an excellent method of evaluating patients with cervical spine injuries. It`s advantages include axial imaging and excellent cortical detail. With new spiral CT technology, high quality sagittal reconstructions that are almost comparable to multiplanar polytomograms are possible; these reconstructions allow detection of subtle, horizontally oriented injuries of the vertebral column.
Advantages of MRI include direct multiplane imaging capabilities, ability to detect non-contiguous fractures and most importantly, its ability to determine the degree of soft-tissue injury, including the intervertebral disc, spinal cord and ligamentous structures.

Timing of surgery

When a progressive neurological deficit exists in the presence of malalignment and/or spinal canal compromise, emergency decompression is indicated. In all others with spinal cord injuries, timing of surgery is controversial. Some authors recommend treatment as soon as the patient is medically stable, while others advocate a delay of 4 or more days to allow posttraumatic swelling to resolve. Whether early decompression and reduction of neural structures enhances neurological recovery continues to be debated. Currently, a reasonable approach would be to treat non-progressive neurological deficits on a semi urgent basis, when the patient's systemic condition is medically stable.

Fractures and dislocations of the upper cervical spine

Atlas fracture

Fractures of the atlas generally are the result of an axial load injury. The C1 ring fracture, which may be isolated to the anterior arch is secondary to an axial load with flexion force. Isolated posterior arch fractures are due to an extension force combined with the axial load. Stability is determined by measuring the spreading of the lateral masses on the open mouth AP radiograph. If the total radiographic excursion of the lateral masses of C1 is greater than 8 mm`s, transverse ligament is most likely torn and the fractures are unstable. Stable isolated C1 fractures can be treated with a hard collar. In burst and lateral mass fractures, treatment has been controversial. Immediate immobilization in a halo-vest does not maintain or achieve reduction of lateral mass displacement. In addition, short term halo traction is inadequate to maintain even an achieved reduction. Levin et al. treated their patients with isolated posterior arch fractures or burst or lateral mass fractures with 2 mm or less lateral displacement in a cervical orthosis for 10-12 weeks. Patients with lateral displacement of 2-7 mm`s are treated with halo traction for up to 7 days. Then the patient is immobilized in a halo-vest for 3 months. Patients with more than 7 mm`s of lateral displacement are treated with halo traction for 6 weeks. The patient is immobilized in a halo for 6-8 additional weeks. An alternative treatment for unstable fractures of the atlas is primary surgical reduction of fracture with lateral mass screws and rod, developed by Harms.
At the conclusion of treatment, dynamic flexion and extension radiographs are performed to evaluate stability. If instability persists despite of bony union, surgical stabilization of the C1-C2 can be undertaken. Occiput-C2 fusion is required only when significant damage has occurred to the occiput-C1 articulation. Patients with a fracture through the facet joint or a comminuted pattern are high risk for nonunion, chronic neck pain and spastic torticollis. They may benefit from posterior C1-2 arthrodesis. A patient who develops an unstable nonunion of C1 will require an occiput-C2 fusion.

Atlantoaxial rotatory subluxation and dislocation

Fielding and Hawkins classified atlantoaxial rotatory fixation into four groups according to severity. Type I is the most common. Here, rotation is fixed, without evidence of significant soft tissue disruption. Only mild anterior displacement (3 mm) is noted on the lateral radiograph. In type II injuries, rotatory fixation occurs with anterior displacement of one C1 lateral mass by 3-5 mm, pivoting on the non-displaced contra lateral C1-2 articular process. In type III fixation anterior displacement of >5mm of both C1 articular masses occurs with a marked increase in the atlantodental interval demonstrated on the lateral radiograph. Tpye IV fixation with posterior C1 subluxation is rare. The treatment and prognosis of rotatory injuries of the C1-2 level depend on the severity of displacement, presence of neurologic deficit, and duration of deformity. This injury often can be treated conservatively with rigid immobilization for 6-8 weeks. Occasionally however, it requires skeletal traction to reduce the subluxation. If rotatory subluxation is left untreated, it may go on to a fixed rotatory deformity and require surgical treatment. Posterior C1-C2 fusion is classical surgical treatment. Alternatively, Harms advocates open reduction and temporary stabilization with plate through transoral approach.

Odontoid fractures

Fractures of the odontoid are most often the result of a flexion force causing anterior displacement. Fractures with posterior displacement have a much higher incidence of neurological injury and are caused by hyperextension force. The type 1 injury is an oblique fracture through the upper part of the odontoid. Type 2 fracture occurs at the junction of the odontoid process and the body of the axis. In type 3 fracture, the fracture line extends downward into the cancellous portion of the vertebral body. Type 1 fractures are extremely uncommon; they can be safely treated with a collar for 8 weeks. Type 3 fractures have 85-90% union rate and most often they can be treated successfully with a halo-vest for 12 weeks. These fractures, however are not benign lesions, and malunion may occur. Type 2 fractures have the highest rate of nonunion. Displacement greater 5 mm`s, angulation greater than 10° , and age greater than 40 years

contribute to a higher rate of nonunion. Despite the overall high rate of nonunion, a significant number of type 2 odontoid fractures will heal with halo vest immobilization if anatomic alignment can be obtained and maintained. Primary posterior C1-2 fusion and anterior screw fixation are surgical alternatives for treating patients at high risk for nonunion or patients for whom a halo vest is contraindicated. Anterior screw fixation of the odontoid is an alternative to halo immobilization or posterior fusion. Anterior screw fixation has the advantage of decreasing of the nonunion rate of type 2 dens fractures while preserving atlantoaxial rotation. Although this technique initially was used in the treatment of odontoid nonunions, its use today is primarily in the treatment of type 2 dens fractures. Frontal oblique fractures tend to displace laterally with compression; sagital oblique fractures often have little bone available to provide stable fixation and tend to displace sagitally. Additional contraindication is significant thoracic kyphosis.

Axis fractures

Traumatic spondylolisthesis of the axis is caused by a hyperextension force. If a flexion component is added to the injury, there may be disruption of discs and ligaments causing a forward subluxation of C2 on C3. A type 1 injury includes all nondisplaced fractures as well as all fractures that have no angulation and less than 3 mm of displacement of C2 on C3. Type 2 is a hyperextension and axial loading injury that has angulation and translation. Type 3 fracture dislocations are secondary to a flexion as well as a posterior distraction force. They have both severe angulation and displacement along with a unilateral or bilateral C2-C3 facet dislocation. Type 1 and 2 injuries can be successfully treated with traction for reduction and then halo immobilization. Alternatively, once the fracture is reduced in traction, surgical stabilization by osteosynthesis through the pedicles can be achieved, which can be done with screws placed through the C2 pedicle. Type 3 injuries usually require open reduction of facet dislocation with posterior fusion and stabilization. Posterior plating for C2-3 facet injury can be considered. In that instance it is necessary to use pedicle screws in the C2 pedicle. The screws at the C2 level also may be used to stabilize the accompanying pedicular fracture as well. Alternatively, an anterior C2-3 discectomy, facet reduction and fusion with anterior plate fixation can be considered. This approach may not allow for an easy reduction of the facets and the posterior approach is most probably the procedure of choice for most surgeons. Nonunions can be treated with a posterior C1-3 fusion or an anterior C2-3 discectomy and fusion.

Fractures and dislocations of the lower cervical spine

Classification

Allen's et al.'s classification remains one of the most widely used today (Figure 1). In a retrospective review of 165 cases cervical spine injury, they developed a mechanistic classification of fractures and dislocations of the lower cervical spine. The authors divided the injuries into six groups, each named according to the presumed position of the cervical spine at the time of injury and initial dominant mode of load to failure. Their categories included compressive flexion, vertical compression, distractive flexion, compressive extension, distractive extension, and lateral flexion.

Spinal stability

In an intact spine, instability of the lower cervical segments was defined as a translatory displacement of two adjacent vertebra greater than 3.5 mm or an angulation of greater than 11 degrees compared with adjacent normal motion segments. Furthermore, a comprehensive checklist for the diagnosis of traumatic instability of the lower cervical spine was developed (White).

Compressive flexion injury

Compressive loads applied to the flexed spine result in compression of the anterior column and distraction of the posterior column. The resultant shortening of the anterior column and leghtening of the posterior column can be graded into five stages. In stages 1 and 2, the structural integrity of the middle and posterior elements has not occurred. Neurological injury is uncommon. Although there is risk of late kyphotic deformity, most patients can be managed successfully in a rigid cervical orthosis or halo-vest orthosis for 8-12 weeks. In stages 3 and 4 (without displacement and <3 mm displacement) complete posterior ligamentous disruption is possible. These patients require evaluation by MRI to rule out posterior ligamentous disruption. A halo-vest orthosis is sufficient for patients with an intact posterior column. However, for those patients with ligamentous disruption , the risk of late kyphotic deformity is high, and posterior cervical fusion and instrumentation recommended. A stage 5 injury involves a teardrop fragment with greater than 3 mm`s of subluxation and the posteroinferior portion of the body retropulsed into the spinal canal. This injury usually involves two motion segments. A combined anterior and posterior stabilization procedure should be considered in these cases.

Vertical compression injury

These injuries are the result of compressive forces applied to a neutrally aligned spine, and lead to shortening of both the anterior and middle columns of the spine. In stage 1 and 2, posterior ligamentous structures are usually uninjured, and late kyphotic deformities are unusual. Therefore, patients who are neurologically intact can be managed for 6-8 weeks in a rigid cervical orthosis or halo-vest. Patients with neurological involvement will require anterior decompression and anterior stabilization. Stage 3 injuries usually involve fragmentation and displacement of the vertebral body. Occasionally this injury may involve bony failure in the anterior column followed by ligamentous failure of the middle and posterior columns with subsequent posterior translation and cord impingement. Patients without neurological injury may simply require posterior fusion and stabilization. However, many of these patients will present with neurological injury, and will therefore require anterior decompression and reconstruction augmented with posterior stabilization and fusion.

Distractive flexion injury

This injury represents the most common injury pattern. Distractive loads applied the spine in a flexed position cause tensile failure and lengthening of the posterior column in the early stages and associated failure of the anterior and middle columns during the latter stages. In general less than 25% anterior anterior subluxation is indicative of facet subluxation (S1), 25-50% subluxation indicative of unilateral facet dislocation (S2), and 50% or greater subluxation indicative of bilateral facet dislocation (S3). Full body displacement is defined as Stage 4 injury. All stages of flexion distraction injury may be associated with facet fractures as well. Closed reduction should be attempted for all stages of distractive flexion injuries as soon as the patient is medically stable. Following successful close reduction, patients with distractive flexion injuries treated by non-surgical methods in the halo-west orthosis have up to 64% incidence of late instability. Primary posterior cervical fusion is preferred for patients in all stages of distractive flexion injuries when neurologically intact. It has been recognized that 54-80% of patients with distractive flexion injuries have associated acute disc herniations at the level of injury. Several authors have reported catastrophic neurological damage following closed reduction of this injury. Careful review of this studies however, indicates that many of these patients underwent closed reduction under general anesthesia. No case of neurological deterioration caused by herniated nucleus pulposus during a conscious closed reduction has been reported. Before an open procedure an MRI may be considered to exclude a possible disc herniation. For patients with herniated discs should have anterior discectomy before open reduction and fusion. Some authors have reported that addition of an anterior plate may preclude the need for a further posterior stabilization procedure; however in the presence of posterior element damage a combined approach is usually preferable.

Compressive extension injury

Compressive forces applied to the spine in extension result in early failure of the posterior column of the spine followed by failure of the anterior column. Stages 1 and 2 of compressive extension injuries result in single or multilevel posterior element fractures without vertebral body displacement, which are best managed with a rigid cervical orthosis or halo-west. Later stages are relatively uncommon. Later stages are more unstable and require stabilization. If neurological injury exists, decompression must be directed toward the pathology, followed by appropriate stabilization procedures.

Distractive extension injury

Distractive forces applied to the spine in extension cause tensile failure and lengthening of both anterior and posterior columns of the spine. The injuries without evidence of vertebral body displacement can be treated in a rigid orthosis. Alternatively for anterior ligamentous injury, a primary anterior arthrodesis may be considered. Vertebral body displacement mandates fusion. Anterior fusion with plate fixation is most often successful. Posterior fusion can be added in extremely unstable cases.

Lateral flexion injury

The asymmetric nature of force loading in the coronal plane results in tensile failure of one side of the spine, and compressive failure of the opposite side. Injuries without displacement can often be managed without surgery, whereas displaced injuries most frequently require surgical stabilization and fusion.

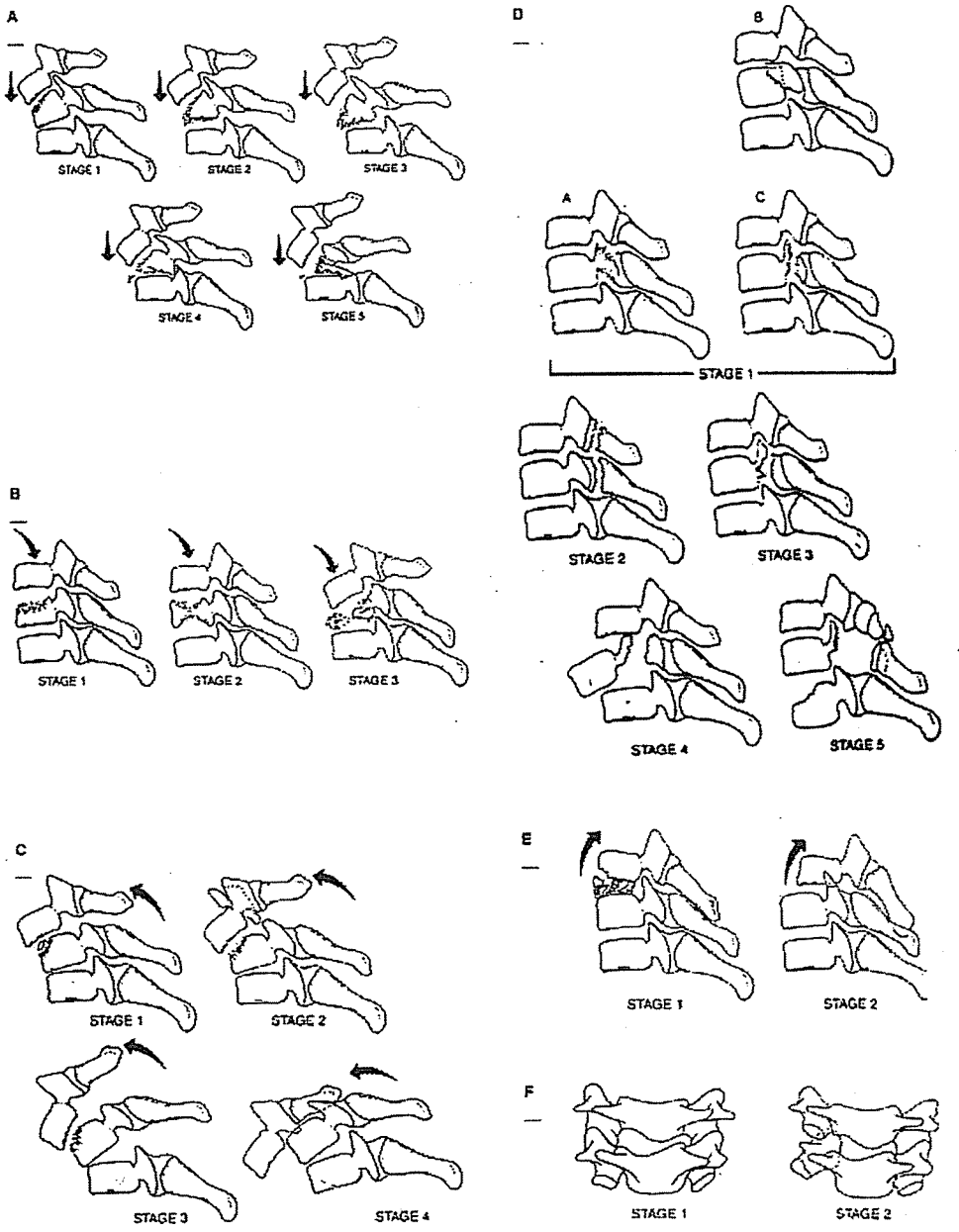

Figure 1: Allen-Ferguson Classification
A. Compressive flexion injury
B. Vertical compression injury
C. Distractive flexion injury
D. Compressive extension injury
E. Distractive extension injury
F. Lateral flexion injury

The Role of MRI in the Classification of Thoracolumbar Spine Injuries

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Thoracolumbar spine fractures are complex injuries of a structure, which is composed of parts with different susceptibility to injury and different healing potentials. This complexity is reflected in the difficulties with the classification attempts and in the confusion in the literature about the effectiveness of different treatment regimes. Remarkable differences in the long-term results of conservative treatment regimes or surgical methods have been reported in the literature. These difficulties were probably caused by inadequate definition of some of the essential prognostic parameters. Since Holdsworth (1963), architectonic abstractions such as columns have been used to comprehend these complex injuries and their mechanical consequences In the two-column spine of Holdsworth and the subsequent three column spine concepts of Louis (1977) and Denis (1983), the non-osseous structures of the spine were considered integral parts of these columns. The integrity of soft tissue structures, however, could only be inferred from indirect evidence from radiograms and later from CT scans. The Denis classification has been quite influential. Although this classification was a refinement in the understanding of the nature of these injuries, it was amenable to many simplifications and led to some persistent confusion. Although Denis emphasized that his columns are formed by osseous and non-osseous structures, no attempt has been made to progress the diagnosis of non-osseous injuries. The three-column concept was reduced to what is imagable with CT. It has been simplified and reduced to a simple rule of the thumb, which states that any injury to two of the three columns, as seen on CT, i.e. bony injury, make the spine unstable. Further, an intact middle column has been seen as a guarantee of stability, although Denis mentioned some of these lesions as first-degree unstable. Also the differentiation between the first, second and third degree instability was lost, leading to a vague, poorly defined instability concept, which has remained dominant during the past decade.

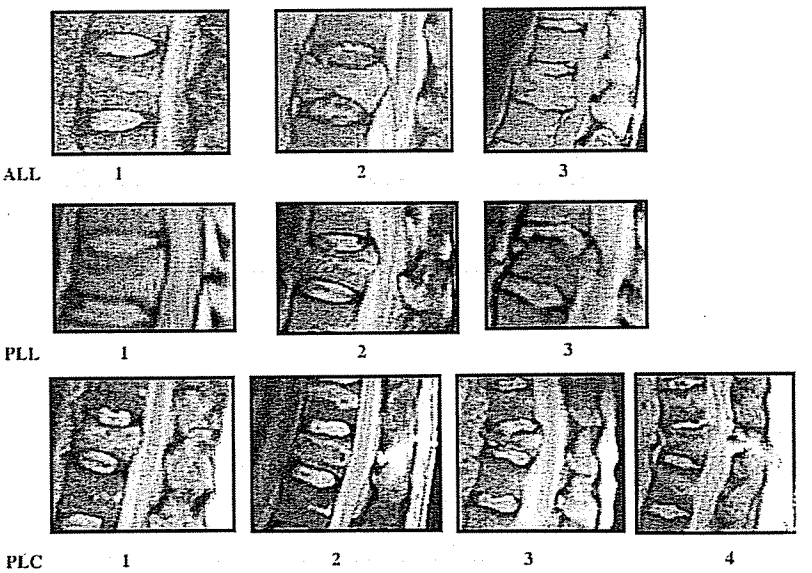
Despite its widespread acceptance there have been criticism of the Denis classification and attempts to modify it. Ferguson and Allen (1984) called the columns a poor semantic choice because these tissues do not anatomically or biomechanically resemble a column. They claimed that "the term, although appealing for its verbal ring, is anatomically and biomechanically incorrect ". They suggested a mechanistic classification in stead according to a presumed mechanism of injury deduced from the patterns of tissue failure. McAffee et al (1983) suggested a division of the burst fractures as stable and unstable. McCormak et al proposed the load-sharing classification in 1994. This proposal was a specific elaboration of the Denis system with a specific problem in mind. The authors were disturbed by the high rate of failure of posterior fixation in their patients with three column fractures and fracture dislocations, and searched for factors predictive of this failure. Their conclusion was that the degree of comminution of the vertebral body together with apposition of fragments and the degree of deformity correction was a factor predictive of the failure of posterior fixation.

The most sophisticated classification system, which has been proposed to date, is the Comprehensive Classification presented by a committee of the AO foundation on this subject (Magerl et al 1994). In this scheme there are three main types of injury, defined by common morphologic characteristics and a common injury producing force. Extent and direction of soft-tissue injury are the main determinants of these types. Type A injuries represent vertebral body compression caused by axial load with or without an element of flexion but without disruption of soft-tissues in the transverse plane. Type B injuries are anterior and posterior element injury with distraction, representing soft-tissue disruption in the transverse plane. Type C injuries are anterior and posterior element injuries with rotation. Each type is further subdivided into groups and subgroups using the common AO 3-3-3 grid. The A 1 subgroup correspond to the "wedge fracture" and A 3 to the "burst fracture" of the Denis classification. The bony involvement in Type B and C fractures follows

essentially the subdivision of the Type A fractures. The involvement of soft-tissues, which is the key determinant in type level of classification, was indirectly deduced from radiograms and CT scans in the original series of the authors. Although this scheme is very elaborate and allows a detailed analysis of the fractures, its relative complexity makes it prone to problems of reproducibility. A recent study showed poor reproducibility of the type level classification of this scheme with radiograms and CT's alone, which improved with the use of MRI (Oner 2002).

It is clear that many authors feel that soft tissue injury patterns are essential prognostic parameters. But these parameters have been poorly defined due to diagnostic difficulties. A reliable clinical examination of the soft tissue involvement is not possible in the thoracolumbar spine. Radiograms and CT's provide only indirect evidence of soft tissue involvement. MRI has been shown to be capable of depicting ligamentary injury associated with these fractures in clinical and experimental studies. Petersilge et al reported on MRI's of 25 "burst fractures" according to the definition of Denis. They found in seven of the fractures posterior ligamentary disruption, which would be unsuspected on radiograms and CT scans. Terk et al report detection with MRI of posterior ligamentary complex injury in 36 of the 68 fractures studied. Leferink et al (2002) found in 1/3 of their operatively treated patients posterior ligamentary complex injury unsuspected on radiograms and CT's. Another study by our group showed the prognostic importance of changes in the disc space, especially in the conservatively treated patients, and classified these changes on MR images (Oner 1998). There are two cadaver studies, which showed excellent correlation between MR findings and anatomic sections. Kliewer et al (1993) showed in a cadaver study good correlation between MR images and anatomic sections of acute spinal ligament disruption. In a similar study Oner et al (1999) reported perfect correlation between MR images and anatomic sections of injuries to the discs and endplates. These studies establish MRI as a highly accurate modality for determining disco-ligamentary injury patterns and describe the MRI features of different structures involved.

We attempted to clarify these issues in a prospective study using MRI's in a consecutive series of patients. We categorized the MRI findings of all relevant structures in a sample of 100 patients (Oner 1999) (Fig. 1). A wide variation of different injury combinations was seen in this study. The crucial question is which of these injuries have prognostic significance and whether these injury patterns can be captured with existing classification systems. In a consequent prospective study of 53 patients (Oner 2002) we found that an unfavorable outcome in the conservative group was related to the progression of kyphosis, which in most cases was predictable with the use of trauma MRI findings concerning the EP and COR involvement. In the operatively treated group, recurrence of the kyphotic deformity was predictable by the lesion of the PLC together with endplate comminution and vertebral body involvement as seen on trauma MRI. These studies confirm the value of the mechanistic classification of the Magerl system and the load-sharing classification, which can be combined in order to develop schemes with higher predictive value.



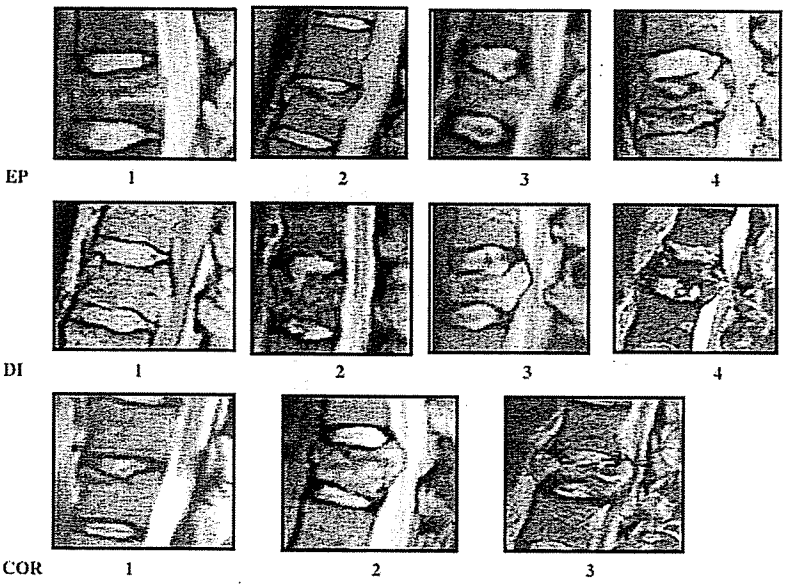


Figure 1: States of the ligamentary structures endplates, discs and vertebral bodies observed on the MRI's. ALL: Anterior Longitudinal Ligament; PLL: Posterior Longitudinal Ligament; PLC: Posterior Ligamentary Complex. EP: Endplate; DI: Intervertebral Disc; COR: Corpus (Vertebral body). (Oner 1999).

Recommendations

Mechanistic classification schemes are the best tools to conceptualize the spinal injuries and to develop prognostic means. A classification system is valuable as long as it can be used as a prognostic tool and can be refined with reassessment by the users. At this moment, the best conceptual scheme for thoracolumbar fractures is the Comprehensive Classification based on the mechanical model of a crane (Fig. 2).

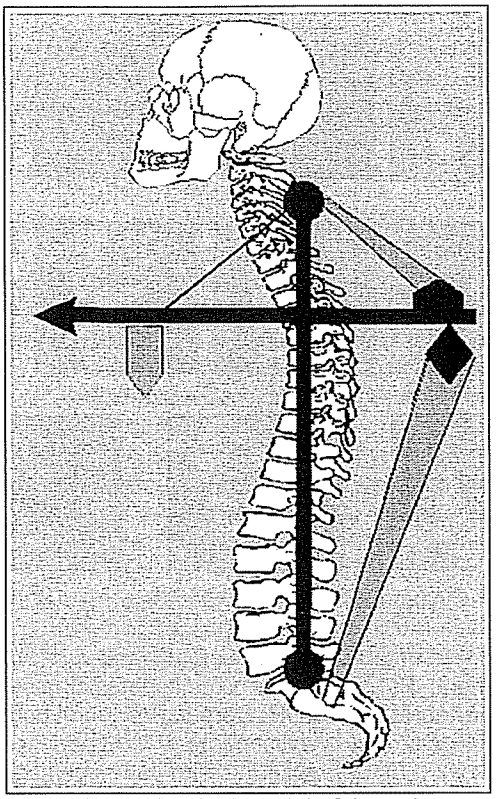


Fig 2: The basic mechanical model of the spine as a crane.

As we can see in this crane model, the amount of deformity, which the construct can withstand, is dependant on the integrity of the posterior tension band. The integrity of the tension band can be reliably assessed only with sagittal MRI's. In our study we saw that even incomplete injuries to the PLC had important mechanical consequences. The basic mechanisms of mechanical failure of the crane can be captured with the A, B, C Type distinction of the Comprehensive Classification (Fig. 3).

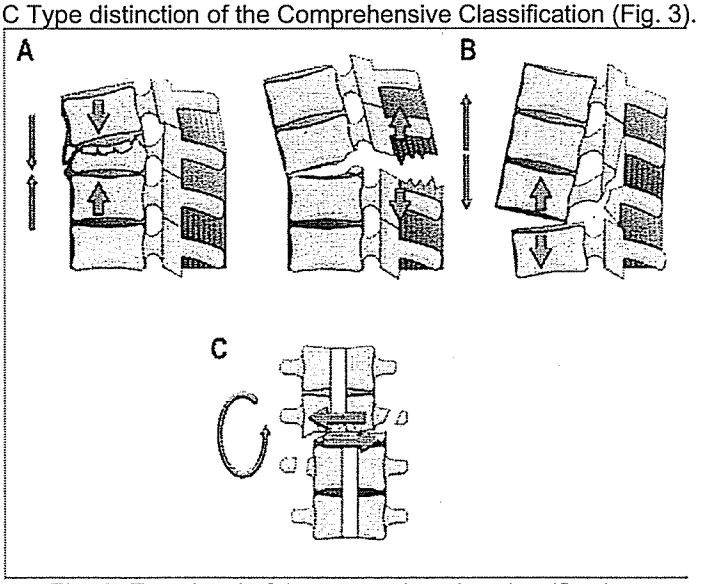
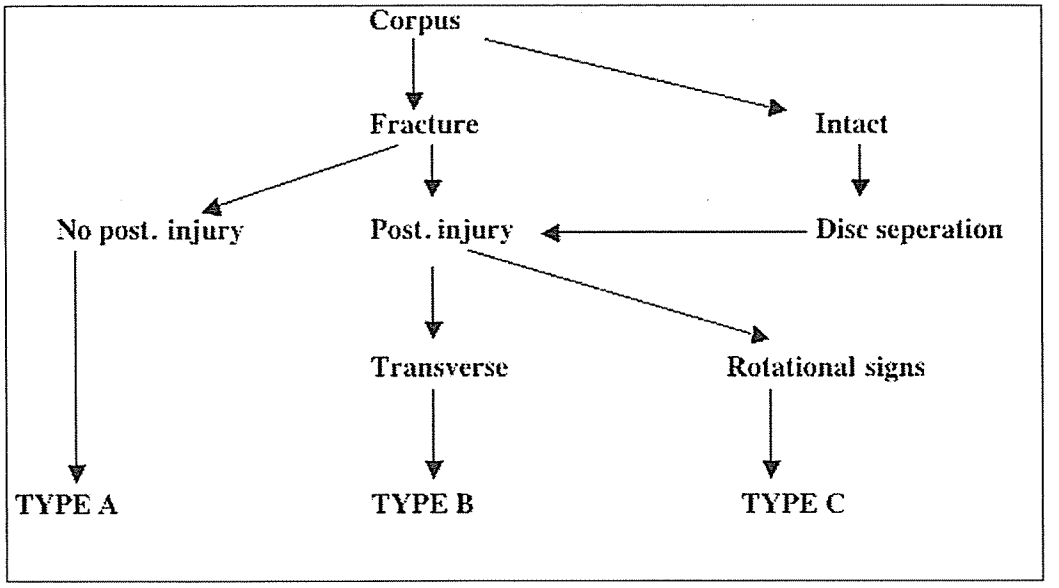


Fig. 3: Type level of the comprehensive classification.

The distinction between common and more stable Type A injuries and the non-A (B and C) injuries is difficult and MRI studies are necessary. Even incomplete injuries to the tension band should be seen as indicative of non-A injury. A simple algorithm to make this distinction is as follows:



The next crucial point is the load-sharing capacity of the anterior elements (the tower of the crane). The nature (bony-discoligamentary) and extent (amount of COR, EP and DI involvement) of the injury should be studied to understand the short and long-term consequences. Bony injuries, as long as the deformity is sufficiently corrected and stabilized can be expected to heal rapidly in the young and healthy trauma patients. Discoligamentary lesions may be more unpredictable. However, in the majority of the patients, it seems that insufficient reduction of the endplate deformity more important is for the long-term stability than frank disc degeneration (Oner 1998). Use of our MRI scheme in larger populations may provide more information and help define the residual load-sharing capacity of the anterior elements and help refine the Comprehensive Classification for a better prediction of the long-term stability.

We must not forget that any classification scheme, however sophisticated, can only provide the surgeon with a mental tool to understand the injury and to make an "educated guess" on the three crucial types of stability:

- Immediate mechanical stability
- Neurologic stability
- Long-term stability.

Any treatment advice based solely on whatever sort of classification is dangerous and should be discouraged. We recommend the use of MRI for all who are interested in contribution to the research of this subject. Further, considering the alarming percentages of PLC injuries missed on conventional radiograms and CT's, we also think that it is prudent to obtain MRI if one considers non-operative treatment.

(For a more detailed discussion of the subject and complete literature list see the academic thesis of the author that can be accessed via: http://www.library.uu.nl/digiarchief/dip/diss/1885237/inhoud.htm
The entire thesis can be downloaded as a PDF file 2.464 kB)

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Low Lumbar Burst Fractures

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ANATOMICAL CHARECTERISTICS OF LOW LUMBAR REGION

- Lordotic segment
- Anterior height of vertebrae and disc more than posterior
- Sagittal position of facets
- Decreased length of posterior elements
- Increased pedicle diamater and medial angulation
- Relative increase of coronal diamater with respect to neural structures
- Neurologic injury as in the form of peripheric nerve injury and increased chance of recovery
- Axial loading and flexion distraction are the main forces in injury

"Low lumber burst fractures have distinct biomechanical and anatomical features."

"Treatment and management considerations for low lumbar fractures are somewhat different than for the rest of the axial skleton."

Denis F, Spine, 1983

"Burst fractures of the lumbar spine are the result of axial compressive forces with an associated flexion moment creating a kyphotic deformity in a normally lordotic spine."

Court-Brown CM, Spine, 1987

Axial forces increase kyphosis by compressing anterior elements in vertebrae above L2 in which there is already kyphosis.

However; Axial compresive forces below L3 cause uniform compression instead of kyphosis due to lordosis in this region altough vertebrae is flexed.

The iliolumbar ligaments and location below the pelvic rim, are two stabilizing factors that are unique to low lumbar vertebrae when compared to thorocolumbar junction.

"It is important to detect the presense of subluxation and/or presense of thecal sac and posterior nerve roots compression between greenstick laminar fractures in low lumbar fractures.

In such a case,first posterior approach is mandatory."

Cammisa FP, JBJS, 1989

Denis F, Spine, 1991

SAGITTAL PROFILE

Most of the lordosis (%76) is between L3 and sacrum.

Most lordotic segments are L3-4, L4-5 and L5-S1.One of the goals of treatment of spinal fractures is to restore the sagittal profile to a nearly normal configuration.

It is more difficult to control the sagittal profile in low lumbar spine than thorasic and upper lumbar spine.

Difficulty of anterior approach.

Difficulty of fixation to sacrum.

In this region,isolated nerve root deficits act similarly to peripheral nerve injury with a good prognosis for spontaneus recovery with conservative treatment."

Andreychik D, JBJS, 1996

CLASISFICATION

Boehler	1929
Watson-Jones	1931
Nicoll	1949
Holdworth	1963
Kelly-Whitesides	1968
Louis	1973
Denis	1983
Farcy	1990
Magerl	1994

DENIS CLASSIFICATION

COMPRESSION FRACTURES

BURST FRACTURES

SEAT-BELT FRACTURES

FRACTURE-DISLOCATION

CLASSIFICATION (MAGERL)

TYPE A: COMPRESSION OF VERTEBRAL BODY

A1 :İmpaction fractures

A2 :Split fractures

A3 :Burst fractures

TYPE B: ANTERIOR AND POSTERIOR ELEMENT INJURY TOGETHER WITH DISLOCATION

B1 :Posterior ligamentous injury

B2 :Posterior bony injury

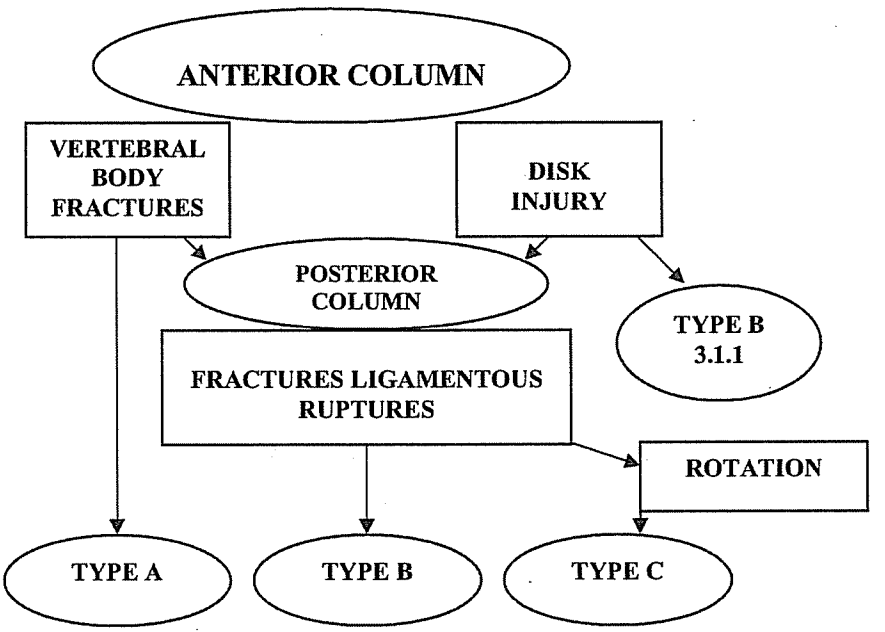
B3 :Anterior injury through disc

TYPE C: ANTERIOR AND POSTERIOR ELEMENT INJURY TOGETHER WITH ROTATION

C1 :Type A injury with rotation

C2 :Type B injury with rotation

C3 :Rotational shearing injury



"Stable vertebrae can withstand the anterior axial forces acting on the vertebral body, posterior tension forces and rotational stresses."

"By that way,vertebrae can hold the body erect and protect spinal canal contents without producing kyphosis."

Whitesides

"Clinical instability is defined as that vertebrae can not protect the relations between vertebrae under physiological loading."

White A.A

TREATMENT

- Medical treatment of spinal cord injury
- Consevative
- Surgical
  - Anterior
  - Posterior
  - Anterior-Posterior
  - Posterior-Anterior

CONSERVATIVE TREATMENT

- Bed-rest
- Brace
- Cast

- Technical difficulty
- Patient incompliance

The results of conservative treatment are better than surgical treatment with long instrumentation.

An HS, Spine, 1991

Conservative treatment is successful in neurologically intact patients.

Finn CA, JBJS, 1992

Mick CA, Spine, 1993

The results of conservative treatment are similar to surgical treatment with short transpediculer instrumantation.

Andreychik D, JBJS, 1996

RADIOLOGICAL FINDINGS AFTER CONSERVATIVE TREATMENT

There may be progression of bony deformities like kyphosis,collapse during conservative treatment.

There may be no correlation between severity of deformity and symptoms during follow-up period.

RELATIVE SURGICAL INDICATIONS

Posterior elements injury

Neurological deficit

Multisegment injuries

Problem in brace use

Patients' desire

SURGICAL TREATMENT

The ideal result of surgical treatment of low lumbar fractures;

Complete decompression of neural elements

Fusion as possible as minimum segment

Establishing the physiological coronal and sagittal position of the spine.

SURGICAL TREATMENT

Posterior

Anterior

Anterior + Posterior

Pseudoarthrosis

İmplant failure

Flat-back syndrome

AIMS OF DECOMPRESION

To treat incomplete neurological deficit

To prevent progression of neurological lesion

To restore the vertebral alignment

INDICATION OF ANTERIOR SURGERY

Incomplete neurological deficit

Burst fractures with Cauda Equina injury.

Occlusion of spinal canal.

Insufficient anterior bony stock.

>25° sagittal index.

Instability after laminectomy.

INDICATION ANTERIOR INSTRUMANTATION

Acute burst fractures with neurological deficit.

Late burst fractures (10 day)

%50 spinal cord compression (without neurological deficit).

KOSTUIK, Spine, 1988

CONTRAINDICATION OF ANTERIOR APPROACH

Dislocation of dorsal bony fragments into spinal canal

Severe osteoporosis

Multiple traumatized patients with thorax trauma

Irreducible dislocation

HAAS, Spine, 1991

INDICATION OF POSTERIOR INSTRUMANTATION

Compression fractures(vertebral body height <%50 or 30° local kyphotic angle)

Ligamentous flexion/distraction injury

Fracture-dislocation

Neurologically intact patient with 15-25° sagittal index

UUMF DEPARMENT OF ORTHOPAEDICS MATERIALS AND METHODS

Twenty-six patients with low lumbar burst fractures were treated from 1995 through 2001.

Medical records, preoperative and last follow-up radiographs were obtained.

Functional results for all patients were based on comparison of the patients occupational and recreational status before the injury and after it.

These results were classified as excellent, good, fair or poor according to Smiley-Webster Scale.

RESULTS

- Twenty-six patients (twenty-eight low lumbar burst fractures) were treated with an average follow-up of 39.5 months (12-80 months).
- Female to male ratio was 5/21 and mean age was 37 years (17-64).
- The most common etiological factor was fall from height (24/26).
- Five of the patients were treated conservatively by immobilization for averagely 3 months in a thoracolumbar orthosis.
- The remaining cases underwent surgery.
- Indications for surgery were neurologic impairment in 9 patients and/or instability/deformity in 14 patients.
- Of the surgically treated group, 2 patients were treated with anterior, 10 patients with posterior and 9 patients with combined approach.
- Seven patients with low lumbar burst fractures had traumatic dural tears and extravasation of the nerve roots outside the dural sac.
- All patients underwent laminectomy, replacement of the roots within the dural sac and primary dural repair in addition to instrumentation and fusion procedures.
- Six patients showed complete neurological recovery in follow-up and one was neurologically intact prior to surgery and remained same.
- Two patients from the surgically treated group required hardware removal due to deep wound infection and migration of screws into the disc space in the postoperative 24 months and 7 months respectively.
- The functional outcome of the entire study group was assessed using the Smiley-Webster Scale. Good to excellent results were obtained in 24 (92%) of 26 patients (100% for nonoperative group, 90% for operative group).

CONCLUSION

Low lumbar burst fractures occur in a relatively young population affecting the most mobile and highly stressed portion of their spine.

If patients are neurologically impaired in association with low lumbar burst fractures, surgical treatment is effective.

In the case of dural tear, it is not possible to detect the tear and nerve root entrapment in greenstick lamina fracture before the surgery.

So, it must be the rule to expose the dura safely with posterior approach before any reduction maneuver.

Tuberculosis Spondylitis

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The most frequent site for extra pulmonary involvement of tuberculosis infection is the vertebral column. Percival Pott described tuberculosis of the vertebral column in 1877 as a kyphotic deformity of the spine associated with paraplegia [36]. Menard in 1894 described a series of patients with Pott's paraplegia successfully treated with decompression via costatransversectomy [26,36]. Pott's disease is now infrequent in developed countries, but still constitutes a public health problem in underdeveloped countries. [2,5-6,9,18,43].

Prior to the era of antibiotics and improvements in general health, multisegmental involvement was thought to be the norm, usually diagnosed at the autopsies, but today involvement of more than one noncontiguous region of the spine is very rare [36]. The true incidence of primary posterior involvement is virtually unknown; however, the introduction of computerized tomography (CT) and magnetic resonance imaging (MRI) have probably increased the rate of identified cases to up to 10 % of the cases with extensive disease [3,37].

Chemotherapy appears to be the mainstay in the treatment of tuberculosis. Only by the introduction of effective chemotherapy regimens could the mortality associated with the disease be controlled, and morbidity has been substantially decreased. Surgery in tuberculosis spondylitis is generally considered to be an adjuvant of effective chemotherapy. Indications for surgical treatment include 1) neurological involvement, 2) deformity and/or impending increase in deformity, and 3) the presence of large tuberculosis abscess and/or abundant necrotic tissue [28,36].

Drainage and debridement of cold abscess has become popular after Hodgson and Stock since 1960 [12]. The gold standard in practice today is probably radical debridement with anterior approach and anterior fusion with anterior strut grafts [36]. As spinal cord compression is usually located anteriorly, anterior approach and decompression is the preferred route for neural decompression [15,36]. Satisfactory fusion rates have been reported with only posterior or anterior approaches [11-12,16,36,42]. However, albeit in low rates, graft resorption can be seen in patients who had anterior or posterior fusion only, and kyphotic deformity due to asymmetric growth is probable in children [11,29, 30,32,35]. Recently, posterolateral or transpedicular drainage without anterior drainage or posterior instrumentation following anterior drainage in the same session is offered as an alternative in attempts to avoid kyphotic deformity [11-12,20,32-33]. Posterior instrumentation in addition to anterior fusion, sequential or staged is associated with increased morbidity [24,35]. Use of anterior instrumentation has been reported on a limited number of series. Oga and coworkers evaluated the adherence capacity of mycobacterium tuberculosis to stainless steel and demonstrated that adherence was negligible, and the use of implants in regions with active tuberculosis infection may be safe [31]. Kostuik reported his experience on cases with healed or inactive disease [19]. Anterior plate fixation along with debridement and fusion of the active disease has been reported for a limited number of patients with active disease by the present author [5,6].

Our prospective series of 63 patients with tuberculosis spondylitis were treated with anterior instrumentation along with anterior debridement and fusion was reported in 2002 [7]. Analysis of the clinical and radiological results of these patients revealed that this procedure was associated with a very satisfactory rate of deformity correction as well as the maintenance of correction (Table - 1). A very high rate of fusion could be achieved, with a negligible number of complications.

Anterior instrumentation in active tuberculosis infection is a relatively new concept, and the results of this study should probably be compared to those achieved with other modalities of surgical treatment as well as other reports on anterior instrumentation.

Indications for surgery in spinal tuberculosis are reported to include the presence of a large paraspinal abscess, the presence of severe bone destruction and kyphotic deformity, reurologic deficit with spinal cord compression, and lack of response to conservative treatment [33]. Posterior fusion had been the standard surgical procedure for the limited correction and prevention of progression of deformity in many centers before

the safe and liberal use of anterior spinal surgery became feasible. However, posterior fusion does not appear to alter the natural course of the disease process, pseudoarthrosis and bending of the fusion mass very frequently leads to substantial increase of the kyphotic deformity [2,11,40].

Anterior debridement without fusion in the treatment of spinal tuberculosis has been evaluated in MRC studies performed in Hong Kong and Bulawayo, demonstrating that the magnitude and the rate of progression of the kyphotic deformity was similar in patients who had no surgery, and were significantly inferior compared to anterior debridement and fusion [21]. Longitudinal follow-up of the same group of patients revealed that bony fusion occurred later in those who had anterior grafting compared to only debridement, but the rates of fusion were similar at five years [22]. Over ten years, debridement group exhibited mean increases in kyphosis of 9.8 degrees for thoracic and thoracolumbar lesions and 7.6 degrees for lumbar lesions, compared to minor changes in the fusion group [23]. Upadhyay and coworkers reported the latest follow-up of the same group of patients, concluding that the debridement group demonstrated increases in kyphotic deformity for up to six months. Therefore, adult patients demonstrated an arrest in progression, while some spontaneous correction of the deformity occurred in the pediatric patients [38-41]. Aksoy et al. reported a series of 100 patients either with posterior or anterior fusion only and demonstrated that kyphotic deformity developed less frequently after anterior fusion [2]. Rajasekaren and Soundarapendian reported 59 % kyphotic deformity with anterior fusion [32].

With anterior debridement and fusion, the MRC trials demonstrated that an increase in kyphotic deformity occurred in only 17 % of patients compared to 39 % of patients treated with chemotherapy. In contrast to patients treated with only anterior debridement, the progression of the kyphotic deformity was considerably less, especially during the first six months of the treatment [21-24]. Kyphotic deformity did not significantly increase in these patients after six months regardless of the treatment method. In another study 59 % of patients had favorable results (excellent or good), 19 % were rated as fair, and 22 % as poor [32].

The necessity of prolonged immobilization following anterior procedures, and the relatively high rates of progression of kyphosis frequently related to the problems with strut grafts prompted the idea that tuberculosis spondylitis may be stabilized by posterior instrumentation [11,36]. Oga and coworkers obtained good clinical results but the instrumentation was extended to an alarming average of 8.5 levels, in spite of the fact that 3.5 levels on average were involved by the disease [31]. Moon et al reported very good rates of correction and good maintenance of correction for both children and adults, fusion occurred in four months in single level spondylodesis cases and in six months in two-level [27].

Several studies have demonstrated satisfactory results using posterior instrumentation along with anterior debridement and fusion [24,28,31,37]. Güven et al. reported a series of 10 cases with posterior instrumentation, in which there was a 3.4° loss in the correction of local kyphosis [10]. Domaniç et al. reported that in their series with anterior debridement, correction of the kyphosis was more successful in-patients who had additional posterior CD instrumentation [9]. Yau et al. reported higher success rates with anterior fusion and posterior instrumentation in the same session [42]. In our recent series, 72 adult patients with different surgical procedures were assessed. Eight patients had only anterior debridement and fusion, with 8.6 % correction rate and average 23.6° correction loss during follow-up, compared to 76.8 % average correction and 2.5° correction loss in 11 patients who had posterior instrumentation following anterior radical surgery. [6].

Kostuik reported a series of 79 patients with anterior decompression and anterior internal fixation in 1983, among whom 51 had reurologic deficits. He reported two patients developing deformity because of spinal tuberculosis [19]. There has been very limited experience with anterior instrumentation following anterior radical debridement and fusion, especially on the early cases with active disease [4]. This reluctance so far probably arises from the presumption that placing the instrumentation in an area with active infection would be prone to complications like disease reactivation or secondary infection [17]. The results of our last study demonstrated that, anterior instrumentation in the presence of active infection does not cause any major complications, probably because of the poor adherence capacity of the tuberculosis bacilli to metals.

We have reported our first nine cases in 1996 [5]. Yılmaz and coworkers reported on 22 patients with single or double level and 16 with multilevel involvement, treated with anterior instrumentation. Their rates of correction were 64 % and 81 % for short and long fusion respectively, an overall average of 3° of correction loss was encountered and there were no major complication [43]. In another study analyzing the results of comparison of 45 anterior radical debridement and anterior instrumentation cases with cases of posterior instrumentation, we have reported that with anterior instrumentation, statistically similar correction rates can be obtained, but this procedure required fewer mobile segments to be instrumented. Also in this study, we suggested that posterior instrumentation could be preferred if there were various regions of involvement, more than 2 vertebrae were involved and if involvement was at the lumbosacral junction [6]. In our last study, the results of 63 patients with 50.9 months of follow - up were evaluated and our correction rates in local kyphosis angle (79.7 ± 20.2 %), our correction loss at the last control visit (1.1° ± 1.7°) and our final correction rate (74.3 ± 23.3 %) were compatible with the results reported in the literature [7].. Evaluation of the effect on sagittal global contours showed a statistically significant correction rate in thoracic, thoracolumbar and lumbar regions and also correction loss rates at the last control visit were very low. The normal physiological sagittal contours were maintained in the thoracic and

thoracolumbar regions in 88 % and 71.4 % of the patients respectively, but physiological normal lumbar lordosis was restored in five patients. It is noted that application of a distraction for correction of the local kyphosis deformity in thoracic region resulted in a decrease in the global kyphosis angle but though this effect neither hypokyphosis nor lordosis was noted in the thoracic region. It played a positive role in the lumbar region by increasing lordosis. Implant failure and pseudoarthrosis were not noted and a solid fusion mass was obtained in all patients. Tuberculosis reactivation was not noted.

Therefore, based on our results and those reported with the use of posterior instrumentation, it can be stated that instrumentation in active tuberculosis spondylitis can be performed safely with few complications, and is effective in obtaining and maintaining the correction of the deformity as well as obviating the need for external support. The two major advantages of anterior instrumentation over posterior are the ability to perform the operation with a single approach, and to prevent the inclusion of unnecessarily large number of levels into fusion.

It should be noted that all patients included in this study have undergone a very aggressive alternating three drug antibiotic regimen for twelve months, which has been the standard protocol in our center over the years, contrary to recent reports suggesting that shorter and less aggressive chemotherapy may be as effective. Fourteenth report of the MRC demonstrated that the clinical results at three years were excellent in patient groups receiving INH and R for six months, the same drugs for 9 months, but only in those receiving INH and PAS or EMB for 18 months [25]. In 1998, Medical Research Council Working Party on Tuberculosis of the Spine, reported in the series with 15 years follow-up that when ambulatory chemotherapy were compared with nonambulatory chemotherapy, with debridement and chemotherapy with Hong-Kong procedure, anterior radical debridement and anterior strut grafting is the most successful procedure for reurologic recovery, fusion and preventing kyphotic deformity [24]. Likewise, Upadhyay and coworkers have found that a regimen consisting of INH, R and streptomycin given for as short as 6 months yielded comparable results with a regimen of INH, PAS and streptomycin, in a group of patients who underwent surgical debridement and grafting [41] .The use of a more aggressive regimen for longer periods might have been effective for a better control of the disease in our series, eventually leading to uneventful healing. Shorter and less aggressive regimens in the presence of anterior internal fixation material needs to be further tested.

Finally, it may be argued that in those patients with suspected Tuberculosis spondylitis, the diagnosis, as well as the absence of secondary non-specific infection needs to be confirmed before the process of surgical decision making. However, in areas where tuberculosis is an endemic problem, the rate of correct pre-operative diagnosis may be very high.

In addition to classical radiograms and laboratory tests, MRI is the most important method in diagnosing tuberculosis [36]. Radionuclide imaging is not very helpful in these cases. There are high false - negative rates with technetium (33 %) and gallium (70 %) scans. CT imaging reveals the extent of bony destruction better than MRI [36]. An and coworkers have reported a diagnostic accuracy of 97 % with MRI in a series of patients with spinal tumors or infectious diseases. [1]. In his series of 24 patients, Desai reported that diagnosis of the disease was possible in the very early stages with MRI [8]. Hoffmann et al. reported that MRI was necessary and very useful for surgical planning and diagnosing the canal compromise [13]. In the present study, our pre-operative rate of diagnosis was 96.8 % (61 out of 63 patients) when a combination of MRI, CT and laboratory studies were used. The 2 patients diagnosed with having solid tumors pre-operatively constitute the false negative cases of this series. It should be noted however, that these figures might be misleading. The probable false positive cases who turned out not to be cases of tuberculosis spondylitis at surgery were not included in this database, hence; it can not be claimed that the diagnostic accuracy of these methods combined is as high as 96.8%. Schmitz and coworkers have demonstrated that Fluorine - 18 flouro - 2 - deoxy - D -glucose positron emission tomography is more sensitive and accurate in the diagnosis of tuberculosis spondylitis compared to MRI especially in the presence of metallic implants [34]. This technique may be used so as to achieve a higher rate of diagnostic accuracy in the future.

In patients without vertebral instability and deformity we prefer conservative management, and in those who have abscess formation in addition, we use invasive radiological techniques in addition to abscess drainage and chemotherapy. It is our contention that, in patients with vertebral destruction and collapse, moderate – severe kyphotic deformity and large abscess formation, vertebral instability and neurological deficits and instability, anterior radical debridement, anterior strut grafting and anterior instrumentation is an optimal method. In patients with involvement in different vertebral regions and multiple levels and in those global sagittal contours are markedly deformed owing to local kyphosis, and in patients who have difficulty in undergoing anterior instrumentation due to lumbosacral junction involvement, posterior instrumentation may be preferred , after anterior radical debridement and anterior strut grafting at the same session or subsequent one.

In conclusion, based on the results of our last study on the treatment of active Tuberculosis spondylitis with anterior instrumentation along with anterior debridement and fusion, it can be stated that, this procedure provides a very high and effective rate of deformity correction and maintenance. Furthermore, as

demonstrated by several other studies, the use of metallic implants in the presence of active tuberculosis infection appears to be a safe procedure associated with a very low rate of complications.

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Table - 1. The average preoperative (PR) and postoperative (PO) local kyphosis (LK), loss of correction values (CL) and postoperative (CP) and final correction percentages (FP) of the patients according to vertebral regions. (n : number of patient)

	PRLK	CPLK (%)	t	P	FPLK (%)	CLLK
Thoracic (n : 25)	22.6° ± 7.5°	75.1° ±	13.5	<0.05	69.8 ± 25.6	1.2° ± 1.8°
Thoracolumbar (n :	24.0° ±	85.8° ±	7.8	<0.05	81.2 ± 24.7	0.9° ± 1.5°
Lumbar (n : 17)	23.5° ± 6.6°	78.9° ±	19.3	<0.05	72.4 ± 16.3	1.4° ± 1.9°
Total (n : 63)	23.4° ±	79.7° ±	18	<0.05	74.2 ±	1.1° ± 1.7°

LEGEND:

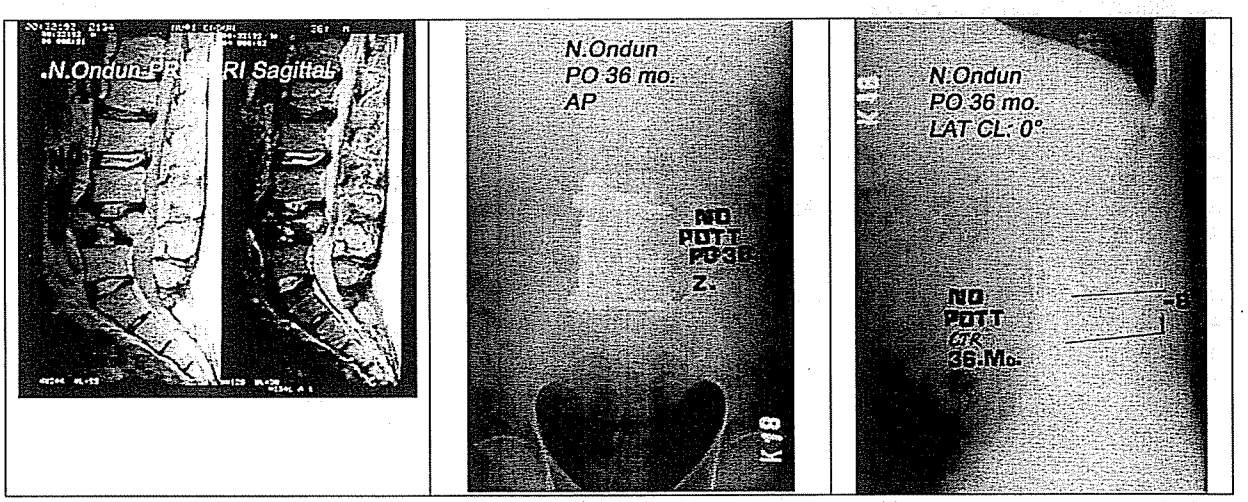

Figure - 1. Preoperative magnetic resonance imaging sagittal view (a) and postoperative 36th month control posteroanterior (b) and lateral (c) radiograms of 36 years old male (N.O.) with Pott's disease in the lumbar 4 vertebra. Two mobile segments were instrumented with anterior Z - plate and 100 % correction rate was obtained after anterior radical debridement and strut grafting. There was 5° loss of correction and solid fusion mass was observed in the last visit.

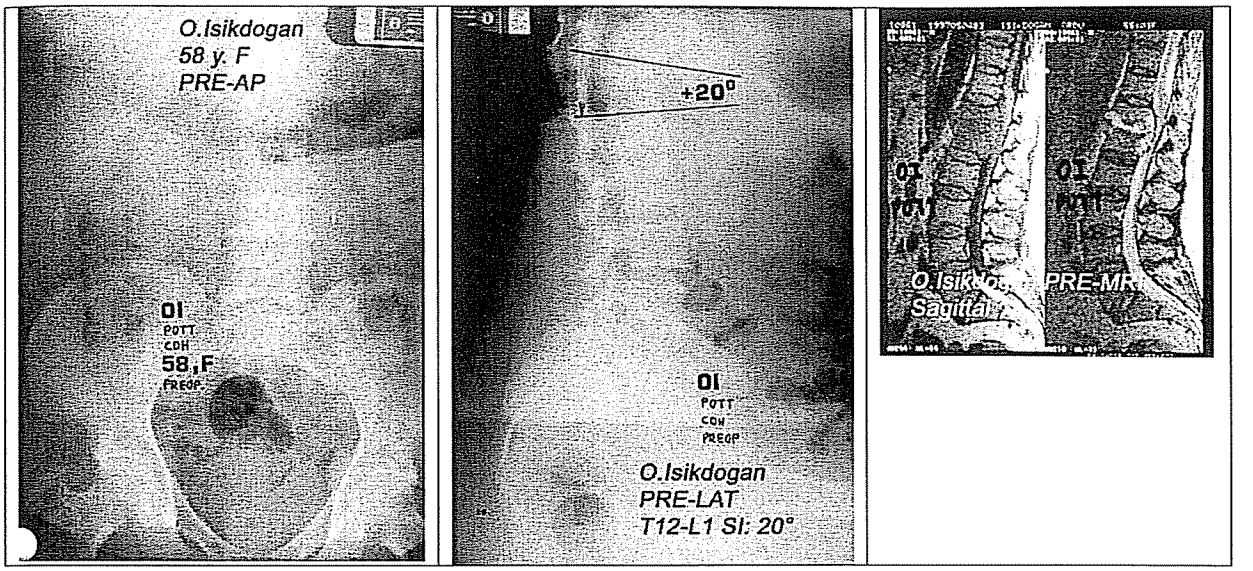

Figure - 2. Preoperative posteroanterior (a) and lateral (b) radiograms and magnetic resonance imaging sagittal view (c) and postoperative posteroanterior (d), lateral (e) radiograms of 58 years old female (O.I.) with Pott's disease in the T12 –L1 vertebrae are seen. Three mobile segment were instrumented with anterior CDH and 100 % correction rate in the sagittal plane and 100 % correction rate in the frontal plane were obtained after anterior radical debridement and strut grafting. There was no loss of correction and solid fusion mass was observed in the last visit.

Tuberculosis of the Spine and Its Sequelae

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Tuberculosis of the spine may be broadly discussed under 3 categories: (a) typical presentation (b) presentation as a difficult clinical problem, and (c) atypical presentation.

TYPICAL PRESENTATION: this group of patients may have one or more of the following: spinal pain, abscess, gibbus, paraplegia. In disease of the cervical spine, paraplegia is common, especially in patients older than 10 years of age. When the disease affects the cervico-dorsal or upper dorsal region, the patient may present with "asthma milare". Radiographs often show narrowing of disc space with paradiscal erosion, a paravertebral shadow, and a kyphosis. In children, spreading in the thoracic spine is rapid, and x-ray may show an aneurysmal syndrome.

DIFFICULT CLINICAL PROBLEM: This group may be further sub-divided into

(1) As a rigid severe angular kyphosis with or without paraplegia. This usually occurs when the disease is already quiescent or healed. If paraplegia is present or impending, decompression is required.

(2) Extensive disease with deformity in old age: in this group of patients bone quality is very poor, and the patients cannot tolerate prolonged recumbency.

ATYPICAL PRESENTATIONS: include (1) disease of the neural arch, which is difficult to diagnose on plane x-ray, (2) as an epidural abscess or extensive arachnoiditis (pachymeningitis), when plane x-ray shows no abnormality and (3) disease of the sacro-iliac joint.

Disease of neural arch can be diagnosed if there is awareness of its existence, and CT scan is very helpful. Epidural abscess and arachnoiditis present with a very spastic type of paraplegia. Arachnoiditis is suspected if a myelographic column shows streaking and an irregular block.

Anti-tuberculosis therapy is the mainstay of treatment for tuberculosis of the spine. The present trend is to use short-course chemotherapy of nine months to one year, with 2 drugs (INAH and Rifampicin) unless there is concern about antibiotics resistance in that locality or there has been inadequate anti-tuberculosis treatment prescribed previously.

Situations where there is a strong indication for surgical intervention include the following:

a) Tuberculosis of the cervical spine, especially in children over the age of 10, because of a high incidence of paraplegia with conservative treatment alone.

b) A large abscess with significant pain not responding to anti-tuberculous drugs administered over an adequate period of time.

c) Extensive disease, e.g. over 3 or 4 levels.

d) Presence of a significant deformity, e.g. kyphosis or kypho-scoliosis.

e) Presence of paraparesis or paraplegia.

Whether anti-T.B. drugs alone or drugs together with surgical intervention is adopted, the only certain way of ensuring healing of the disease is achievement of radiological fusion.

A prospective controlled clinical trial by the Medical Research Council of Britain has produced 5, 10, and 15-year results comparing the treatment regimen of chemotherapy alone, chemotherapy with surgical

debridement, and chemotherapy with radical excision and anterior spinal fusion (the Hong Kong operation). If "favourable status" is used to assess outcome, there is little difference between the 3 regimen. On the other hand, if fusion rate and kyphosis are used as assessment criteria, the Hong Kong operation gives significantly better outcomes in terms of fusion rate (97 versus 73%), and prevention of kyphosis.

Sequelae of acute tuberculosis of the spine:

1. Rigid angular kyphosis

This is a severe cosmetic deformity, with marked shortening of the trunk. There is sometimes concomitant deformity of the anterior chest wall. The segment of the spine above and below the kyphosis compensate by hyperlordosis. There is marked pulmonary compromise.

Correction of such deformity requires the application of a halo-pelvic apparatus, followed by anterior and posterior circumferential osteotomy to increase mobility at the kyphus as well as to prevent the internal kyphus from compressing the spinal cord during correction.

Gradual correction of the deformity is then performed by distraction using the halo-pelvic apparatus, with the patient awake and ambulant. After maximum correction is achieved, anterior strut grafting needs to be performed, together with a posterolateral fusion.

2. Late onset paraplegia due to compression by the internal kyphus.

We have experience of a number of patients who have been diagnosed as tuberculosis of the spine and treated by a full course of anti-T.B. chemotherapy. 20 to 30 years later, the patient presents with paraparesis. There are 2 subgroups of such patients:

(i) Tuberculosis of the spine treated by chemotherapy but has not resulted in fusion. Lack of fusion results in instability, and if the kyphosis is substantial, it would gradually increase over the years, finally leading to compression of the spinal cord by the internal kyphus.

(ii) Compression of the spinal cord by internal kyphus despite spontaneous anterior fusion. In this scenario, formal strut fusion by surgery has not been performed. Fusion progressively occurs with the anti-tuberculous drugs. However, during the process, the soft bone formed initially becomes gradually retropulsed into the spinal canal. In time, the anterior column is fused, but the retropulsion causes marked narrowing of the spinal canal.

In this type of situation, particularly when the site involved is in the upper thoracic or in the lower lumbar spine, decompression can become a difficult problem. The conventional anterolateral approach to the front of the spine is difficult in the upper thoracic region because the chest cavity is cone-shaped, becoming very narrow in the upper part; and in the lower lumbar spine the big arteries and veins become bowstrung across the front of the internal kyphus. This Department has described a *posterolateral transpediculectomy internal kyphectomy* since 1991 which gives direct assess to the internal kyphus after removal of the pedicles at the apex of one side, allowing a very safe decompression under direct vision. This approach, however, does not give an adequate expansile approach for formal anterior strut grafting.

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Problems and Complications Recorded with Clinical Trial of 40 Patients Implanted with Prosthetic Disc Nucleus

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Significance: In the study a total 37 patients who failed to be adequately helped by non-surgical treatment for pain caused by degenerative disc disease (DDD), have been implanted with the PDN Prosthetic Disc Nucleus: Clinical experience for 17 of these patients in the feasibility portion of the study who have been followed for 2 years will be presented.

Materials / Methods: Since January, 1998, 17 patients in the feasibility portion of the study were implanted with the PDN prosthesis after unilateral discectomy. Study inclusion criterial were lumbar DDD restricted to a single level, reduced disc height with at least 5mm disc height remaining intact facets chronic with low back pain unresolved by conservative treatment. The PDN prosthesis, which are implanted in pairs, are available in various sizes and shapes to accommodate patient anatomy.
Findings: Two years follow up for 10 of the 34 patients show improvement of low back pain and increased range of motion as evidenced by 90% improvement of the Oswestry score and 87% improvement in the visual analog score. The recorded complications are as follow:

Retrobulge,
Migration
Anterior migration
Posterior migration
Disc end plate changes
Diskitis

Conclusion: There are problems and complications within acceptable range and still there is room for improvement regarding the device and the technique and in our experience PDN has shown to be promising treatment for mild and moderate degenerative disc disease.

Two Years Follow Up On 37 Patients Implanted with a Prosthetic Disc Nucleus

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Findings: Two years follow up for 10 of the 34 patients shows improvement of low back pain and increased range of motion as evidenced by a 90% improvement of the Oswestry Score and 87% improvement in the Visual Analog Scale.

Conclusions: Our early experience has shown the PDN device to be a promising treatment for mild to moderate DDD.

Lumbar Disc Herniation

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Lumbar discectomy is one of the most successfull operations in a carefully selected patient with radiculopathy pain. But, in an inappropiate patient, the result is disappointing.
Life time prevelance of low back pain in the population is eighty percent and 4 percent of these cases become chronic.

Problems:

- Ninety percent of the attacks of low back pain resolves within two months. But rate of recurrence is about seventy percent.
- Rate of false positive findings in imaging studies such as CT and MRI high.
- Is disc herniation the main cause of back or even leg pain in every patient?
- Which patients will benefit from the surgery?
- When must surgery be performed?

Risk factors:

- Vibration
- Hard labor
- Excessive temperature changes
- Heavy weight lifting
- Monotonous activities or job
- Disturbing positions

Males aged 35-45 are usually affected.
L4-L5 and L5-S1 are the levels most commonly involved.

Types of herniations:

- Protrusion
- Extrusion
- Sequestration

Localisation:

- Posterolateral
- Axillar
- Foraminal
- Central
- Intradural

Characteristics of root pain

a) Radiation of pain is spesific for a certain nerve root
b) Pain is more severe at the peripheric sites of the extremity
c) Numbnesss and paresthesia is present at the distal regions
d) Decreased nerve conduction velocity and fibrillations are noted in EMG
e) Neurologic deficit may be present varying with the nerve root affected
f) Nerve tensioning tests are positive

Characteristics of reflecting pain

a) Pain reflects usually to the proximal site of the extremity.It is rarely reflected to below knee level
b) Pain is more severe at the proximal regions
c) Numbnesss and paresthesia is not present
d) EMG is normal
e) Neurologic findings are not observed

Natural history

- Surgically treated group is better at postoperative one year.
- No difference exists between the groups at postoperative four years

Conservative management

NSAID and bed rest for two to three days is advised.If there is no response, epidural injection of steroids should be considered.

Indications of surgical treatment

- Progressive neurologic deficit
- Intractable pain resistant to conservative measures for six weeks

Preoperative evaluation

- Neurologic deficit
- Tensioning tests
  - Leg raising test
  - Femoral tensioning test
- Psychologic tests
  - Pain charts
  - VAS
  - MMPI

Non organic findings

- Excessive irritability with light touch at nonanatomic sites.
- Pain with axial loading and pelvic rotation
- Nonanatomic motor and sensory findings
- Exagerated reactions during physical examination and pain,
- Positive Laseque test while the patient lying turns to negative at sitting position

Radiologic evaluation

- CT
- CT myelo
- MR

Predictive factors

a) Neurologic deficit
b) Positive tensioning tests
c) Objective documentation(CT , MRI , Myelo)

Results:

97% success if all three of the above mentioned factors are positive.

82% success if two are positive.

70% success if there is only one positive.

Indications of fusion

- Relapse of symptoms more than twice
- Degenerative spondylolisthesis
- Instability (translation more than 4 mm,angular deformity exceeding 20 degrees)

Post operative care

- The patient is allowed to walk at 6 to 8 hour postoperatively after standard discectomy.If there exists a dural tear bed rest for two to three days is mandatory.

Complications

- Wrong level
- Neural injury
- Dural tear
- Scar formation
- Migration of fragments
- Cauda equina syndrome,
- Injuries of iliac arteries and veins or vital organs.

Neurologic recovery rates:

% 25 reflex

% 51 motor

%48 sensory

Success rates correlated with the type of herniations:

- Sequestrated herniation:%99.5
- Extruded herniation:%82
- Protrusion:%63
- Normal or minimal bulging discs:%38

Residual back pain according to the type of herniations:

- Complete:%25
- Minimal bulging:%55

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Spinal Stenosis - Mechanics

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Initial Symptoms

Patients with spinal stenosis always commence with sensory problems long before motor symptoms appear. They feel unnatural heaviness or deadness of the limbs and a sense that their legs are going to give way. Most cases describe these symptoms as commencing in the feet spreading up the legs though some describe the opposite. Severe cases describe the onset of perineal numbness as they walk or even the development of priapism. In some cases the sensory symptoms may ascend to a clinical level significantly higher than the radiological level, almost certainly due to a vascular effect on the cauda equina. In some cases, as the patients walk they will become aware of weakness of the dorsiflexion of the ankle and describe that their feet slap on the ground as they walk further or that they start to trip up.

In all cases these neurologic symptoms are promptly relieved by sitting down or by leaning forward, whereas merely standing still affords no relief at all. Typically, they will develop the symptoms at a regular distance (the threshold) but be able to continue walking for a further similar distance before having to flex forward for relief. Symptoms of sphincteric disturbance are rare, but some patients may describe a sensation of urgency of micturition. At rest, the patients usually complain of little other than backache on prolonged sitting, though some will complain of cramp or a sensation of "restless legs," especially at night.

Neurologic examination of a patient with lumbar spinal stenosis often is remarkably normal.

Loss of ankle jerk and distal vibration sense may be present, but in any case are common in the age group of affected patients. A voluntary decrease in the range of lumbar extension often is seen as it may precipitate symptoms. Straight-leg raising is usually normal.

Dermatomal sensory loss and muscle weakness are uncommon at rest, although they may appear if the patient is reexamined after walking to their tolerance limit. In view of the age range of the typical patient, diminished peripheral pulses or limitation of hip movement may be found.

The Development of Spinal Stenosis

Spinal stenosis is an anatomical term used to describe a small vertebral canal. Its cause is usually developmental. There may be added degenerative change that further restricts the space for the cauda equina, but in the absence of developmental stenosis this does not usually compromise the nerve roots. There is normally adequate spare capacity in the extradural space in both the central and the root canals.

The Causes of Developmental Stenosis

The vertebral canal reaches maturity very early in life. By 1 year of age L1 to L4 has reached the size of the adult cross-sectional area, and L5 is mature by 5 years of age. The canal's most rapid growing period is between 18 and 36 weeks of intrauterine life. Impaired nutrition at that time may permanently stunt the canal.

Biomechanical Factors That May Influence the Development of the Trefoil Shape

The shape of the canal is as important as its size, and about 15% of canals are trefoil at L5. Trefoilness is less common at L4 and rare at more proximal levels. The trefoil configuration and a small mid-sagittal diameter is an unpleasant combination, because the nerve roots can then be very tight in the lateral recess.

Dynamic Changes That Affect the Canal's Size

The vertebral canal is not a fixed bony tube. It is an anatomical space in a segmental structure the size of which is influenced by posture and motion. In addition, the extradural soft tissues within the canal are similarly affected by creep and the vascular engorgement that accompanies changing posture. Furthermore, the size of the neural intramural contents changes with exercise.

The Upright Posture

Axial compression of cadaver spines decreased the cross-sectional area by an average of 50 mm^2 This has been confirmed in vivo by measuring the axially loaded spines during magnetic resonance imaging. We have yet to discover how much of this space reduction is caused by buckling of the ligamentum flavum, and how much is the result of creep.

Spinal flexion and Extension

Knutsson used functional myelography in a stenotic patient in 1942, and showed that the continuity of a completely interrupted contrast column at L4/5 could be restored by flexion. Anatomical studies have confirmed that between flexion and extension, there is an average change in cross-section area of 40 mm.2 This is the result of bulging of the soft tissues anteriorly and posterolateraly. The more a canal is stenotic, the greater will be the relative narrowing by changing posture. In the severe grades of stenosis, even the slightest degree of extension may compress the neural elements.

Posture and Root Canal

In flexion the root has a generous degree of freedom, but in extension there is a pincer action compressing the nerve between the superior articular process posteriorly, and the disc and inferior rim of the vertebral body anteriorly. More distally in the root canal, extension will similarly compress a tight root trapping it between the disc in front and the ligamentum flavum behind.

The Effect of Walking on the Stenotic Canal

Clinical studies suggest that the space in a stenotic canal is reduced further during the activity of walking. The epidural pressure measured by pressure transducer in stenotic patients increased by about 20 mmHg with each step. The pressure was significantly less when a stenotic patient walked in flexion. However, there is not a marked increase in lumbar lordosis during gait and therefore some of the explanation for increased pressure must be sought elsewhere.

There are two possibilities. First the activity of walking produces a segmental motion not only in one plane, but in all of the three planes of rotation. There is a combination of rotation, lateral bend, and sagittal motion all of which affect the space within a stenotic canal. Secondly, the contents of the canal increase in volume during the activity of walking, both from increased extradural venous pressure caused by an increased venous return, and also from vasodilatation of the vessels of the cauda equina. Patients with spinal stenosis not only flex forward after the onset of claudication symptoms, but the center of gravity moves laterally with an increased sway. This suggests that more space is created by movement in more than one plane.

The Clinical Significance of Spinal Stenosis

A small canal does not necessarily cause problems. It is often symptomless, and has been reported in 21% of asymptomatic subjects over 60 years of age. However, stenosis is a factor in the symptomatology of a number of clinical conditions when the canal is compromised by other pathology. It can be important in these conditions. (1) Symptomatic disc protrusion, when a nerve root is compressed by a disc in a small canal. (2) Root entrapment syndrome, when in the presence of degenerative change, a nerve root can be Symptomatic Disc Protrusion

Pathology of the Protrusion

When a disc protrusion is symptomatic, it has been preceded by a longstanding degenerative pathological process. The biomechanics of this degeneration are not understood. In vivo, when an axial spinal load is applied to a healthy spine, the vertebral bodies fracture before the disc is damaged. Similarly in vitro, the bone fails before the healthy disc. Poor nutrition may be responsible for an unhealthy disc developing fissures in response to load, and with multiple fissures, fragments develop. The mechanics of the disc change considerably once a fragment forms, and with a fairly minimal load the fragment displaces posterior, causing the back of the annulus to bulge and sometimes to rupture.

The Mechanics of Root Symptoms

Recent studies suggest that two components are responsible for the root pain in a symptomatic disc protrusion, compression and inflammation. Provided the canal is sufficiently large, patients with a protrusion may experience some back pain, but they are spared root symptoms because the root is not compressed. Patients having disc surgery can have root pressure over 100 mmHg. This is reduced to zero after operation. The root pressure is not related to the degree of reduction in straight-leg raising, suggesting that this root tension sign is probably more related to inflammation than to pressure.

Root Entrapment Syndrome from Degenerative Change

These patients with root entrapment syndrome have constant and severe root pain as a result of nerve root compression in the root canal. Unlike the patient with disc protrusion, they do not have abnormal root tension signs or a trunk list. The pain is present at rest. It is insidious in onset, and it frequently resolves over several weeks or months.

Pathology of Root Compromise

In many patients there is a gradual increase in degenerative change that slowly reduces the size of the root canal. It is a combination of bony change and soft tissue thickening (Fig), which involves the facet joint capsule, the posterior annulus, and the ligamentum flavum.

Biomechanics of Root Entrapment

Many patients with root entrapment syndrome have some degree of vertebral displacement. If the root canal is already small, segmental displacement will reduce the avail-able space further. This can be a particular problem in patients with degenerative spondylolisthesis. If the 5th lumbar root is already tight beneath the superior facet of L5, as the body of L4 displaces forward, the root becomes critically affected (Fig). There is frequently a degree of rotational displacement, which will then give asymmetrical symptoms. When lumbar scoliosis is associated with a stenotic canal, the root entrapment symptoms are particularly troublesome and progressive.

- Figure -

Neurogenic Claudication

The Symptoms of Neurogenic Claudication

Neurogenic claudication is a clinical condition causing discomfort, numbness, and pain or heaviness in one or both legs after the patient has walked a short distance. It is relieved by rest. There is no leg pain at rest. There is often a long history of back pain. Neurogenic claudication is sometimes called spinal stenosis, but stenosis is really an anatomical term. Stenotic spines can be symptomless. There is a biomechanical mechanism to explain why stenotic spines can produce symptoms with walking. This becomes apparent as we examine the abnormal signs.

Abnormal Signs and Characteristics of Patients With Neurogenic Claudication

Patients with neurogenic claudication tend to stoop as they walk, and at the limit of walking tolerance they stoop further and then rest (the Stoop Test). Some patients can walk up a hill more comfortably than walking down a hill; and some can lean forwards and cycle for a long distance without leg symptoms (the Cycle Test), although the Cycle Test is not a good discriminator between neurogenic claudication and intermittent claudication (peripheral vascular disease) . Patients with neurogenic claudication are generally over years of age, with men affected more frequently than women. Most patients with neurogenic claudication have multiple-level spinal stenosis. Half the patients with bilateral claudication have a degenerative spondylolisthesis, which usually affects men rather than women (although degenerative spondylolisthesis is more common in women than men). Half of the patients with unilateral claudication have a degenerative lumbar scoliosis, and this combination is more common in women than in men. Peripheral vascular disease and spinal stenosis often co-exist. Calcitonin can relieve claudication symptoms in a proportion of patients.

- Figure -

A Single Level of Spinal Stenosis

A single level of stenosis does not usually produce claudication symptoms. for example, a large disc protrusion may almost occlude the canal at one level and produce back and/or leg pain but not claudication. Similarly, a large spinal tumor in the lumbar canal may produce bizarre symptoms but not claudication. Compression of a nerve root in the central or root canal will cause root entrapment pain but not claudication. In canine studies a single-level, experimental stenosis constricting the cauda equina by 25% did not cause a neurological deficit.

Multiple Levels of Stenosis

Most patients with neurogenic claudication have two or more levels of stenosis. There may be two levels of central stenosis, or one of central stenosis and one of a more distant root canal stenosis. Animal studies have shown that two levels of cauda equina compression at just above venous pressure can produce major changes in nerve conduction, axon transport, and blood flow.

The Venous Anatomy of the Nerve Roots of the Cauda Equina

The venous anatomy of the cauda equina is highly specialized, with centrifugal venous drainage from the conus down the nerve roots to the foramen. By contrast, the arterial flow is centripetal. There is a physiological valve in the radicular veins at the level of the nerve root sleeve. This prevents a back flow of venous blood from the veins in the extradural nerve root, protecting the cauda equina from high venous pressure.

If there is a single level of stenosis the veins of the peripheral part of the nerve root drain to the intervertebral foramen, whereas the veins proximally drain back to the conus. These anastomose with other root veins and then drain distally to the foramen of the respective roots. There is no sigmficant venous congestion. However, in the presence of two levels of stenosis (above the venous pressure) there will be venous engorgement of the root veins in the segment between the two stenoses to a pressure equal to the occlusion pressure (Fig). This might be as great as 1OOmm Hg, and it will probably affect nerve root function in a similar way to that shown in animal studies.

Although this hypothesis accounts for some of the features of neurogenic claudication, it is necessary to explain the absence of symptoms at rest, the age and sex characteristics, and the biomechanical affect of posture and of walking.

The Effect of Exercise on Claudication Symptoms.

Electrical stimulation of the cauda equina in a porcine model is associated with electromyclography activity in the tail muscles and an increase in cauda equina blood flow to 300% of the resting level. This is maintained if the stimulation continues for more than 30 minutes. However, if a double level of occlusion is applied to the cauda equina, and the proximal region is then stimulated electrically, the increase in blood flow is less marked and of shorter duration (Fig). This model suggests that in the presence of venous congestion, the arterial vasodilatation associated with exercise is inadequate for pro-longed activity. It suggests that there is an arterial explanation for the claudication symptoms, and that with lower limb activity, arterial vasodilatation of the cauda equina fails and nerve conduction may be impaired. An arterial component of the pathology is compatible with these patients being in the arteriosclerotic age group, often having coexistent peripheral vascular disease, and sometimes responding to calcitonin, which is a potent arterial vasodilator.

The Affect of Posture on Claudication Symptoms

A stooping posture can help to relieve claudication symptoms in some patients. As they lean forward on a bicycle or when walking up a hill, they may have less discomfort.

It has been shown that flexing the lumbar spine can increase the cross sectional area of the

- Figure -

Blood flow in a porcine cauda equina. (A) After stimulation of the cauda equina proximally. (B) When producing a two-level block just above venous pressure. (C)

Stimulation of the cauda equina in the presence of a two-level block. Central canal by reducing the posterior bulge of the annulus, and stretching a buckling ligamentum flavum. Similarly flexion will increase the cross-sectional area of the root canal.

It is probable that some patients have a block pressure at one of the stenotic levels just above venous pressure in extension, but just below venous pressure in flexion. These patients are able to walk in flexion without the roots being congested; but with extension and rotation, venous engorgement causes problems. However, patients with a very stiff ankylosed spine do not have sufficient segmental motion for symptoms to be influenced by posture.

Symptoms of lumbar spinal origin in and complaints due to vascular disease sometimes may be confused.

The most common differential diagnosis of neurogenic claudication is intermittent ischemic claudication due to peripheral vascular disease. This originally was described in horses and then in humans by Charcot.

The nature and mechanisms of lumbar spinal stenosis and vascular disease are completely different. With vascular problems, pain and malfunction are initiated in tissues (internal organs, muscles, skin) inadequately irrigated or drained by the defective vessels, with an exception for the acute aortic dissection and the rupturing aneurysm where nociceptive signals also arise from the vessel wall itself and from the possible effects of acute expansion in the surrounding retroperitoneal space.

The clinical picture is likely to be blurred in patients suffering from both vascular and spinal conditions. Reaching a precise and complete diagnosis in such circumstances can be more challenging.

ACUTE CONDITIONS:

Ruptured Abdominal Aortic or Iliac Aneurysm, Acute Aortic Dissection, and Acute Leg Ischemia

This situation is the result of acute arterial occlusion by thrombosis, embolism, dissection, trauma, or extrinsic compression. The history may yield immediate clues to the diagnosis (risk factors such as smoking, previous arterial disease, cardiac disease, trauma). The signs and symptoms are obvious: decreased temperature and capillary fill, absent pulses, and pale or marmore-like skin.

Presentation

Arterial claudication involves the posterior leg muscles only, sometimes the buttocks, perhaps the thigh, always the calf, never the anterior muscles, and never the groin (Fig.). It is most likely to be confused with S 1 root suffering. Intermittent numbness of the sole of the foot may occur after exercise. Numbness (hypoesthesia) must not be confused with paresthesia (pins and needles)!

In spinal claudication, elements other than the leg pain alone often are present: sensorimotor disturbances (pain, paresthesia, numbness) in the related nerve root area and low back pain. The pain may appear or be worsened by lying supine, sitting, or walking downstairs. Bending forward often will alleviate the pain. These factors would never be seen in arterial disease. However, both arterial and spinal claudication may be absent when riding a bicycle and may be present on climbing stairs (the latter as a rule in arterial claudication).

Diagnosis

The diagnosis is to be oriented by taking a careful history (smoking, previous arterial disease, cold feet, previous lumbar problems, postural and occupational pain factors, walking distance, walking stairs) and giving a thorough physical examination, including appropriate orthopedic and neurological tests (Table 1). A quick run through the pedal pulses before and after a simple tip-toe exercise test also should be performed. Immediately after the exercise test, remember to look at the color of the soles. In many cases it will be possible to exclude one of the two conditions on clinical grounds alone. In the troublesome case doubt will persist. Sometimes people develop both arterial and lumbar disease! In such a case the orthopedic and vascular surgeons must cooperate in evaluating the patient.

Conclusion

Spinal stenosis does not usually cause symptoms unless there is an added pathology. The clinical syndromes are now clearly defined. An appreciation of the affect of load and motion on the stenotic spine and its contents should help us to understand more about the pathophysiology of these conditions and how best they can be managed.

Total Laminectomy

The primary aim of decompression should be the relief of leg pain and neurogenic intermittent claudication, and not the treatment of low back pain.

In the last decade, new advances in diagnostic imaging techniques have allowed better localization of the offending areas of neural compression. More conservative surgical approaches have been recommended with hemilaminectomies, partial laminotomies, and even multilevel interlaminar decompression to avoid postoperative instability. These usually are used in selective patients with predominantly lateral stenosis.

In central canal stenosis and mixed centrolateral stenosis, as in the trefoil-shaped central canal, wide decompression by total laminectomy with facet joint sparing technique is a relatively safe operation that has high success in the medium to long term

Age is not a limitation for this type of surgery, although co-morbidity (diabetes mellitus, hip osteoarthritis, cardiovascular and pulmonary disease) contribute to poor outcome.

Preoperative instability should be evaluated as well as possible by standing and flexion extension radiographs.

SURGICAL TECHNIQUE: IMPORTANT POINTS

Proper positioning of the patient to avoid abdominal pressure will minimize blood loss during operation.

If there is no contraindication due to hip or knee osteoarthritis, the kneeling position is preferred, as it allows the abdomen to hang free, decreases lumbar lordosis, and releases tension of the distal nerve roots.

In special circumstances, as with patients who are obese or who have respiratory problems, the lateral position with a pad between the flexed knees and a pelvic restraining strap may be chosen.

Magnification with a loop and use of a fiberoptic head light afford better visualization of neural and vascular structures. Bipolar coagulation is desirable.

The appropriate level should be marked carefully and checked against the patient's x-ray films for anatomic marks or anomalies that can be easily identified. If in doubt, the appropriate level should be checked by radiograph or image intensifier. We must remember that surgical failure can occur by performing the right operation at the wrong vertebral level.

The paraspinous ligament often can be preserved to increase posterior stability. Careful segmental paraspinal muscle separation may decrease blood loss with good exposure of the posterior arch. In developmental stenosis, the laminae may be thicker and shorter than normal, whereas in degenerative stenosis the osteophytes and overgrowth of the posterior facets may give the laminae a shorter appearance. Overlapping of the laminae may make access to the spinal canal more difficult. When excising the ligamentum flavum, we may find that its consistency varies between normal elasticity and partial ossification (Fig.).

In developmental stenosis, the convex laminae may produce considerable narrowing of the central canal, which carries a great risk of neural damage during surgical decompression. In degenerative stenosis, constriction of the central portion of the canal is produced by osteophytes and overgrowth of the inferior facet of the cephalad vertebra. Degenerative changes of the superior facet of the caudal vertebra produce narrowing of the lateral recess and the foramen.

Excision of the medial half of the facets often gives good decompression of the central and lateral recess, which allows dural re-expansion and good mobilization of the compressed root; however, complete decompression is the main object of the surgical procedure and total facetectomy should be done if it is needed. For adequate decompression, all stenosed levels must be decompressed.

As Verbiest pointed out, with mixed stenosis there is a question of whether a part of the canal showing relative stenosis in the absence of an additional compressive agent should be decompressed prophylactically. With pure relative stenosis, the problem is how far to extend decompression beyond the level of any additional compressive agent. Bulging discs should be left undisturbed, and disc protrusions inside an area of stenosis should never be removed without previous posterior decompression. In developmental stenosis, it is a surgical dilemma whether the decompressive laminectomy should be performed over the entire area to avoid recurrence of symptoms of stenosis at other non-decompressed levels.

Any dural laceration should be repaired carefully. Safe and accurate interoperative and postoperative bleeding control is mandatory. The exposed dura should be covered by a free or pedicle fat graft, Gelfoam, or other synthetic membranes or products to isolate it from the paraspinal musculature to decrease epidural scarring.

The dorsolumbar fascia should be sutured carefully to the paraspinous ligament to maintain lordosis and to increase posterior stability. A suction drain may be placed over the fascia, but never proximal to the exposed dura.

Extensive decompression increases the risk of instability of the correspondent vertebral level. Preoperative instability and postoperative hypermobility following decompression is an indication for concomitant arthrodesis of the decompressed segments. Discectomy and especially preoperative lumbar scoliosis are known to increase the risk of postoperative instability and may be indications for adjunctive fixation.

With spinal instability, the best chance to regain permanent stability is a solid instrumented posterolateral arthrodesis with pedicular screws and rods. Fusion indications and techniques will be discussed extensively in the following chapters.

The problem with fusion is that it considerably increases the operative time, blood loss, and morbidity of the surgical procedure, especially in elderly patients with degenerative stenosis. There is extensive agreement that the dangers of postoperative instability and vertebral slippage due to extensive, careful decompression are much less than the consequences of insufficient decompression of the neural structures in the stenosed lumbar spinal canal. Therefore, in the absence of obvious segmental instability in elderly patients, no fusion is necessary after decompression surgery (Fig.).

The risk of postoperative slipping is assumed to be low in older patients with advanced degenerative changes of the disc . The results of local decompression for sciatica and neurogenic claudication in the elderly are good, and fusion is not indicated in older patients with degenerative stenosis.

Neural compression at multiple levels is a relative contraindication to surgical decompression in the elderly. The results of surgery tend to be disappointing when two or more spinal levels are involved

- Figure -

Diabetic patients had high rates of postoperative wound complications and prolonged hospitalization. The poorer results may have been related to coexisting diabetic neuropathy or to the failure of the nerve roots to recover after decompressive procedures.

Spivak stated that, in his experience, relief of activity-related symptoms after decompression has been as reliable in patients who have diabetes as in those who do not. The relief of constant pain and abnormal sensations in the lower extremity has been less reliable in patients who have diabetes, presumably because of residual symptoms of underlying diabetic neuropathy.

Postacehini and Cinotti reviewed 40 patients treated surgically for spinal stenosis, 5 to 19 years (mean 8) after operation, and evaluated bone growth after total laminectomy and bilateral laminotomy. Their findings indicate that growth of the posterior arch is stimulated by abnormal vertebral motion and represents an attempt to increase vertebral stability. Growth of posterior facet joints may deteriorate the quality of the results with increasing time from surgery, reproducing previous pathologic conditions. On the other hand, growth of the laminar arch does not cause significant compression, except in degenerative spondylolisthesis. The proportion of satisfactory clinical results progressively decreased from the group with mild bone growth to the group with marked growth. Growth was more likely to occur after a narrow laminectomy (Fig.) and if the operated vertebral level was unstable

Chen et al. also described varying degrees of bone growth in surgical laminar defects as a natural postoperative repair process, with increased association with instability and in levels adjacent to spinal fusion. This association was related with poor clinical outcome in the middle and late follow-up periods.

Current trends toward more limited operative decompression with retention of the stabilizing elements and a decrease in short-term morbidity may lead to a higher rate of long-term failure due to recurrent stenosis or the development of stenosis at an adjacent level .

Another more immediate consequence of connective tissue repair following laminectomy is epidural scarring and heterotopic bone formation.

Peridural fibrosis is a natural consequence of laminectomy and surgical invasion of the spinal canal. The extent of fibrosis depends primarily on the extent of the surgical procedure and the degree of hemostasis. Peridural fibrosis can be well visualized by magnetic resonance imaging with or without gadolinium enhancement.

Scar fixation of the dura and nerve roots interferes with normal physiologic movement of these structures within the spinal canal, leading to pain and limitation of activities and simulating spinal instability ("instability catch").

Experimental studies of LaRocca and MacNab and Langensidold and Kiviluoto showed that the principal source of the scar was from the erector spinae muscle mass, which was covering the dura and extending into the canal to adhere to the dura and nerve roots. They advocated covering the dura with Gelfoam and free or pedicule fat transplants to prevent epidural scar formation.

Other synthetic membranes have been used, including Silastic, Dacron, and Gelfoam impregnated with methylprednisolone, with inconsistent results. None of these synthetic membranes covers the nerve roots and ventral areas adequately.

ABSTRACTS

ORAL PRESENTATIONS

BASIC SCIENCE

(September 5, Thursday;10:30-12:30)

Moderator: *Kazuo YONENOBU, Necdet ALTUN*

BS-01 Measurement of sagittal inclination of the lumbar vertebrae at prone position
A. Esat Kiter, Fahir Demirkan, B. Alper Kilic, Gurkan Erkula, Ertan Er

BS-02 The Use of Demineralized Bone Matrix with Autogenous Bone Graft, or Allogenic Bone Graft for Posterolateral Lumbar Intertransvers Spine Fusion
Sevki Kabak, Volkan Kayar, Mehmet Halici, Mahmut Argun, Sami Engin

BS-03 Experimental Spinal Fusion with Bioabsorbable Rods
Murat Bezer

BS-04 Comparison of short segment pedicle instrumentation with supplemental hook fixation (Under axial compression): A biomechanical study on calf spine
Kivanc Muratli, Haluk Berk

BS-05 In Vitro Biomechanical Evaluation of A New Rod-Screw Implant System for The Posterior Occipito-Cervical Instrumentation
Balkan CAKIR, H-J WILKE, L.CLAES, W. PUHL, M. RICHTER

BS-06 Preliminary results for axial low back pain treated with Coblation: A comparison of patients with and without a central focal protrusion
Curtis W. Slipman, Atul L. Bhat, Russell V. Gilchrist, Zacharia Isaac, Anthony Lee, Cyndi Garvan, Larry Chou, David A. Lenrow, Edward J. Vresilovic Jr

BS-07 Disc Temperature Measurements During Nucleplasty and Idet Procedures
Duran N. Yetkinler, William H. Nau, Lori L. Brandt, Chris Diederich

BS-08 The Effect of Radiofrequency Energy on Dural Tissue: Histomorphologic Analysis
Michael Vives, Richard Manos, Philip Yuan, Christopher Kauffman, Steven Garfin, Duran N. Yetkinler

Measurement of Sagittal Inclination of The Lumbar Vertebrae at Prone Position

A. Esat Kıter(1)(C), Fahir Demirkan(1)(O), B. Alper Kılıç(1)(O), Gurkan Erkula(1)(O), Ertan Er(1)(P)

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Objective: Transpedicular screws are widely used in spinal instrumentation, however many complications could be seen during this procedure. Anatomical landmarks, entry points and proper screw inclination in transverse and sagittal planes are important points during transpedicular screw application. Besides the orientation of pedicle in sagittal plane, motions of the vertebra in sagittal plane may have an effect on direction and position of screw. In this study, sagittal inclination of lumbar vertebra in prone position is investigated.

Methods: Right lateral decubitus position (DP) and prone position (PP) radiographs are obtained from 30 volunteers (average age 29 years old) without low back complaint. The position of the patient during the radiographs is similar to the prone position during surgery which is routinely used in our clinic. Longitudinal pillows with a diameter of 18 cm are placed under the chest and abdomen extending from axilla to the iliac crest. Sagittal plan inclination (SPI) of each vertebra are measured manually on both radiographs. Values are analyzed statistically with paired t test.

Results: SPI of the L1 vertebra at DP and PP position are measured as +19.8 and 14.3 respectively (p=0.000). SPI of the L2 vertebra are measured as +16.0 at DP position and +13.1 at PP position (p=0.017). There are no statistically significant difference between groups of L3, L4 and L5 level (respectively p=0.973, p=0.056 and p=0.071). There is statistically significant difference in lumbar lordosis between two groups (p=0.000).

Discussion: Lumbar vertebrae have greater range of motion at sagittal plane. According to our results upper lumbar vertebrae (L1-L2) have significant movement when the patient's position DP is changed to PP. During the application of transpedicular screw fixation at upper lumbar vertebrae (L1-L2) radiological evaluation of the sagittal alignment of the upper lumbar segments at prone position may contribute to the proper insertion of the screw.

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The Use of Demineralized Bone Matrix with Autogenous Bone Graft, or Allogenic Bone Graft for Posterolateral Lumbar Intertransvers Spine Fusion

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The aim of this study designed as an experimental model of posterolateral intertransvers fusion in rabbits is to demonstrate effectiveness of combination of demineralized bone matrix with autogenous or allogenic bone grafts on bone formation and spinal fusion in the cases autogenous bone graft is insufficient or not possible.

In this study, single-level lumbar arthrodesis was performed at L5-L6 in 110 adult New Zealand White rabbits. The rabbits were divided into 5 groups. The rabbits were assigned to one groups based on the graft material they received: 3.0 mL demineralized bone matrix (DBM; made from rabbit bone) (Group I), 1.5 mL DBM plus 1.5 mL allogenic bone graft (Group II), 1.5 mL DBM plus 1.5 mL autogenous bone graft (Group III), 3 mL autogenous bone graft (Group IV), and 3 mL allogenic bone graft (Group V) on each side. Rabbits were killed after 6 and 12 weeks, and the spines were excised and evaluated by manual palpation, radiographs, biomechanical testing and histology.

Fusions were assessed by manual palpation at 6 weeks for comparisons among the five groups of graft materials. The DBM used with allogenic bone graft resulted in fusion 60% (6/10), when combined with an equal amount of autogenous iliac crest bone, DBM resulted in fusion 80% (8/10). At the 12 weeks, the DBM combined with allograft resulted in fusion 80% (8/10) whereas that combined with autogenous graft resulted in fusion 100 % (10/10).The groups II and III were of statistically significant superiority to the remaining groups with regard to mean stiffness and ultimate load to failure. There was no statistically difference between the group II and III in this regard. More mature fusions with greater amounts of trabecular bone were present histologically in rabbits that received DBM than those which autograft and allograft were used.

In cases for which an adequate quantity of autogenous bone graft is not available, combination of DBM with allogenic or autogenous graft may facilitate greater bone formation and successful fusion.

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Experimental Spinal Fusion with Bioabsorbable Rods

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Purpose of Study: To examine the potential benefits SR-polylactide rods in posterior spinal fusion.

Methods: Twenty-four skeletally immature rabbits were divided into three groups. Bioabsorbable rods were fixed in eight immature rabbits onto three adjacent laminae on the right side. In the stainless steel instrumentation group 2,5 mm rods were used similarly. In control group eight rabbits were used. The adjacent three laminae of these rabbits were decorticated but not instrumented. Autogenous bone grafts were placed on the laminae to obtain fusion. The implantation area was assessed for bone formation and fusion by radiography and histological examination.

Results: There was a significant difference between bone formation in the instrumented two groups and the control group individually. When the stainless steel and SR-polylactide instrumentation groups were compared, no significant difference was noted.

Conclusion: The SR-polylactide rod was found to be an effective metallic rod substitute for achieving in situ posterior spinal fusion.

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Comparison of Short Segment Pedicle Instrumentation with Supplemental Hook Fixation (Under Axial Compression): A Biomechanical Study on Calf Spine.

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Objectives: The aim of this study is to determine the added benefits of supplemental hook fixation to standard short segment pedicle instrumentation construct by means of screw and rod strain measurements.

Background: Implant failure is an important and a common problem in cases with unstable burst fractures treated with standard short segment pedicle instrumentation. Several methods can be utilized to prevent this including supplemental sublaminar offset hook fixation, anterior strut grafting and use of longer spinal constructs.

Study Design: In this biomechanical study stresses in screw necks and rod strains were measured comparing short segment pedicle screw fixation and supplemental hook fixation (Argenson method) under axial compression. The role of anterior grafting technique and effect of posterior ligamentous structures were also evaluated.

Materials and Method: Four calf spines were instrumented with standard short segment pedicle screw-rod fixation method and four other calf spines instrumented with supplemental sublaminar offset hooks on cranial and caudal ends of the instrumentation. Strain gauges were placed on the neck of all four pedicle screws and on the rods. Measurements done for each specimen in the following order; intact spine, corpectomy, strut grafting (graft placed anteriorly), srut grafting (graft placed more posteriorly), anterior strut grafting with negative posterior ligaments and and vertebrectomy with absent posterior ligaments. Six channel strain measurement was done for each specimen under axial compression in the order of 400, 500 and 600 Newtons.

Results: Statistical analysis of recorded data done using Mann Whitney U test. 108 parameters evaluated for each specimen and the results showed no statistically significant difference except for the 3rd experiment group (vertebrectomy + anterior strut graft) distal pedicle screw (screw number 3) strain measurements, 4th experiment group (vertebrectomy + posterior strut graft) distal pedicle screw measurement (screw number 3) and 5th experiment group (vertebrectomy + anterior strut graft + (-) posterior ligaments) distal pedicle strain measurements (screw number 3). These ones showed significantly higher strain measurements in the short segment group.

Conclusion: It can be assumed that under axial compression, supplemental hook fixation with Argenson method only brings some limited benefits.

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In Vitro Biomechanical Evaluation of a New Rod-Screw Implant System for the Posterior Occipito-Cervical Instrumentation

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Introduction: Posterior instrumentation of the occipito-cervical spine is established in different indications. The use of rod-screw systems improved posterior instrumentation due to optimal screw position adapted to the individual anatomic situation. However there are still some drawbacks concerning the different implant designs. Therefore a new modular rod-screw implant system was developed to overcome some of the drawbacks of established systems. The aim of this study was to evaluate whether posterior internal fixation of the occipito-cervical spine with the new implant system improves primary biomechanical stability.

Methods: Three different internal fixation systems were compared in this study: 1. CerviFix system 2. Olerud cervical rod spinal system 3. Newly developed neon occipito cervical system. Eight human cervical spine C0-C5 specimens were instrumented from C0 to C4 with occipital fixation, transarticular screws in C1/2 and lateral mass or pedicle screws in C3 and C4. The specimens were tested in flexion/extension, axial rotation, and lateral bending using pure moments of ±2.5 Nm without axial preload. After testing the intact spine the different instrumentations were tested after destabilising C0/C2 and C3/C4.

Results: Primary stability was significantly increased in all load cases with the new modular implant system compared to the other implant systems. Pedicle screw instrumentation tended to be more stable compared to lateral mass screws, nevertheless significant differences could be observed only for lateral bending. As the experimental design precluded any cyclic testing the data represent only the primary stability of the implants.

Conclusions: In summary this study showed that posterior instrumentation of the cervical spine using the new neon occipito cervical system improves primary biomechanical stability compared to the cervifix system and the olerud cervical rod spinal system.

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Preliminary Results for Axial Low Back Pain Treated with Coblation: A Comparison of Patients with and without a Central Focal Protrusion

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Objective: It is widely accepted that the most common etiology of low back pain is that of discogenic disease. A new minimally invasive technology of Coblation or Nucleoplasty may provide a less aggressive alternative treatment of a proven symptomatic contained disc protrusion. The objective of this study was to report on our preliminary results for axial low back pain treated with Coblation.
Methods: A prospective study design using an independent reviewer to assess consecutive patients with back pain greater than leg pain was used. Other inclusion criteria included absence of precipitating trauma, symptom duration of at least 6 months, absence of a neurological deficit, and failure to respond to conservative management including the use of oral or injected analgesics/anti-inflammatory agents combined with physical therapy. Results of lumbar magnetic resonance imaging (MRI) led to categorization of subjects into two groups. Patients with a central focal protrusion (CFP) deemed to "tent" the posterior longitudinal ligament constituted Group I and those without a central focal protrusion were identified as Group II. Following a provocative discography reproducing concordant pain, coblation was subsequently performed at the affected level using a power level set of two. Outcome measures used included visual analog scores (VAS) score and modified Oswestry disability score. Each patient was assessed immediately prior to the intervention and at 2 weeks, 1 month, 2 months, 3 months, and 6 months. Statistical analysis was performed using a student-t test.
Results: There were fourteen patients who met the inclusion criteria (Group I: 7; Group II: 7). A total of 9 disc levels received Coblation in each group. For Group I, the disc levels were L3-4 (n=1), L4-5 (n=4), and L5-S1 (n=4). For Group II, the disc levels were L2-3 (n=1), L4-5 (n=2), and L5-S1 (n=6). Of Group I, five of seven patients demonstrated a statistically and clinically significant improvement in each of their outcome measures. In contrast, only one of seven from Group II demonstrated clinical improvement. For the five patients from Group I that improved the average and range of VAS ratings were: Pre- 49 (25-70); 2weeks- 21 (5-40); 1 month- 24 (5-50); 2 months– 17 (5- 30); 3months– 17 (5-30), 6 months 17 (5-30). At each follow-up time interval there was a statistically significant difference ($p<0.05$) for VAS and Oswestry disability scores when compared with to the baseline scores. For patients in Group II, there was no statistical significant difference in any of these ratings.
Discussion and Conclusion: Coblation technology generates RF energy that is applied to a conductive medium, creating a highly focused plasma field around the introduced catheter. The plasma field comprised of highly ionized particles leads to cleavage of organic molecular bonds within the applied tissue; in this instance nucleus pulposis. The end result is the low temperature, molecular disintegration of nuclear material resulting in a controlled volume of tissue removal, while simultaneously avoiding collateral annular or end plate necrosis. Microscopic studies have documented the presence of a large continuous network of interlacing nerve fibers innervating the posterior longitudinal ligament. Their afferent pathway is primarily through the sinuvertebral nerve into either the rami communicantes or ventral rami of the respective segmental disc level. The presence of such neural input suggests that a tensile force applied to the posterior longitudinal ligament may lead to the perception of back pain. If this concept were accurate then one would expect symptom reduction to rapidly transpire when that load is removed. In this study, reducing the volume of nuclear material appears to have effectively reduced this tensile load. This pilot study suggests that coblation may a useful technique in the treatment of patients with back pain secondary to a central herniated nucleus pulposis associated with "tenting" of PLL and not in patients without such a central herniated nucleus pulposus.

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Disc Temperature Measurements During Nucleoplasty and Idet Procedures

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Objective: Minimally invasive devices for the treatment of contained herniated discs are gaining popularity. The Nucleoplasty procedure both ablates and coagulates the nucleus pulposus to provide disc decompression, while IDET provides heat at the nuclear-annular junction. Temperature assessments in and around the intervertebral disc tissue are important to understand the safety and efficacy of these devices.

Methods: Three temperature experiments were conducted. First, radial temperatures were obtained in fresh chicken breast tissue during the ablation phase of the Nucleoplasty™ (ArthroCare Corp., Sunnyvale, CA) procedure. Using power setting 2 for 5 seconds, temperatures were recorded using thermocouple probes, every 0.1 seconds.

In the second experiment, the Nucleoplasty procedure was performed using an array of custom multi-junction thermocouple probes (5 to 6, 0.5 mm diameter junctions 2 or 5mm spacing) placed throughout a human cadaveric specimen. Transient temperature data was collected at 26+ points within the desired heating volume.

The last experiment compared the temperatures achieved at key anatomical locations during the IDET™ (Oratec Interventions, Inc., Menlo Park, CA) and the Nucleoplasty procedures in a human cadaveric lumbar spine model. Two fresh frozen human cadaveric spine specimens were obtained and L1-L2 through L5-S1 intervertebral discs were used in both specimens. In both procedures, temperatures were recorded as temperature increase from baseline.

Results: For the radial temperature distributions, after 5 seconds of heating in ablation mode, the maximum temperature change at the tip was 19.7°C and measured 0.5°C mm at a radial distance of 4mm.
Intradiscal temperatures of 60-65 °C in the cadaveric spine were obtained within 2-3 mm radial distance from the introducer path, using the Nucleoplasty procedure.
For Nucleoplasty, the average temperature increase (TI) in the cadaveric nucleus and superior endplate was 6.0°C and 1.8 °C, respectively. In the IDET procedures however, the average TI in the nucleus and superior endplate were 13.5°C and 12.4°C, respectively. Essentially no TI occurred at the nerve root in either the Nucleoplasty or IDET procedures.

Discussion and Conclusions: These preliminary results suggest that the Nucleoplasty procedure results in relatively lower temperatures, providing a somewhat higher margin of safety than other procedures, such as the IDET procedure. Temperature distributions and intradiscal temperatures in cadaveric models further support the safety of the practice.

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The Effect of Radiofrequency Energy on Dural Tissue: Histomorphologic Analysis

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Objective: Radiofrequency energy is an innovative technology offering promise for applications including soft tissue ablation, disc removal and scar tissue dissection in spinal surgery. Bipolar RF devices have been shown to cause minimal collateral tissue damage, however the effects of radiofrequency energy on dural tissue is unknown. The objectives of our study were to analyze collateral tissue in dural tissue exposed to radiofrequency energy.

Methods: Fresh frozen cadavers underwent laminectomy from T4 to S1. The bipolar radiofrequency electrode was placed in direct contact with the dura and used at settings "5" and "9" for 1 and 3 seconds, until dural penetration occurred. Epithelial destruction and collateral tissue damage were measured in histologically prepared tissue by scanning electron microscopy.

Results: Macroscopically, dura tissue shrank at the point where the device was activated, for all power settings and time duration. Histologic analysis revealed minimal tissue alteration in the superficial dura mater in specimens in which the device was activated for one second. Lesions measured 300-400 microns deep x 1-1.5 millimeter wide. Specimens treated for 3 seconds, showed lesion sizes of 1.75-2.0 millimeter wide x 700-800 microns deep. Dural penetration occurred after activating the device for 5 seconds. The dura surrounding the treatment level was markedly thickened and. the fibro-collagenous matrix compacted and moderately homogenous. The subdural connective tissue, dorsolateral fasciculus and nerve roots, immediately below treatment pathway appeared unaffected in all specimens.

Discussion and conclusions: Radiofrequency energy has potential to become an adjunct in both minimally invasive and open spine surgery. Our results, in cadaveric tissue, suggest that collateral damage to the dura and underlying neural structures is minimal unless a transmural dural defect is created.

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TRAUMA

(September 5, Thursday;10:30-12:30)

Moderator: *F.Cumhur Oner*

T-01 The Outcome of Surgery of Acute Vertebral Fractures of the Thoracic and Lumbar Spine
JJ Verlaan, C.H. Diekerhof, F.C. Oner, W.J.A. Dhert, A.J. Verbout

T-02 Results of Conservative Treatment in Thoracolumbar Vertebral Fractures
Erden Erturer, Mehmet Tezer, Irfan Ozturk, Unal Kuzgun

T-03 Vertebroplasty with the use of hydroxiapatite cylindrical sticks in treating painful thoracolumbar osteoporotic collapse
Tomoaki Toyone, Tadashi Tanaka, Daisuke Kato, Ryutaku Kaneyama

T-04 The course of non-surgical management of burst fractures with intact posterior ligamentous complex (PLC): An MRI study
Ahmet Alanay, Egemen Turhan, Emre Acaroglu, Muharrem Yazici, Aysenur Cila, Adil Surat

T-05 Lumbar Vertebral Transverse Processes Fractures: Are They Really Innocent ?
Bulent Daglar, Bulent Adil Tasbas, Kenan Bayrakci, Guzelali Ozdemir, Ugur Gunel

T-06 Comparison of The Results of Anterior Screw-plate Instrumentation and Anterior Dual-rod Screw Instrumentation in The Treatment of Thoracolumbar Burst Fractures
Serdar Akalin, I.Teoman Benli, Gokhan Temelli, Mehmet Citak, Mahmut Kis

T-07 Evaluation of Spinal Canal Compression and Remodeling and The Effect of Posterior Instrumentation and Fusion in Thoracolumbar Burst Fractures
Serdar Akalin, Ozgur Karakas, I.Teoman Benli, Evrim Duman, Mahmut Kis, Erbil Aydin

T-08 Effect of The Different Instrumentation Techniques in Protecting The Surgical Correction of The Unstable Thoracolumbar Vertebral Fractures
Erhan Serin, Lokman Karakurt, Erhan Yilmaz, Oktay Belhan

The Outcome of Surgery of Acute Vertebral Fractures of the Thoracic and Lumbar Spine

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Study Design: A systematic review was performed on the available literature for the outcome of surgical treatment of acute traumatic vertebral fractures of the thoracic and lumbar spine.
Objectives: To provide information on the safety and outcome of the various surgical approaches in terms of radiological deformity, neurological status, functional recovery and complications.
Summary of Background Data: Different techniques of operative treatment of spinal fractures have been introduced and used extensively during the last two decades. General performance of these techniques, results and complications have not been studied from literature since 1994.
Methods: A MEDLINE search was performed to obtain the relevant publications (n>= 10 and follow-up >=12 months) describing the surgical treatment and outcome at follow-up. All data were extracted uniformly using pre-defined criteria. The data were regrouped in five subgroups: posterior short-segment (PS), posterior long-segment (PL), combined reports of posterior short and long segment (PSL), anterior (A) and anterior combined with posterior, either long or short (AP).
Results: From 376 papers resulting from the search, 240 were rejected due to failure to meet the inclusion criteria or insufficient data. The remaining 136 papers describe the treatment and results of a total of 5463 patients. The sample size of each subgroup was PS: 1825; PL: 1839; PSL: 903; A: 628 and AP: 268. Patient characteristics: The mean age for each subgroup were comparable (range: 32-35 years) and the mean follow-up varied between 25 (AP) and 37 months (A). Most of the fractures, 60 % (PL) to 84% (A), were 'burst' type fractures. The neurological deficits varied for the subgroups. The mean local kyphosis angle at admission ranged from 13.1 (PSL) to 23.7 (A) degrees. Surgical details: Mean blood loss varied from 912 ml (PS) to 1584 ml (AP) while mean duration of the intervention ranged from 190 min. (PS) to 450 min. (AP). Radiological outcome: The mean local kyphosis angle directly post-operative and at final follow-up was PS: 0.2 and 6.3; PL: 5.6 and 11.8; PSL: 0.5 and 5.3; A: 7.9 and 11.3 and for AP: 2.4 and 11.9 degrees. Neurological outcome: Only two patients, both from PL, deteriorated neurologically (Frankel E to D) following surgery. A deficit, if present, improved 1 or 2 Frankel scales in 55 % (PL) to 78 % (A) of the patients.
Functional outcome: During follow-up pain was reported not to be a problem in 65 % (PSL) to 89 % (A), while 54 % (PSL) to 83 % (PS) were re-employed in their former jobs. Complications: Post-operative complications were relatively rare but included deep infections of the surgical site (mean 1.7% of all patients), malpositioning of devices (mean 3% of all patients) and early device failure (2.5% of all patients) without obvious differences between the subgroups. Late complications were device failure (3.3% (AP) to 18.4% (PSL)) and non-elective reoperations (3.6% (PS) to 8.7% (PL)) although these late events seemed to have remarkably little impact on the clinical results.
Conclusions: Despite significantly different techniques, operative treatment of thoracic and lumbar spine fractures, in general, seems to be a safe and effective treatment option. Complication rates, even during the introduction period of operative treatment, are low. Functional outcome, i.e. pain and employment, seems to be better than generally believed.

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Results of Conservative Treatment in Thoracolumbar Vertebral Fractures

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Introduction: Treatment modalities for thoracolumbar vertebral fractures differ according to the type and stability of the fracture and neurological deficiencies present. Stable fractures are generally treated conservatively whereas a surgery is planned for the unstable ones.

Materials and methods: Out of 227 conservatively treated patients in the period of 1988-1999, 48 cases with adequate follow-up period were included in our study. Average age of patients (23 female, 25 male) is 46.2 with a range of 18-76 years. Follow-up period varied between 31 to 137 months with an average of 77.5 months. Mechanism of injury was a fall from a height in 29 cases (%60.4), motor vehicle accident in 13 cases (%27.1), simple fall in 5 cases and direct trauma in 1 case. 32 compression fractures (%60.4) and 16 burst fractures (%33.4), both being mostly in the thoracolumbar junction, were detected. None of the patients presented neurological deficit. 29 cases were treated by TLSO (Thoracolumbosacral orthosis), 7 by body cast, 6 by bed rest only, and 6 by body cast followed by TLSO. In addition to pain and functional scoring, angle of kyphosis and scoliosis, wedging index, vertebral index and height loss percentages were measured and compared at the time of injury and in the follow–up periods.

Results: In compression fractures, the results were found to be statistically insignificant when angle of kyphosis, vertebral index and height loss percentages were compared ($p>0.05$). Differences in angle of scoliosis and wedding index were statistically significant ($p<0.05$). Pain score had an average value of 1.66 while functional score was found to be 1.03. In burst fractures, angle of kyphosis did not change statistically before and after treatment ($p>0.05$). Percentile values of angle of scoliosis, vertebral index, wedging index, and height loss were increased after treatment ($p<0.05$). Mean pain score was 1.26 and functional score was 0.93 in burst fractures.

Conclusion: In our study, deformity was increased after conservative treatment in plain radiography but pain and functional scores did not accompany this increase. We conclude that compression fractures with angle of kyphosis less than 30° can be accepted as stable and treated conservatively. If angle of kyphosis is more than 30°, MRI (Magnetic resonance imaging) should be obtained and if posterior ligamentous complex is damaged, surgery should be considered. In burst fractures, posterior ligamentous complex should be imaged by MRI and conservative treatment should be considered if there is no neurological deficit and the ligaments are intact. Otherwise, surgery should be planned.

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Vertebroplasty with the Use of Hydroxiapatite Cylindrical Sticks in Treating Painful Thoracolumbar Osteoporotic Collapse

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Objective: The aim of this study was to determine the efficacy of vertebroplasty with the use of hydroxiapatite (HA) in treating painful thoracolumbar osteoporotic collapse.

Methods: Vertebroplasty with the use of HA was performed for 16 patients (11 women, five men; 61-80 years old) with osteoporotic vertebral collapse suffering from intractable pain that had been unrelieved by nonoperative care over a three-month period. Eight patients underwent this procedure percutaneously under local anesthesia. The other eight patients were treated by additional bisegmental posterior transpedicular instrumentation (Universal Spine System) under general anesthesia. Both groups were comparable with regard to age and degree of vertebral deformity. In order to augment the deficient bone, eight to ten HA cylindrical sticks (4x40mm, processed by solid HA granules) were inserted transpedicularly. External support was continued for six months.

Results: No patients were lost up to at least one-year follow-up. Neither neurological compromise nor failure of the screw fixation was observed. Wedging rate was defined as a percentage of the anterior vertebral height to the posterior one. The mean wedging rate of all 16 cases was 43% (range, 20-66%) preoperatively and 90% immediately after operation. In patients without instrumentation, postoperative radiological examinations demonstrated progression of collapse, and the wedging rate was 50% at 12 months after surgery. In patients with instrumentation, the loss of correction within the fractured vertebral body was small, and was maintained up to the final follow-up.

Although surgery provided relief of pain in all cases, the collection loss was associated with back pain. All eight patients with instrumentation were satisfied with the outcome of their surgery, whereas only three out of eight patients without instrumentation were satisfied.

Discussion and Conclusion: Vertebroplasty with polymethylmethacrylate has become increasingly popular. Extrusion of polymethylmethacrylate into the spinal canal leading to neurological compromise, however, has been reported. In this study, collapsed vertebral bodies of patients with severe vertebral deformity were filled with HA cylindrical sticks. This procedure has been effective to relieve pain without any neurological complications, but additional posterior instrumentation is to be recommended.

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The Course of Non-surgical Management of Burst Fractures with Intact Posterior Ligamentous Complex (PLC): An MRI Study

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Purpose: A prospective study to evaluate the results of nonsurgical treatment of burst fractures with intact PLC and to investigate the effect of trauma and/or residual kyphotic deformity on adjacent and neighboring (next-adjacent) discs.

Material and Methods: Fifteen consecutive neurologically intact patients with burst fractures (T11-L2) were managed nonoperatively with the indication based solely on the integrity of PLC determined by MRI. Correction of deformity and stabilization with a total body cast under sedation were the mainstays of treatment. Patients were mobilized the next day and casts were removed at the end of the 3rd month f/up with no further external stabilization. Local kyphosis (LK), sagittal index (SI) and percent of compression of body height (ABH) were measured on pre-treatment, post-treatment, 3rd month and latest f/up x-rays. All patients' preoperative and latest f/up MRI studies were analyzed to examine discs adjacent to and neighbouring the fractured levels. Patients' perception of function, pain and appearance were analysed using Likert Questionnarre.

Results: There were 8 female and 7 male patients with an average age of 28 (range 15-49) years. Average f/up was 31 (24-51) months. Twelve patients had Denis type B while 3 had type A fractures.

Pre-treatment MRI analysis revealed changes in the shape of the discs (narrowing or herniation into the body) with no change in the signal intensity of nucleus pulposus(NP) in 8 of the cranial and in 5 of the caudal adjacent discs. On follow-up MRI, there was only one intact disc with a normal shape cranially. All others had height loss but only one had complete loss of signal intensity. Caudally, 4 additional discs had changes in shape without any gross changes in signal intensity of NP. None of the neighbouring discs had changes in shape or signal intensity at the time of injury or at latest f/up. Average score of function, pain and appearance were 4, 4 and 3.5 respectively at the latest f/up. All patients returned to original work at 3.6 (range 1-9) months on average and all were satisfied with their treatment.

Discussion: Conservative treatment based on integrity of PLC is controversial, probably due to poor evaluation by clinical and indirect radiographic findings. Degenerative changes in the adjacent discs due to trauma and/or residual kyphotic deformity is a common expectation. Our study revealed that an intact PLC may not prevent loss of correction gained by non-surgical management of burst fractures. Significant loss occurs in the first 3 months despite external stabilization. However, the magnitude of residual deformity usually remains close to the original deformity. Although changes in the shape of adjacent discs occur due to trauma and/or natural course, significant loss in signal intensity of nucleus pulposus is very unlikely. Patient outcome seems to be highly satisfactory despite residual deformity.

Table1. The results of x-ray analysis

	Pre-treatment	Post-treatment	3rd month f/up	Latest f/up
LK (degrees)	16.5 (0-34)	5 (-19-25)	14.6 (4-24)	18 (4-29)
SI (degrees)	18 (0-27)	10 (-2-21)	15.6 (-2-23)	19 (4-34)
ABH (%)	30 (5-57)	19 (3-36)	28 (10-52)	39 (12-60)

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Lumbar Vertebral Transverse Processes Fractures: Are They Really Innocent?

Bulent Daglar(1)(B), Bulent Adıl Tasbas(1)(O), Kenan Bayrakcı(1)(O), Guzelalı Ozdemır(1)(O), Ugur Gunel(1)(O)

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1) Ankara Numune Training and Research Hospital;4th Ortohopaedic and Traumatology Clinic

Objective; to investigate the clinical importance of fracture of the lumbar vertebral transverse processes

Methods; 106 patients, sustained different kinds of trauma between January 2000 and January 2001, were included in the study. All patients were operated for intra abdominal causes. Of these 62 (%58) had one or more fractured lumbar transverse processes documented (group I) and remaining 44 had not (group II). Age, gender, additional skeletal and intra abdominal injuries, ISSs, laboratory tests results at presentation, transfusion needs and the end results were compared using SPSS 10,0 package.

Results; patients with transverse process fractures were older (38 versus 27, p=0,001, r=0,452, r^2=0,204). Trauma causes, ISS, additional systemic traumas, skeletal traumas were not different between groups (p values are; 0,148, 0,125, 0,423, 0,673 respectively). However, hemoglobin levels, intra abdominal organ injuries, total hospital stay and end results were significantly different in group I (p= 0,005, 0,042, 0,002 and 0,012).

Discussion and conclusion; although lumbar transverse process fractures do not directly related with vertebral stability, the presence of such a fracture should alert physicians. Especially in multiply injured patients, lumbar vertebra transverse process fracture predisposes more serious intra or retroperitoneal organ injuries.

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Comparison of the Results of Anterior Screw-Plate Instrumentation and Anterior Dual-Rod Screw Instrumentation in the Treatment of Thoracolumbar Burst Fractures

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The potential for clinical and neurological instability following thoracolumbar fractures has evoked a progressive increase in interest in the surgical treatment of unstable thoracolumbar fractures. Ninety-nine consecutive patients who had thoracolumbar burst fracture associated with neurological deficit, spinal canal compromise over 30%, sagittal index more than 15° were treated with single stage anterior spinal decompression, strut grafting and anterior spinal instrumentation at 1st Orthopaedics and Traumatology Clinic of Social Security Ankara Teaching Hospital. Mean follow up was 57 months.. Mean correction rate in sagittal index was 75.6% in 54 patients in which anterior titanium plate-screw fixation system (Z-Plate) was used and 79.7% in patients treated with anterior dual-rod-screw fixation system (Cotrel Dubousset Hopf (CDH)). Statistically significant difference was not obtained ($p>0.05$) in these two patient groups regarding sagittal index , however follow up and the last control data showed statistically significant difference in correction loss in the patients which plate-screw instrumentation was used. (mean Plate-screw instrumentation: 5.8°±2.4°, mean CDH 1.1°+1.4°) Also, any frontal plane deformity was not noted in patients with CDH instrumentation but averagely 7.1° of iatrogenic scoliosis was caused in 13.9% of the patients with plate-screw instrumentation. None of the patients had iatrogenic neurological deficit and 90.9% of the patients with neurological deficit improved at least one Frankel grade. In conclusion it is suggested that dual rod-screw fixation system (CDH) provided higher success in the treatment of thoracolumbar burst fractures at the restoration of frontal and the sagittal plane contours compared with anterior Z-plate screw system.

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Evaluation of Spinal Canal Compression and Remodeling and the Effect of Posterior Instrumentation and Fusion in Thoracolumbar Burst Fractures

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The disappointing results achieved with conservative treatment, the use of computed tomography and the developments in spinal biomechanics leading a better understanding of vertebral fractures have led to an increasing popularity of surgical treatment of thoracolumbar vertebral fractures in the last 15 years. From 1994 to 2000, 326 patients with thoracolumbar burst fractures were treated surgically at 1st Orthopaedics and Traumatology Clinic of Social Security Ankara Teaching Hospital. One hundred of these patients with a minimum follow up of 36 months were included in this study who admitted for the last control CT scans.

The aim of this study was to evaluate the spinal canal remodeling after posterior instrumentation and fusion.

Views that were obtained from the scanograms were processed by AutoCAD 2000 program regarding antero-posterior diameter, interpedicular diameter and the area of the spinal canal of the one above, one below and the affected segment(s) and the scales were measured and corrected. Mean age was 40 years of the sum of 40 female and 60 male patients.

The preoperative, postoperative and last control mean spinal canal area at the affected segment were 1.61±0.44 cm^2, 1.81±0.43 cm^2 and 2.21±0.54 cm^2 and mean anteroposterior diameter were 1.03±0.21 cm, 1.2±0.34 cm, 1.33±0.30 cm and mean interpedicular diameter were 2.22±0.40 cm, 2.21±0.38 cm and 2.39±0.35 cm respectively.

The results showed statistically significant difference in anteroposterior diameter and spinal canal area suggesting effective remodeling of spinal canal after surgical treatment of thoracolumbar burst fractures with posterior instrumentation and fusion. Also this study is noted to be the first in the literature regarding the technique used to measure the scanograms and suggested to be effective and reliable.

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Effect Of The Different Instrumentation Techniques in Protecting the Surgical Correction of the Unstable Thoracolumbar Vertebral Fractures

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Objectives: The purpose of this study was to investigate the effect of the different instrumentation techniques in protecting the surgical correction of the unstable thoracolumbar vertebrae fractures.

Methods: 56 cases with unstable thoracolumbar vertebrae fractures were treated surgically and divided into 3 groups according to the instrumentation technique. Group I had 21 cases with offset-hook long segment posterior instrumentation, group II had 20 cases with long segment posterior instrumentation and group III had 15 cases with short segment instrumentation. Lateral radiogram of the thoracolumbar vertebrae at the early postoperative period and 12th month postoperatively was taken and wedge index (WI-early, WI-12), local kyphosis angle (LCA-early, LCA-12), anterior compression angle (ACA-early, ACA-12) and compression ratio (CR-early, CR-12) were estimated in all groups and statistical analysis was performed with student's t-test.

Results: Between the group I and group II, there was no difference statistically. Between the group I and group III, significant difference was found for WI-12, LCA-12, ACA-12, CR-early and CR-12 ($p<0.05$). Between the group II and group III, there was significant difference for LCA-12, ACA-12, CR-early ($p<0.05$). Group I and Group II had more stability than group III for protecting the intraoperative vertebral deformity correction along the postoperative period.

Discussion and conclusion: For protecting the surgical correction of the unstable vertebrae fractures, offset-hook long segment instrumentation and long segment instrumentation was superior to the short segment instrumentation. According to us, short segment instrumentation technique is a bad choice for unstable thoracolumbar vertebral fractures.

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DEFORMITY

(September 6, Friday;10:30-12:30 and 14:30-16:00)

Moderator: *Lawrence Lenke, Mehmet Altinmakas*

D-01 The Residual Rotation and Tilt of the Lowest Instrumented Level (LIV) in Posterior instrumentation for Adolescent Idiopathic Scoliosis (AIS). Are They Really Important?
Emre Acaroglu, Vedat Deviren, Ahmet Alanay, Akin Cil, Akin Uzumcugil, Muharrem Yazici, Adil Surat

D-02 Scoliosis screening with evaluation of joint laxity. The relation between trunk rotation and joint laxity
A. Esat Kiter, Gurkan Erkula, B. Alper Kilic, Ertan Er

D-03 Reliability of The Superficial Abdominal Reflexes in Spinal Examination
A. Esat Kiter, Gurkan Erkula, Ertan Er, Haluk Berk

D-04 Correction of Adolescent Idiopathic Scoliosis Using Thoracic Pedicle Screw Fixation versus Traditional Hook Contructs: A Single Surgeon Retrospective Review
Steven K. Storer, Michael G. Vitale, Darria E. Long, Julie C. Choe, Joshua E. Hyman, Francis Y. Lee, David P. Roye Jr.

D-05 Pediatric Spine Deformity: Assessing Patient Outcomes and Quality of Life
Michael G. Vitale, Douglas E. Levy, Julie C. Choe, Annetine C. Gelijns, Alan J. Moskowitz, Joshua E. Hyman, Francis Y. Lee, David P. Roye Jr.

D-06 Effect of Bracing on The Quality of Life of Adolescents with Idiopathic Scoliosis
Obinwanne F. Ugwonali, Guillem Lomas, Julie C. Choe, Joshua E. Hyman, Francis Y. Lee, Michael G. Vitale, David P. Roye Jr.

D-07 The effect of apical vertebral instrumentation in surgical treatment of King type II curves
Omer Akcali, Can Kosay, Emin Alici

D-08 Assessment of Curve Flexibility in Adolescent Idiopathic Scoliosis
F.Erkal Bilen, Ufuk Talu, Mehmet Tezer, Cuneyt Mirzanli, Unsal Domanic, Azmi Hamzaoglu

Moderator: Adil Surat, Emre Acaroglu

D-09 Evaluation of Titanium Mesh Cages Used for Anterior Column Support Following Corpectomy in the Thoracic and Lumbar (T1-S1) Region with Minimum Two-Year Follow-up
Oguz Karaeminogullari, Mursel Debre, F.Erkal Bilen, Ufuk Talu, Unsal Domanic, Azmi Hamzaoglu

D-10 Thoracic Adolescent Idiopatchic Scoliosis: Correction with Translation Using Polyaxial Reduction Screws
Cuneyt Sar, Onder Kilicoglu

D-11 Does fulcrum bending predict postoperative correction in adolescent idiopathic scoliosis King-Moe type III curves?
Haluk Berk, Ilker Ozden, Cem Ozan Ardic, Omer Akcali

D-12 Gait analysis before and after posterior fusion in unbalanced adolescent idiopathic scoliosis
A.Sukru Solak, Behzat Kentel

D-13 Combined Anterior-Posterior Arthrodesis For Adult Lumbar and Thoraco-Lumbar Scoliosis
Vedat Deviren, Sigurd Berven, Serena Hu, David Bradford

D-14 Treatment of Thorocolumbar Scoliosis with Anterior Instrumentation; Adults vs. Adolescent
Vedat Deviren, Sigurd Berven, Serena Hu, David Bradford

D-15 Trunk Balance Analysis of Late Onset Idiopathic Scoliosis Patients Treated with TSRH Instrumentation
I.Teoman Benli, Mahmut Kis, Mehmet Citak, Serdar Akalin

D-16 Neural Axis Abnormalities Determined by MRI in The Patients with Type III Idiopathic Scoliosis
I.Teoman Benli, Evrim Duman, Levent Gurses, Baki Hekimoglu

Moderator: *Reinhard Zeller, Teoman Benli*

D-17 Anterior Fusion and Instrumentation in The Treatment of Congenital Spinal Deformities
Mahir Gulsen, Cenk Ozkan

D-18 Pain in Patients with Scoliosis and Syringomyelia
Remzi A. Ozerdemoglu, Ensor E. Transfeldt, Francis Denis

D-19 The efficacy of convex hemiepiphysiodesis in patients with iatrogenic posterior elment deficiency due to diastematomyelia excision
Akin Uzumcugil, Muharrem Yazici, Ahmet Alanay, Emre Acaroglu, Pinar Ozisik, Nejat Akalan, Adil Surat

D-20 Analysis of Upper and Lower Thoracic Kyphosis in Healthy Individuals
Remzi Arif Ozerdemoglu, Ufuk Aydinli, Salim Ersozlu, Aytun Temiz, Cagatay Ozturk

The Residual Rotation and Tilt of the Lowest Instrumented Level (LIV) in Posterior Instrumentation for Adolescent Idiopathic Scoliosis (AIS). Are They Really Important?

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Purpose: Posterior instrumentation for AIS is usually extended down to the least rotated (neutral) because of the possibility of decompensation. This study aimed to clarify the relationship between the residual rotation and coronal plane tilt of the lowest instrumented level and the frontal, sagittal and transverse plane parameters of imbalance.

Patients and Methods: Forty-seven AIS patients (ave. age 14,5 ± 1,9) treated with posterior translation instrumentation were included. Average f/up was 49,6 ± 20,5 (24-96) months. PA and lat. X-rays obtained pre- and post-operatively and at latest f/up visits were measured for frontal and sagittal curve magnitudes, AP tilt and offset of T1, sag. offset of T1, rotation of the level below LIV and shoulder balance (coracoid process height). In thirty patients, additional rotation measurements of 10 landmark levels (inc. T1, interclavicular bisect (ICB), upper end of inst. (UIV), apices, LIV, level below LIV(LBLIV) and L4) were measured by CT pre- and post-operatively, at 6 and 12 months, and normalized by the rotation of pelvis.

Results: The thoracic curves measured 57,4 ± 13,6 deg pre-, 19,4 ± 9,4 deg post-operatively (66,4 ± 13,6 % correction) and 22,2 ± 11,9 deg at latest f/up. LIV was at T12 in 5, L1 in 11, L2 in 14, L3 in 14 and L4 in 3 cases. Rotation immediately below these levels as measured by the Perdriolle method was 8,8 ± 6,2 (0-25) deg pre-, 9,1 ± 6,4 (0-30) deg postoperatively (11,5 % increase) and 10,0 ± 7,6 (0-30) deg at latest f/up, the corresponding coronal tilts were 15,5 ± 8,0 deg, 5,4 ± 4,3 deg, and 9,7 ± 9,9 deg respectively. The magnitude of neither significantly affected the T1 tilt, AP and sag. T1 offset and shoulder balance. Likewise, the CT measurements of rotation revealed that residual rotation at the vicinity of LIV was not associated with a rotational imbalance (p>0,05)(Table 1).

Rotation (deg)	LBLIV	LIV	T1	ICB
Pre-op	9,2 ± 6,2	10,4 ± 7,5	5,6 ± 4,4	4,3 ± 4,2
Post-op	9,6 ± 5,5	9,6 ± 5,7	4,1 ± 4,7	6,1 ± 4,4
6 mos.	10,3 ± 5,5	12,4 ± 6,7	3,3 ± 3,2	2,3 ± 3,3
12 mos.	9,4 ± 5,0	10,0 ± 7,0	3,5 ± 2,4	3,4 ± 2,4

Conclusion: The residual angular deformity at the level of the lower end of posterior translation instrumentation for AIS could not be demonstrated to have any effect on the overall post-operative balance of the spinal column in any of the planes.

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Scoliosis Screening with Evaluation of Joint Laxity. The Relation Between Trunk Rotation and Joint Laxity

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Objective: Adam's forward bending test and scoliometric measurements are preferred in school screening because of its low radiation and its cost effectiveness. However, real spinal deformity could not be evaluated with both techniques.

Many investigators have noted the association of the joint laxity and scoliosis. However the relationship between joint laxity and scoliosis is unclear. In the current study, the joint laxity of the children are also evaluated during scoliosis screening. The data obtained from screening, especially trunk rotation are analysed statistically to determine their relationship with joint laxity.

Methods: One thousand two hundred seventy three (598 females-675 males) primary school children with an average age of 10,4 (8-15), are recruited for the scoliosis screening. The trunk rotation is measured by forward bending and scoliometer, among the other spinal tests, and their joint laxities are evaluated by using Beighton scoring system. Trunk rotation of 7° and over are evaluated radiographically.

Results: Joint laxity is found in 41 children (3,2%), and trunk rotation of 7° and over is found in 30 children (2,3%). Joint laxity in children with trunk rotation of 7° and over is found to be greater than those with 6° and less, but only a third of the children (n=10) is found to have a significant scoliotic curve after radiographic analysis.

Discussion: Although the number of the scoliotic patients are not enough for a definitive conclusion, there are some findings which denote a specific relation between scoliosis and joint laxity. Interestingly, children without a scoliotic curve, but a trunk rotation of over 7°, are found to have a higher incidence of joint laxity than the general population. The use of scoliometer determine the trunk rotation in the thoracic and lumbar region however there might be several other reasons that can change this topography of the surface other than scoliosis. This study shows that joint laxity may be one of the reasons changing the topography of the thoracic and lumbar region.

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Reliability of the Superficial Abdominal Reflexes in Spinal Examination

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Objective: Examination of the superficial abdominal reflexes in scoliotic patients has been considered important in early detection of spinal cord pathology. The purpose of this study is to evaluate and discuss the importance of the superficial abdominal reflexes in the spinal examination.

Methods: Four hundred and eleven (189 girls- 222 boys) primary school students were screened. Average age of the children was 10,6 years (8-13). After full physical examination, spine was evaluated in Adams forward bending position with scoliometer. Testing of the reflexes is performed in four quadrants surrounding umbilicus.

Results: Three hundred seventy two (90.5%) subjects had bilaterally normal superficial abdominal reflexes. Twelve (2.9%) subjects had no reflex detected in at least one quadrant. Two (0.4%) subjects completely had no reflexes on the left side. Twenty-five (6%) children had absent reflex in all quadrants. Favorable reflexes examination could not be performed in nineteen (4.6%) subjects because of tickling sensation. There are no statistically significant differences between boys and girls, younger than 10-year-old group and older. There was no statistically significant correlation between the presence or absence of abdominal reflexes and scoliosis (n=5).

Discussion: Precise neural pathway of the superficial abdominal reflexes is not completely understood yet. It can be absent in healthy population. Different techniques of the abdominal reflex testing can affect the results. To eliminate abdominal muscle contraction, cooperation with the child is important. In the current study 4.6% of the subjects tested negative reflexes because of the muscle contraction due to inevitable tickling sensation. In our opinion, contribution of the superficial abdominal reflexes examination in deciding further neurological examination or performing an MRI investigation is a poor indicator. If a surgery is planned one should perform precise neurological examination and obtain MRI of the scoliotic spine when in doubt.

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Correction of Adolescent Idiopathic Scoliosis Using Thoracic Pedicle Screw Fixation Versus Traditional Hook Constrcuts: A Single Surgeon Retrospective Review

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Objective: There is considerable controversy regarding the role of pedicle screws in the correction of thoracic spinal deformity. While pedicle screws offer several theoretical advantages, including more rigid fixation, improved correction, and decreased loss of correction with time, these advantages have not been examined rigorously in all cases. Furthermore, many surgeons have voiced concern about the potential for higher rates of neurological complications with their use. The purpose of this study was to retrospectively review the senior author's surgical outcomes comparing traditional hook constructs and constructs including thoracic pedicle screws for the treatment of adolescent idiopathic scoliosis.
Methods: A retrospective review of 25 consecutive cases of children with adolescent idiopathic scoliosis undergoing instrumented posterior spinal fusion by the senior author was conducted. Immediate preoperative and 6-week postoperative radiographs were examined and the patients were categorized into two groups: (1) those in whom the construct involved thoracic pedicle screws and (2) those in whom the thoracic construct was composed solely of hooks. The endpoints of interest included radiographic measures, complications, and revision surgery. Quality of life outcomes were measured using the Child Health Questionnaire (CHQ). Independent sample t-tests were used to determine whether there were any significant differences in these outcomes between the two patient groups.
Results: Among the 25 patients, 10 children underwent spinal fusion using thoracic pedicle screw fixation, and 15 children underwent thoracic constructs composed solely of hooks. The majority of the patients were girls (20 girls vs. 5 boys). The average age of the patients at the time of surgery was 14.5 years and did not differ between the two patient groups. The mean preoperative Cobb angle of the structural curve was 53.5 degrees for the screw group and 52.5 degrees for the hook group. The mean percent correction was 70.2% for the screw group and 68.1% for the hook group. There were no significant differences between the two patient groups in terms of percent change after surgery, absolute change after surgery, apical vertebral translation, or end vertebral tilt angle. There were no neurological complications in either group. There were no significant differences in quality of life outcomes between the two groups. The cost of constructs using thoracic pedicle screw fixation is significantly greater.
Discussion and conclusions: In the treatment of adolescent idiopathic scoliosis in this patient group, the correction obtained from thoracic pedicle screw fixation was comparable to traditional hook constructs. Our results represent the senior author's twenty-years of experience using segmental hook instrumentation and his initial experience using thoracic pedicle screw fixation. Both constructs are reliable in treating adolescent idiopathic scoliosis, with potential for excellent deformity correction and a high margin of safety. Because these constructs represent the senior author's early use of thoracic pedicle screw fixation, ongoing analysis may show improved correction with subsequent thoracic pedicle screw constructs.

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Pediatric Spine Deformity: Assessing Patient Outcomes and Quality of Life

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Objective: The objective of this study was to assess the validity of several new pediatric outcomes instruments in measuring the quality of life in children with scoliosis.

Methods: Parents of 279 children seeking care for spinal deformity completed both the Child Health Questionnaire (CHQ) and the American Academy of Orthopaedic Surgeons (AAOS) Pediatric Outcomes Data Collection Instrument (PODCI); the Scoliosis Research Society (SRS) instrument was completed directly by the affected children, as dictated by the developers of this measurement tool. The treating physician completed a subjective rating of physical and psychosocial health and documented pertinent socioclinical data for each child. Scores were compared with one another and to the clinical parameters using univariate statistics.

Results: Ceiling effects were noted for each instrument, particularly in the physical function and self esteem domains. However, patients with scoliosis scored significantly lower than previously published normative values for "healthy" children in several domains of the CHQ (t-test): physical function ($p<0.005$), role physical ($p=0.02$), bodily pain ($p=0.01$), parental time impact ($p=0.02$), parental emotional impact ($p<0.005$), behavioral scale ($p<0.005$), and family cohesion ($p=0.001$). Moreover, patients with larger curves exhibited larger detriments in health status as measured by the CHQ, supporting the face validity of this measure. In general, the CHQ exhibited superior psychometric characteristics over the AAOS-POI in this population. Four SRS domains were correlated with degree of curvature: physical function ($r=-0.17$, $p=0.008$), bodily pain ($r=-0.32$, $p<0.005$), self image ($r=-0.24$, $p<0.005$), and satisfaction ($r=-0.29$, $p=0.02$).

Discussion and conclusions: The CHQ, AAOS PODCI, and SRS measure all suggest that scoliosis has a negative effect on the physical and psychosocial health status of affected adolescents. The CHQ may be the most practical to administer and offers several advantages. Further work is necessary to better define the appropriate use of these health status measures in this unique population.

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Effect of Bracing on the Quality of Life of Adolescents with Idiopathic Scoliosis

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Introduction: While available data suggest that bracing may improve the natural history of adolescent idiopathic scoliosis patients with moderate curves, little attention has been paid to the potential impact of brace treatment on the psychosocial health and quality of life of adolescent patients. The purpose of this study was therefore to assess quality of life issues, including self-image, role function, and psychosocial health, in a cohort of patients under evaluation for adolescent idiopathic scoliosis and to examine differences between patients treated with a brace versus patients treated with observation alone.
Methods: Quality of life data was collected from all patients with a diagnosis of adolescent idiopathic scoliosis and a spinal curvature greater than 10 degrees at the Children's Hospital of New York between September 1997 to June 2001. Two new quality of life instruments were used to capture physical and psychosocial aspects of quality of life – the Child Health Questionnaire (CHQ) and the American Academy of Orthopaedic Surgeons (AAOS) Pediatric Outcomes Data Collection Instrument (PODCI). Parent responses to both questionnaires were used as proxies for their children. Regression and multivariate analyses were conducted to compare the two groups (brace versus observation group) and to determine the effect of age, gender, and Cobb angle on quality of life.
Results: Our patient cohort consisted of 130 patients, who were predominantly female (76%), with an average curve of 28 degrees and an average age of 13.6 years. Ninety patients were treated with observation alone (average curve 24 degrees), while 40 patients were treated with bracing (average curve 36 degrees). The quality of life in this group of adolescents with idiopathic scoliosis significantly differed from age-adjusted norms for three CHQ domains, all of which were higher in our patient group – behavior scale (p=0.001), self esteem (p=0.01), and parental-impact time scale (p=0.0003). Furthermore, regression analysis showed differences in several quality of life domains within this group of adolescents. Overall, girls tended to have higher quality of life scores, especially with respect to general health (p=0.0497), parent-impact time scale (p=0.03), expectations (p=0.042), and upper extremity & physical function (p=0.01). In addition, as the Cobb angle increased, quality of life tended to be lower, particularly on the parental-impact emotion scale (p=0.003) and the physical summary score (p=0.02). There were few differences in health-related quality of life between patients undergoing brace treatment versus those undergoing observation. Multivariable analysis with Bonferroni adjustment showed that braced adolescents had statistically higher quality of life scores in only one CHQ domain (parental impact-time scale, p=0.0498) and one PODCI domain (happiness, p=0.027). The remaining domains were not statistically significantly different between the two treatment groups.
Discussion and conclusions: While adolescent idiopathic scoliosis may affect quality of life in this patient group, patients treated with spinal bracing did not seem to have significantly different health-related quality of life, as compared with patients in the observation group.

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The Effect of Apical Vertebral Instrumentation in Surgical Treatment of King Type II Curves

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Aim: The aim of this study is to evaluate the effect of apical vertebral instrumentation in the surgical treatment of King type II idiopathic scoliosis.

Materials and Method: Seventy-six consecutive patients with King type II idiopathic scoliosis, treated with posterior spinal instrumentation were included into the study. The mean age was 14.5 years (10-18), and the mean follow-up was 49 (28-74) months. Preoperative radiological evaluation was performed with posteroanterior, lateral, traction and side-bending radiograms. Vertebral rotation was measured with Perdriolle torsion-meter. Patients were retrospectively divided into two groups according to the presence of apical vertebra instrumentation. Group 1 consisted of 43 patients and both upper and lower neutral and intermediate vertebrae of thoracic curves were instrumented on concave side. In Group 2, there were 33 cases and instrumentation of apical vertebra on the concave side was added to the configuration of Group 1. Posterior fusion was added in all patients. Thoracic and lumbar Cobb angles, sagittal plane measurements and axial plane measurements were compared between two groups both preoperatively and at the last follow-up.

Results: Preoperative age-gender distribution, Cobb angle and rotational measurements, and correction ratios on side-bending films were similar in both groups. Although, preoperative mean values of both thoracic and lumbar Cobb angles, sagittal plane measurements and apical rotation were not statistically significant between two groups ($p>0.05$), postoperatively, mean values of apical rotation were significantly different ($p<0.05$). At the same time, apical derotation ratios were significantly different between Group 1 and 2 ($p=0.000$).

Conclusion: We conclude that, instrumentation of apical vertebra provides better derotation at the apex of the King type II curves.

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Assessment of Curve Flexibility in Adolescent Idiopathic Scoliosis

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Purpose: Along with magnitude, flexibility of a scoliotic curve has always been a major determinant for preoperative planning and surgical outcome for adolescent idiopathic scoliosis (AIS). The purpose of this study was to use and evaluate mostly accepted or described radiologic techniques or methods to determine flexibility and compare the results to those obtained by supine traction X-rays under general anesthesia just before surgery and correlate all findings to surgical correction.
Methods: 34 consecutive AIS patients who had surgical treatment were studied. 25 were female, 9 were male and average age was 15.7 (12-19) years. Preoperative radiologic evaluation consisted of standing AP and lateral, supine lateral bending and traction, fulcrum X-rays and also supine traction X-rays under general anesthesia (GA) just before surgery. All structural curves were measured and flexibility ratio was determined on each radiograph. Calculated values were correlated with amount of surgical correction achieved by pedicle screw instrumentation.
Results: Curves were accepted to be moderate if between 40° and 65° (29 patients) and severe if >65° (5 patients). In these 29 patients, average frontal Cobb angle of the thoracic and lumbar curves were 39.7° (40° -60°) and 39.4° (22° -58°) respectively. Average thoracic curve flexibility was 49 % (23 %-64 %) at traction, 79 % (30 %-88 %) at traction under GA, 66 % (25 %-82 %) upon lateral bending and 74 % (50 %-87 %) at fulcrum X-rays. Average surgical correction of the thoracic curve was 76 % (52 %-95 %). Average lumbar curve flexibility was 56 % (35 %-73 %) at traction, 59 % (39 %-72 %) at traction under GA, 81 % (61 %-100 %) upon lateral bending and 83 % (66 %-100 %) at fulcrum X-rays. Average surgical correction of the lumbar curve was 74 % (44 %-100 %). In the other group of 5 patients, average frontal Cobb angle of the thoracic and lumbar curves were 79° (47° -110°) and 67° (38° -90°) respectively. With the same order above, average thoracic curve correction was 35 % (29 %-38 %), 52 % (49 %-58 %), 43 % (35 %-55 %) and 45 %(41 %-50 %). Also average lumbar curve correction was 40 % (32 %-50 %), 60 % (45 %-79 %), 51 % (40 %-65 %), 53 % (38 %-69 %). Average surgical correction of the thoracic and lumbar curve in this group were 68 % (64 %-72 %) and 63 % (42 %-79 %) respectively.
Conclusion: Traction under GA > fulcrum > bending > seems to be the order of X-rays for better predicting flexibility and correction in curves > 65°. Pedicle screw instrumentation however provides even more correction than are obtained by traction under GA. On the other hand fulcrum > bending > traction under GA > is the order of X-rays for better predicting flexibility and correction in curves between 40°-65°. Amount of surgical correction in this group is either close or equivalent to correction at fulcrum x-rays. Traction X-ray under GA may show much better flexibility and thus, it may eliminate the need for anterior surgery in seemingly rigid, > 65° curves.

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Evaluation of Titanium Mesh Cages Used for Anterior Column Support Following Corpectomy in the Thoracic and Lumbar (T1-S1) Region with Minimum Two-Year Follow-up

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Purpose: There are some studies on mesh cages used as interbody fusion devices after discectomy. To our knowledge, there is no clinical study analyzing titanium mesh cages (TMC) used for anterior column support following corpectomy. Our purpose was to evaluate the clinical and radiologic results and complications after thoracic and lumbar level corpectomy and reconstruction using TMC with either anterior instrumentation, posterior instrumentation or a combination of all and to determine ideal configuration.

Methods: 29 adult patients who had thoracic and/or lumbar corpectomy for various reasons (17 fractures, 5 spinal tuberculosis, 5 deformity) were included. Average age was 48.6 (17-86) years and follow-up ranged from 24 to 56 (mean, 28) months. Total 36 level corpectomy (min 1, max 4 levels) was performed. Structural TMC filled with autogenous bone graft was used for anterior column. In addition to TMC and on the same day, 2 had only anterior, 20 had only posterior and 7 had anterior and posterior instrumentation. Standing AP and lateral, supine AP, lateral and both oblique X-rays and high resolution CT reconstruction have been used to assess fusion status for TMC in the anterior column. Sagittal Cobb measurements were obtained across all consecutive levels containing anterior TMC for every patient's preoperative, immediate postoperative and 2 year postoperative radiographs. Besides the status of anterior and posterior instrumentation, anterior cage status was assessed for settling, migration and/or fatigue. Fusion status for TMC was assessed according to a previously published (Bridwell et al, 1995) fusion grading system. More than 2mm settling and 4° correction loss were accepted to be significant.

Results: Mean immediate postoperative sagittal correction was 25.6° (8°-60°). Mean correction loss was 0.9° (0°-8°). There was no failure of anterior and posterior instrumentations. No cage failure or migration was observed. There was no pseudarthrosis and fusion was achieved in all patients. 6 (20.6 %) showed cage settling of more than 2mm. Of these 3 had more than 4° and 3 had less than 4° correction loss. These patients with significant settling and correction loss were either osteoporotic with damaged end-plates or no end-plate collar was used in the TMC.

Conclusions: The configuration consisting of TMC+anterior single rod instrumentation+short segment posterior instrumentation after corpectomy involves no correction loss and cage settling and seems to be the ideal solution. There is a risk of correction loss and cage settling in osteoporotic patients when only short segment posterior instrumentation is used, especially with no end-plate collar in the TMC.

Posterior instrumentation after corpectomy should be two level above and below in patients with previous laminectomy and serious sagittal plane deformity.

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Thoracic Adolescent Idiopathic Scoliosis: Correction With Translation Using Polyaxial Reduction Screws

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Introduction: Since the introduction of Cotrel-Dubousset instrumentation for three dimensional correction of scoliosis using rod rotation maneuver, newer techniques have been developed providing reduction through translation. In these techniques, translation is mainly achieved by using sublaminar wiring and pedicle hooks. Widespread use of thoracic transpedicular screws, the possibility to use polyaxial reduction screws for translation has appeared.

Material Method: 65 adolescent idiopathic scoliosis (AIS) patients with thoracic deformities have been treated with posterior instrumentation and fusion between 1996-2001. Transpedicular screws were used in all of these instrumentations (Synergy Spinal System, Moss Miami). Reduction screws placed on the concave side of the deformity were tightened and the vertebral column was gradually approximated to the rod, providing correction. Thoracoplasty was performed in 52 of the patients within the same session.

Results: Mean follow-up was 28 months (range 14-70 months). Mean preoperative Cobb angle was 56° (range 40°-92°), while postoperatively it decreased to 12° (range 0°-28°). Mean ratio of correction was found to be 78% (range % 56-100). No neurological complication was encountered. Frontal imbalance was noted in four patients in the early postoperative period, which were controlled with braces.

Conclusion: Significant correction may be achieved in thoracic AIS through posterior instrumentation with polyaxial reduction screws. Additional thoracoplasty provides a better cosmetic outcome.

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Does Fulcrum Bending Predict Postoperative Correction in Adolescent Idiopathic Scoliosis King-Moe Type III Curves?

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Study Design: A retrospective evaluation of radiographs in patients who underwent posterior spinal fusion for adolescent idiopathic scoliosis with King-Moe type III curves

Objective: To determine the most effective preoperative radiographic method for evaluating frontal plane correction by comparing preoperative side bending, traction and fulcrum bending radiographs and postoperative correction.

Methods: Preoperative frontal radiographs of 14 consecutive patients undergoing spinal fusion for King-Moe type III adolescent idiopathic scoliosis obtained while standing, lying supine, side-bending (maximally bending while supine), and fulcrum-bending (curve apex suspended over a radiolucent fulcrum while lateral) were compared with standing postoperative radiographs. Cobb angles were determined and evaluated for statistical significance.

Results: Mean preoperative thoracic Cobb angle was 50.9 degrees (SD 11.7; min 32 max 72 degrees) whereas lumbar Cobb angles measured 24.5 degrees (SD 6.1; range 10-30 degrees). Preoperative side bending, traction and fulcrum bending radiographs revealed 33.1 degrees (SD14), 37.5 degrees (SD: 13.5) and 25.4 (SD: 11.6) respectively. Postoperative Cobb angles measured 14.4 degrees (SD: 6.7). The difference between preoperative and postoperative values was statistically significant ($p<0.005$). The fulcrum-bending radiograph demonstrated better correction than other preoperative methods for main thoracic curves but under estimated the correction obtained surgically. Side bending radiographs predicted better correction for lumbar curves.

Conclusion: To achieve maximal preoperative correction, thoracic fulcrum-bending radiographs should be obtained for evaluating main thoracic curves, whereas side-bending radiographs are advisable for evaluating lumbar curves.

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Gait Analysis Before and After Posterior Fusion in Unbalanced Adolescent Idiopathic Scoliosis

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Objective: To determine the most effective preoperative radiographic method for evaluating frontal plane correction by comparing preoperative side bending, traction and fulcrum bending radiographs and postoperative correction.

Methods: Preoperative frontal radiographs of 14 consecutive patients undergoing spinal fusion for King-Moe type III adolescent idiopathic scoliosis obtained while standing, lying supine, side-bending (maximally bending while supine), and fulcrum-bending (curve apex suspended over a radiolucent fulcrum while lateral) were compared with standing postoperative radiographs. Cobb angles were determined and evaluated for statistical significance.

Results: Mean preoperative thoracic Cobb angle was 50.9 degrees (SD 11.7; min 32 max 72 degrees) whereas lumbar Cobb angles measured 24.5 degrees (SD 6.1; range 10-30 degrees). Preoperative side bending, traction and fulcrum bending radiographs revealed 33.1 degrees (SD14), 37.5 degrees (SD: 13.5) and 25.4 (SD: 11.6) respectively. Postoperative Cobb angles measured 14.4 degrees (SD: 6.7). The difference between preoperative and postoperative values was statistically significant ($p<0.005$). The fulcrum-bending radiograph demonstrated better correction than other preoperative methods for main thoracic curves but under estimated the correction obtained surgically. Side bending radiographs predicted better correction for lumbar curves.

Conclusion: To achieve maximal preoperative correction, thoracic fulcrum-bending radiographs should be obtained for evaluating main thoracic curves, whereas side-bending radiographs are advisable for evaluating lumbar curves.

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Combined Anterior-Posterior Arthrodesis for Adult Lumbar and Thoraco-Lumbar Scoliosis

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Introduction: Adult Lumbar and thoracolumbar scoliosis curves have a higher risk of degeneration and are more likely to be associated with pain. Surgical treatment of these deformities often requires a combined anterior-posterior fusion from thoracic spine to L4, L5 or the sacrum in order to correct rigid deformity, maintain lumbar lordosis and increase fusion rate. Outcome and complication rate differences for fusion to L4, L5 or the sacrum of these adult deformities is not well documented.

Purpose of this study is to investigate the outcome and complication rate of combined anterior-posterior arthrodesis to L4 vs L5 vs Sacrum in patients with painful adult lumbar and thoracolumbar scoliosis.

Material and Methods: Forty consecutive adult patients with lumbar or thoracolumbar scoliosis who had undergone a combined anterior and posterior fusion from the upper thoracic spine to L4 (12), L5 (6) or to the Sacrum (22), with an average age of 53 years (25-78), and a minimum follow- up of two years were included in this study. Peri-operative and long term complications were analyzed and outcome data was obtained by using the modified SRS outcome instrument.

Results: Sixteen patients (40%) had peri-operative minor or major complication. There were thirteen long-term complications. Over all there were more complications in patients fused to the sacrum (13 patients-32.5%) than in fusions to L4 or L5 (6 patients-15%). Patients with short fusions were assessed for degenerative changes distal to the fusion. Three patients had fusions to L4 and three had fusions to L5 had radiographic degenerative changes. Only two patients fusion to L5 had clinical symptoms related to these degenerative changes. The average structural curve correction was 55% for the entire group, with no statistical difference among the groups. Modified SRS outcome instrument score for fusion to the sacrum (73%) was less than for fusion to L5, L4 (83%). Patients with fusions to sacrum scored lower in all categories than fusions to L5 or L4.

Conclusion: Patients with fusion to the sacrum had a higher complication and a lower outcome score. Despite a high complication rate, 86% of our patients were satisfied with their overall outcome and 89 % of patients would have the same management again. Combined anterior and posterior arthrodesis for painful adult lumbar and thoracolumbar spinal scoliosis provides a predictable correction of the deformity, excellent pain relief, and an extremely high patient satisfaction rate in patients for whom this extensive surgery is indicated.

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Treatment of Thorocolumbar Scoliosis with Anterior Instrumentation; Adults vs. Adolescent

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Introduction: Recent reports have shown excellent deformity correction and high patient satisfaction with anterior spinal fusion in well selected patients However comparisons between these two groups, have not been reported. Objectives of this study are to evaluate the efficacy of anterior instrumentation and compare radiographic and clinical outcomes of anterior spinal fusion in these two patients populations.

Methods: A retrospective review of 30 consecutive cases with minimum 24 months follow-up in which anterior spinal fusion of thoracolumbar and lumbar idiopathic scoliosis in adults and adolescents was performed. One adult and one adolescent were lost to follow-up.Charts were reviewed, and pre- operative, post-operative, and final follow-up films of the entire spine were evaluated. Modified SRS Outcomes Instrument (MSRSI) used for clinical outcome evaluation.

Results: The average pre-operative major curve was similar in both groups which improved to 13 degrees at follow-up, with a 73% correction. The thoracolumbar sagittal plane alignment (T11-L4) was –15 degrees preoperatively and –13 degrees postoperatively. On average 1.1 levels were "saved". Follow-up MSRSI total outcome scores averaged 85%, and scores were high within the following domains without difference between adults . and adolescents. There were significant differences in post-op curve, curve correction, flexibility and number of "saved disks" (Table 1).

Conclusions: The radiographic and clinical outcomes of anterior spinal instrumentation and fusion in this select group of adults and adolescents are highly satisfactory. Significant differences were found in numbers of discs saved, flexibility of pre-operative curves, and final post-operative correction of the major curves. Adults presented with pain, while adolescents presented with cosmetic complaints and curve progression. Although the absolute primary curve magnitudes were similar, the more rigid curves adults require longer fusion constructs to allow adequate balancing of the spine in the coronal and sagittal planes.

Table 1: Results

	Age	Follow-up (min. 24 months)	Preop-Major curve	Curve Flexibility	Post-op Major curve	Major Curve correction	Saved disks	MSRSI
Adult	37	47	51°	63%	17°	68%	0.6	82%
Adolescent	16	46	49°	79%	10°	80%	1.5	88%
Total	27	47	50°	70%	14°	73%	1.1	85%
p	<0.05	>0.05	>0.05	<0.05	<0.05	<0.05	<0.05	>0.05

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Trunk Balance Analysis of Late Onset Idiopathic Scoliosis Patients Treated with Tsrh Instrumentation

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As scoliotic curve is a rotational deformity, derotation maneuvre was used as the corrective factor, but recent studies demonstrated spinal imbalance and decompensation problems in patients treated with this method. This study evaluates 217 late onset idiopathic scoliosis patients surgically treated Texas Scotish Rite Hospital System (TSRH) from September 1991 to November 1996 with a minimum 5 years follow up. Preoperative and postoperative Cobb angles in the frontal plane and thoracic kyphosis and lumbar lordosis angles in the sagittal plane are measured. The balance was analyzed clinically and radiologically by measurement of the lateral trunk shift (LT), shift of head (SH) and shift of stable vertebra (SS) in vertebral unit (VU). At final follow - up correction loss, infection and other complications were documented. Mean age of the patients was 14.8 ± 2.3 and mean follow up period 91.8 ± 29.5 months. When all the patients were included, preoperative mean Cobb angles of major curves in the frontal plane was 59.1° ± 20.7°. Major curves that were corrected by 34.8 ± 20.5 % in the bending radiograms were achieved by 58.9 ± 19.5 % correction postoperatively. At the last control, 8.6° ± 7.4° of correction loss was recorded in major curves in the frontal plane. Also postoperative kyphosis angle and lumbar lordosis angles were 31.4 ° ± 11.6 ° and 30.6° ± 10.9° respectively. Postoperatively, a statistically significant correction was obtained in LT, SH and SS values. None of the patients had complete balance (SH: 0 VU, SS: 0 VU) preoperatively. Only 39.2 % of the patients had clinically balanced curves (0 VU < SH < 0.5 VU and 0 VU < SS < 0.5 VU). Postoperatively, 47.9 % of the patients were found to be completely balanced, while 43.8 % had a balanced curve. Overall 91.7 % of the patients had a trunk balance after surgical intervention. The remaining 8.3 % imbalanced curve rate raised up to 16.6 % at final follow up, but the loss of correction rates in SS and SH values were found to be insignificant. The postoperative "imbalance" problem was mostly seen in Type II and Type IV curves. However, at final follow up, the imbalance problem due to overcorrection which became evident especially by "shift of head" to opposite side was seen in all types of curves. It is established that high correction rates can be obtained in scoliotic curves with TSRH instrumentation. No undue effects were observed in the uninstrumented lumbar curves. Thoracic sagittal contours of the hypokyphotic patients were improved. Use of this instrumentation system causes minimal imbalance problems and with proper preoperative planning high correction rates can be achieved.

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Neural Axis Abnormalities Determined by Mri in the Patients with Type III Idiopathic Scoliosis

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Purpose: Evaluate the existence of neural axis abnormalities by magnetic resonance imaging (MRI) in patients who have clinically and radiological absolute flexible thoracic curves (King – Moe Type III).

Study Plan: There are additional congenital deformities in some patients who are considered to have idiopathic scoliosis. On the other hand MR scanograms revealed neural axis abnormalities especially in patients with infantile and juvenile rigid idiopathic scoliosis. In this study preoperative, MRI graphs of 84 patients (average age 14.1 ± 3.6) with adolescent idiopathic scoliosis who had flexible thoracic curves were evaluated prospectively. Clinical and radiological indications for MRI are investigated according to these results.

Results and Conclusions: Five patients (5.9 %) were found to have syringomyelia while diastometamylia was found in 1 (1.2 %) patient. The finding of 7.1 % neural axis abnormality in patients with type III curves – the curve type which is not expected to be in association with these kind of abnormalities – is a considerably high rate and this result supports the idea that intraoperative neurologic monitorization is absolutely essential to minimalize the risk of neurological deficits. This study did not reveal any clinical or radiological indicator for preoperative MRI. As results, preoperative MRI is essential to minimalize the neurological deficit risks, to determine the type of treatment and prognosis even in Type III curves unless intraoperative neurologic monitorization is available.

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Anterior Fusion and Instrumentation in the Treatment of Congenital Spinal Deformities

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Study design: An analysis of the effect and results of anterior fusion and instrumentation in fourteen patients treated for congenital spinal deformity.

Summary of Background Data: Posterior arthrodesis have been used in wide series with success to treat the congenital deformities. But necessity for fusion of long segments, crankshaft phenomenon especially in Risser 0 patients with open triradiate cartilages, risk of pseudoarthrosis, being unable to perform hemivertebra excision are disadvantages. Anterior fusion and instrumentation mostly used in idiopathic cases is reported to have the advantage of providing triplanar correction while sparing distal segments.
To our knowledge, there is no reported series about anterior fusion and correction with anterior instrumentation of congenital spinal deformities in the literature.

Objectives: The degree of correction obtained and maintained, changes in sagittal profile, pelvic obliquity, spinal alignment, balance, and complications were evaluated.

Methods: Diagnosis was scoliosis in six cases, kyphoscoliosis in eight cases. Mean age at operation time was 11.2 years (range, 4 to 18 years). Postoperative follow up averaged 18 months (range, 12 to 49 months)

Results: Regarding coronal plane deformity, average index curve was 54 degrees preoperatively; 32 degrees at the time of discharge from the hospital and 34 degrees at the latest follow up. Early average correction obtained was 22 degrees (41%). Eight curves in coronal plane were better compared with the preoperative radiograph of the best side bend, by an average of 10 degrees. In eight cases of kyphoscoliosis sagittal plane deformity improved from 65 degrees to 40 degrees at the time of discharge from the hospital and 43 degrees at the latest follow up with an early average correction of 25 degrees (% 38). The sagittal profile changes in cases with isolated coronal plane deformity were evaluated; no progressive kyphosis greater than 10 degrees was observed. Increase in kyphosis averaged 7 degrees. Lumbar lordosis did not change significantly. Pelvic obliquity existing preoperatively in 10 cases improved from 9,2 (3-20) degrees to 5,1(0-13) degrees postoperatively. Preoperative decompensation of 2,4 (0,5-9) cm improved to 1,3 (0-4,5) cm postoperatively. Preoperative trunk shift of 5,5 (3,1-11) cm was corrected to 4,2 (0-10) cm postoperatively. Junctional kyphosis above the level of most proximal level of instrumentation (T11) occurred in one case of kyphoscoliosis and pseudoarthrosis was observed in a case of scoliosis. No neurological complication occurred.

Conclusion: Anterior instrumented fusion is an effective and safe method for obtaining and maintaining correction of congenital spinal deformities.

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Pain In Patients With Scoliosis and Syringomyelia

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Background/Purpose: In patients with scoliosis [SC] pain is an indication for further investigation for intraspinal abnormalities such as syringomyelia [SM], Arnold-Chiari Malformation [ACM], and tethered cord. However, there has not been much known about the pain pattern and relationship between pain and syrinx in these patients. The main purpose of this study was to investigate the pain found in patients with SC and SM.

Methods: The records of 119 patients with SC associated with SM were analyzed. Patients with congenital SC and myelomeningocele [MM] were included, whereas patients with SM associated with tumors, trauma, and arachnoiditis were excluded. The mean follow-up was 11.8 years.

Results: Seventy patients (59%) had associated spine pain, at the average age of 18.1 years (range, 3.1-47.6 years). Pain was present at the time of the initial diagnosis of the SC in 23 patients (19.3%). In the remaining 47 patients, the onset of pain occurred from 1.5 months to 44.5 years after initial SC diagnosis. Thoracolumbar pain was the most frequent (47.1%) location of pain; headaches (32.9%) and cervical pain (28.6%) were also encountered. Among the 70 patients with pain, 32 patients (46%) continued to have pain at late follow-up.

The incidence of headaches was higher in patients with MM ($p=0.032$). The presence of headache also increased with the presence and severity of an ACM ($p=0.027$). There was no significant correlation between the size of syrinx as measured by the maximal diameter and the length of the syrinx and the presence of pain ($p>0.05$). The only relationship between location of syrinx and type of pain was the significant correlation between presence of lower extremity radicular pain and more caudally located syrinx ($p<0.05$).

Conclusions: (1) Pain is a fairly frequent (59%) accompaniment in these patients. (2) Pain may develop after the initial diagnosis of scoliosis, and inquiry for presence of pain should be conducted throughout follow-up visits. (3) Pain persisted at late follow-up in approximately one-half of the patients. (4) The presence of leg pain in a patient with scoliosis should raise the suspicion of a caudally located syrinx. (5) There appears to be no correlation between size of syrinx and presence of pain.

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The Efficacy of Convex Hemiepiphysiodesis in Patients with Iatrogenic Posterior Element Deficiency due to Diastematomyelia Excision

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Purpose: Anterior and posterior convex hemiepiphysiodesis is a well accepted treatment method for severe and progressive congenital scoliosis in young children. Many patients with congenital spinal deformities have intraspinal pathologies that require neurosurgical intervention with laminectomy. The efficacy of this method has not been studied in these patient populations. The purpose of this study is to investigate the safety and efficacy of anterior and posterior hemiepiphysiodesis in patients with iatrogenic posterior element deficiency.

Materials and Methods: Between 1990-2001, 82 patients with congenital spinal deformity were treated with convex epiphysiodesis. Sixteen patients (2 male, 14 female) who underwent diastematomyelia excision and were followed up for at least 2 years were included. Diastematomyelia excision was performed before the orthopaedic procedure in 8 patients and at the same stage in 8 patients. Mean age at the time of the fusion was 18 months (6-48) and, average follow-up was 41 months (24-120).

Results: The mean Cobb angle was 58° (31-115) preoperatively and, 54° (30-90) at final follow-up. Any increase more than 6 degrees was accepted as progression. Seven patients (44%) had a true epiphysiodesis effect [64° (40-115) preoperatively, and 49° (30-90) at follow-up]; 7(44%) patients had a fusion effect [50° (31-68) preoperatively and 53° (36-73) at follow-up]. Two patients (12%) had a postoperative progression of deformity [63° (54-72) preop. and 75° (65-84) follow-up].

Conclusion: Convex epiphysiodesis is an effective method in patients with midline laminectomy defect as is in the patients with intact posterior elements. Since the facet joints and transverse processes are usually unaffected, the presence of midline defect does not diminish the efficacy of the technique.

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Analysis of Upper and Lower Thoracic Kyphosis in Healthy Individuals

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Objective: To determine if there is any interaction between upper and lower thoracic kyphotic segments, as well as to analyze their variation with age and sex.

Methods: This prospective study includes 157 healthy individuals without any complaints related to their spine, and a thoracic kyphosis of not more than 50 degrees. Subjects were evaluated by medical history, physical examination, and standing spinal roentgenograms. Cases with prior history of spinal trauma, surgery, or other abnormalities and pathologic conditions were excluded. Age and sex of the patient, together with the degree of upper (T1-5), lower (T5-12) and the whole (T1-12) thoracic kyphosis -measured by the Cobb method- were the parameters used for statistical analysis.

Results: There were 49 male and 108 female with the mean age of 42±16 years (range, 11-76). Mean values of the upper, lower, and whole thoracic kyphosis were found to be 13±6° (range, 2-30°), 21±8° (range, 4-43°), and 34±9° (range, 11-50°), respectively. No significant differences for any parameter could be detected between men and women. Increasing age correlated to a higher degree of kyphosis in the lower thoracic segment, without an increase in the upper thoracic kyphosis (Pearson correlation test, c=0.222, p=0.007, c=-0.038, p>0.05, respectively). There was also a negative correlation between the degree of the upper and lower thoracic kyphosis (Pearson correlation test, c=-0.194, p=0.015), suggesting that one segment has the capability to decrease for some amount, when the other segment is increasing in healthy individuals.

Discussion: Degree of upper thoracic kyphosis reported by Gelb et al. [Spine 20(12):1351-3, was almost the same as ours [14±8° (range, -4-35°)]. Taken into consideration that the average age of their patients were higher than ours (57 years), the finding that the degree of lower thoracic kyphosis was higher than ours was also in consistency with our finding that the lower thoracic kyphosis increases with age. In addition, by using the data of this previously published series, the interaction (negative correlation) between the upper and lower thoracic kyphosis could also be demonstrated (Pearson correlation test, c=-0.245, p=0.046).
The interaction between the upper and lower thoracic kyphosis could also be demonstrated by using the data of a previously published study of Gelb et al. [Spine 20(12):1351-3, 1995], (Pearson correlation test, c=-0.245, p=0.046).

Conclusions: Kyphosis of upper thoracic segment did not change with age, whereas, there was a significant increase of kyphosis in the lower thoracic segment. In addition, there seems to be an interaction (negative correlation) between the upper and lower thoracic kyphosis, suggesting that there is some amount of "compensation" between each other in healthy individuals.

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TUMORS/INFECTION

(September 6, Friday;14:30-16:00)

Moderator: *Takeshi Fuji, Tarik Yazar*

TI-01 Combined Anterior-Posterior Surgical Treatment for Adult Thoracolumbar Pott's Disease
Mehmet Tezer, Erden Erturer, Cuneyt Erken, Irfan Ozturk, Unal Kuzgun

TI-02 Risk factors of postoperative deep wound infections in spinal instrumentation, analysis of 869 cases
Cem Ozan Ardic, Can Kosay, Omer Akcali, R.Haluk Berk, Emin Alici

TI-03 - Withdrawn -

TI-04 Surgical Outcome of Primary Benign and Malignant Spinal Tumors
I.Teoman Benli, Serdar Akalin, Mahmut Kis, Sukru Solak, Erbil Aydin, Evrim Duman

TI-05 Treatment of Vertebral Body Replacement with Expandable Titanium Cages
Benjamin Ulmar, Balkan Cakir, Markus Richter

TI-06 Surgical Approach in T4N0M0 (Vertebral Involvement) Lung Cancer
Ufuk Aydinli, Cengiz Gebitekin, Sami Bayram, Salim Ersozlu, Cagatay Ozturk

TI-07 Surgical Outcome of Metastatic Spinal Tumors
I.Teoman Benli, Mahmut Kis, Serdar Akalin, Mehmet Citak, Sukru Solak, Erbil Aydin

TI-08 Failures in oncologic surgery of the spine: causes and treatment
S.Boriani, S.Bandiera, A.Gasbarrini, F.De Iure

Combined Anterior-Posterior Surgical Treatment for Adult Thoracolumbar Pott's Disease

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Introduction: Tuberculosis, which is closely related to socioeconomic structure, continues to be a major cause of morbidity and mortality worldwide. In endemic regions, bone penetration has an incidence of 10% for tuberculosis and 50% of these cases are Pott's disease. Two basic problems of the disease are development of vertebral deformity and neurological deficit.

Materials and methods: 16 adult patients with Pott's disease underwent anterior debridement, and strut grafting, followed by posterior instrumentation and fusion between 1995 and 2001. 14 cases with sufficient follow-up time have been evaluated. 6 women and 8 men patients had a mean age of 36 (21-70). Locations were thoracic in 4, thoracolumbar in 7, lumbar in 2 and lumbosacral vertebrae in 1 case. Tricortical iliac and costal grafts were used in 7 cases whereas fibular and costal grafts in 3, only costal in 2, femoral allograft in 1, and titanium cage in 1 case for anterior stabilization. Posterior procedure included pedicular screw-hook combination for instrumentation, and fusion. Postoperative chemotherapy was applied for 9 months. All cases were defined via culture and/or histopathological examination. Mean follow-up period is 36,3 months (12-78).

Results: 4 cases with Frankel A and C preoperatively upgraded to D whereas 5 cases with Frankel D upgraded to E. 5 cases with Frankel E conserved their levels. Mean preoperative kyphotic angle of 27 (4-56) has been measured as 12 (4-22) in early postoperative period. In late follow-ups, mean kyphotic angle was measured as 16,8 (5-40) with a mean correction loss of 6,8. Mild low back pain was the only complaint in 5 cases. No problem was observed concerning anterior strut grafting. Posterior deep wound infection in one case was eradicated after extraction of instruments when solid fusion was obtained in 8th month. Infection did not relapse in any of the cases.

Conclusion: Basic aims in treatment of vertebral tuberculosis are eradication of active infection, prevention of deformity and paraplegia. Infection can be controlled by chemotherapy. But chronic sagittal imbalance can best be corrected via anterior approach and strut grafting. Posterior instrumentation prevents graft fracture, resorption and insufficiency. It decreases rate of pseudoarthrosis and permits early ambulation.

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Risk Factors of Postoperative Deep Wound Infections in Spinal Instrumentation, Analysis of 869 Cases

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Aim: Postoperative deep wound infection is a major and devastating complication of spinal instrumentation. The aim of this study is to determine and evaluate the risk factors of postoperative deep wound infections in spinal instrumentation.

Materials and Methods: The study group includes 29 deep wound infection cases and age, sex, etiology matched 92 control cases among 869 cases with spinal instrumentation between 1989 and 2000. Cases were also grouped as early and late onset infection cases and their matched control groups. Recorded variables were age, sex, etiology, body mass index, year, duration and type of operation, implant material, number of segments involved, paraplegia, duration of preoperative hospitalization, duration of urinary catheter, history of smoking, polytrauma. Possible other factors not available for statistics were given 1 point each and cumulating was computed as a risk factor (diabetes mellitus, massive transfusion, long stay in ICU, pre and post long-lasting wound drainage etc.). Chi-square, students-t, mann-whitney-u, anova tests and logistic regression model were used for statistics.

Results and Conclusion: Logistic regression analysis revealed that the most important risk factors were staged surgery ($p = 0,005$), preoperative hospitalization more than 4 days ($p = 0,042$), polytrauma ($p = 0,012$), paraplegia ($p = 0,039$), having more than 1 point of other possible factors cumulating ($p = 0,005$). Duration of urinary catheters ($p = 0,007$), duration of operation (more than 210 minutes, $p = 0,022$) and segments involved (segments between 4-7, $p = 0,006$) were other risk factors in decreasing importance. Body mass index was a risk factor for adult patients ($p=0.024$). Staged spinal surgery increased risk of infection 6 times (risk is 10.5 times higher in early onset group), and hospitalization preoperatively more than 4 days increased risk of infection 6 times (risk is 5.3 times higher in early onset group).

For late-onset infection group, only duration of urinary catheters and having more than 2 points of other possible factors was found to be important risk factors ($p = 0,009$ and $p=0,040$ respectively).

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Surgical Outcome of Primary Benign and Malignant Spinal Tumors

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The objective of surgical treatment in painful and disabling spinal tumors is the pathological identification of the tumor, neurological decompression, establishment of spinal stability and maintenance of a comfortable life span. Twelve benign (BPST) and 17 malignant primary spinal tumors (MPST) cases were assessed according to their clinical, radiological and surgical outcome in this study. The average age of BPST and MPST cases were 48.1 (7–66) years and 51.6 (13-65) years respectively. Computerized tomography (CT) and magnetic resonance (MR) was obtained for radiological assessment. Together with Enneking classification, Weinstein – Boriani (WBB) surgical staging was used for surgical planning. Benign tumors were most commonly located in L1 vertebra. The average of affected vertebra was 1.1±0.4 and the most common BPST types were eosinophilic granuloma (3 patients), aneurysmal bone cyst (3 patients) and hemangioma (3 patients). Following en-block resection, neurological findings of patients with BPST recovered 100 %. Anterior approach, autologous strut grafting and anterior instrumentation was carried out in 9 patients, while posterior approach, autologous fusion and instrumentation was preferred in 3 patients. The involvement of mobile segments in the fusion area was 3 in the cervical, 2.6 in the thoracal and 2 in the lumbar region. Sagittal contours improved significantly by this method. Total pain relief was observed in 7 patients while pain decreased significantly in the remaining 5 BPST patients. In 17 MPST patients, the average of involved vertebra was 1.8±1.1, all patients were Enneking stage II B and the involvement according to WBB was between 4 and 9. All patients underwent anterior vertebrectomy. 13 had anterior or fusion and autologous strut grafting, while posterior autologous fusion and instrumentation at the same session was the method of treatment in the remaining 4 patients. An average of 3.2±1.7 mobile segments was obtained by this method. Eight of the MPST patients had preoperative neural deficits. The rate of total recovery following surgery was 75 % and improved in neurological status was observed in 25 % patients. The most common type of lesion was multiple myeloma followed by plasmocytoma and osteosarcoma. The preoperative pain – functional assessment (PFA) score decreased from 16.9 to 10.0 ($p < 0,05$). In conclusion, en-block tumor excision, anterior strut grafting and / or anterior or posterior instrumentation in the same session is effective in the maintenance of spinal stability, relief of pain, recovery of neural symptoms and improved functional capacity.

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Treatment of Vertebral Body Replacement with Expandable Titanium Cages

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Introduction: Instabilities of different origin with insufficient anterior column support due to destruction of the vertebral bodies should be stabilized and the anterior column should be restored. This can be done with the anterior distraction device (ADD, Ulrich Medizintechnik, Ulm, Germany) in the cervical spine combined with an anterior plate and in the thoracic and lumbar spine with the vertebral body replacement (VBR, Ulrich Medizintechnik, Ulm, Germany) combined with an posterior instrumentation. Both implants, the ADD and the VBR are continuously in situ distractible devices.

Methods: Between April 1997 and March 2002, 39 patients were treated with vertebral body replacement in the orthopedic department of the University of Ulm. Average age of patients was 59,4 years (range: 38,3 - 77,9 years), 14 of them have male and 25 female gender. The diagnosis was in 21 cases vertebral body destruction by tumour or metastasis, in 14 cases unstable osteoporotic and in 4 cases traumatic fracture of the vertebral bodies. In the tumour patients there were in 6 cases metastasis of breast cancer, in 5 metastasis of an kidney tumour, in 4 cases plasmocytoma and 1 patient with the metastasis of a prostata-, bronchial-, oropharynx-, uterus-, nasal mucous membrane carcinoma and osteosarcoma of the vertebral body, respectively. The average follow-up was 14,5 months (range 3,1 - 56,4 months).
Results: Tumour embolisation was performed in 5 patients with a metastatic destruction by kidney tumour. In 4 cases the vertebral body replacement was done in the cervical spine in a single anterior approach with the ADD, combined with an anterior plate fixing of the adjacent vertebral bodies. In 9 cases we performed an anterior vertebral body replacement in the thoracic, in 14 cases in the thoracolumbal, in 10 cases in the lumbar and in 2 cases in the lumbosacral spine. All these operations were made as a double approach after postehor instrumentation of the adjacent vertebral bodies with an internal fixator. The average intraoperative bloodloss for was 1800 ml (range: 250 ml - 6500 mi) and the average operation time was 180 min (range: 95 min - 420 min).

Following intraoperative complications were reported: 1 female patient with metastasis of a breast cancer died in haemorragic shock (perioperative bleeding loss: 15700 ml). 2 patients had dura-lesions. Postoperative two patients developed an infection of the urinary tract, 1 patient a deep venous thrombosis. 2 patients who have had radicular symptoms preoperatively kept them postoperatively. At the further follow-up there was no implant related complication. No implant dislocation or breakdown was registered. 1 patient had an implant loosening due to tumor growth which was reoperated. 16 of 18 patients with fractures had still a good pain relief, good reconstruction of the anterior column and a restoration of the sagittal profile. 10 of the tumour patients (47,6 %) died for tumour progression in the further follow up. On average they reached a survival of 190 days (range: 54 days - 328 days).

Conclusions: The ADD for the cervical and the VBR for the thoracic and lumbar spine are in situ continuously distractible vertebral body replacement systems. Indications are the stabilization and restoration of the anterior vertebral column after total or incomplete vertebrectomy due to destruction of the vertebral bodies. Causes of vertebral body destruction could be tumors, fractures or inflammations. Advantages of both systems is the simple and safe implantation and the short operation time with less blood loss. In our opinion both systems promise a good clinical and radiological result.

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Surgical Approach In T4n0m0 (Vertebral Involvement) Lung Cancer

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Objective: Approximately five percent of the lung cancers involve the chest wall and spine by direct extension and remain localized at the time of diagnosis. T4 lesions invading the vertebra are considered inoperable. Although there have been isolated reports of cures of these tumors by surgical resection combined with external radiation or by the use of intersitital implants, 5-year survival rates from different reports are approximately %20.

Methods: During 1998-2002, four patients with T4N0M0 (vertebral involvement) lung cancer underwent en-block surgical resection. All patients were males with a mean age of 57 years (range 46-66). Histological diagnosis was adenocancer in three and squamous cell cancer in one patient. Neoadjuvant chemotherapy in two patients whereas combined radiotherapy and chemotherapy in the other two patients were applied prior to surgery. Involved vertebral levels were Th1-2, Th3-4, Th3-6 and Th4-5 in each patient respectively.

Posterior stabilization, hemilaminectomy and osteotomy of the involved vertebral bodies below the corresponding pedicle was performed in the prone position and then in lateral position en-block resection were completed along with the lung resection and involved vertebral bodies.

Results: Three of the patients were died during the follow-up period at 6., 8. and 14. months respectively. The last patient is still in follow-up.

Discussion and Conclusion: Although T4N0M0 (vertebral involvement) lung cancers are considered inoperable, lung resection with hemivertebrectomy of the involved vertebra after neoadjuvant chemotherapy and radiotherapy is an alternative treatment in this type of lung cancers.

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Surgical Outcome of Metastatic Spinal Tumors

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Spine is a part of the skeleton involved most frequently by metastatic tumors due to its rich blood supply. The surgical treatment of metastatic tumors is usually carried out by the extensive of tumor tissue which is though to influence prognosis favourably. In this study, 30 patients with metastatic vertebrae involvement were investigate for clinical, radiological and pathological findings apart from outcome of tumoral excision, spinal fusion and instrumentation. The average age of the patients with metastatic tumors was 49.2 (21-70). Metastatic tumors were classified according to Harrington classification and Tokuhashi prognostic scoring system was used. It was established that the majority of patients were between the ages 40-69 and the most frequently involved part of spine was lumbar region. Tokuhashi score was mean 9.2 and as it was determined that involvement was in anterior corpus in all patients, following the extensive excision of tumor from anterior and autologous strut grafting, in cervical, thoracal, thoracolumbar and lumbar regions, 2.4, 2.8, 3, and 2.3 mobile segments were instrumented from anterior or at the same session from posterior with titanium plate or rod systems. Overall, it was determined that sagittal index which was 19.2 degrees preoperatively was corrected by 80.8 % postoperatively. The most commonly encountered histopathological type was lung cancer 19 (63.3 %) patients, followed in order of frequency by breast, gastrointestinal system, thyroid and prostate cancers. It was found that, of 15 (78.9 %) patients with lung cancer and neural deficit, improvement was seen in 13 patients. Pain and Functional Assessment (PFA) score which was found to be 15.8 preoperatively was determined to fall as low as 7.5 postoperatively. In view of these findings, it was concluded that spinal instrumentation, performed in metastatic tumors following extensive anterior radical excision and anterior autologous strut grafting in order to provide spinal stability and maintain sagittal contours, is beneficial in terms of decrease in pain and increase in functional capacity.

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Failures in Oncologic Surgery of the Spine: Causes and Treatment

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Objectives: Failures in the treatment of bone tumors of the spine are related to common surgical complications, but the most relevant complication is the recurrence of the tumor. The purpose of this study is to stress on the risks of revision surgery.

Methods: From January 1997 to June 2000, 192 procedures were performed in the spine for tumors. Fifty-nine revisions were performed in tumors in 51 patients. Tumor recurrence was the main indication to revision surgery (48/59, 81%); mechanical failure of the hardware required surgery in 4 cases, wound dehiscence in 2 cases, haematoma in 1, aortic dissection in 1.
All the cases were submitted to clinical and radiographic serial controls to monitor the incidence of further recurrence and/or other complications.
Results: Revision surgery is burdened by high risk of further failure: on 48 procedures performed for a tumor recurrence, a further recurrence occurred in 17 cases, (35%). The rate of recurrence observed in the same period in tumors not previously treated in 6% (9/133). This is a very important figure as it remarks the relevance of an appropriate treatment of tumors, according to oncologic criteria, considering that the accuracy of the first treatment is the most important prognostic factor. Complications occurring due to dissection on surgical scar are important as well , as vessels, ureter, nerve roots and dural sac are at major risk during revision surgery (in our series 2 lesions of the aorta, 1 haematoma, 2 wound dehiscence occurred).

Conclusions: Tumor surgery must be performed according to the strict oncologic criteria[1], which dictate the need of enbloc resection for lowgrade malignant tumors and for aggressive bening tumors. High grade malignant tumors must be submitted to the specific protocols of chemo and radiation therapy combined with enbloc or intralesional surgery. Active benign tumors can be treated with intralesional extracapsular excision, combined with radiation in selected cases. An appropriate local control can be achieved in most metastatic disease with intralesional excision combined with radiation and or chemotherapy (immunotherapy and hormonal in selected cases). Renal cell carcinoma is an important exception, requiring when feasible, en bloc resection for reducing the high risk of local recurrence. Revision surgery is at high risk of further recurrence (due to the tumor contamination in the surgical scar of the previous procedure) and requires extensile dissections of important structures included in the scar during the previous anterior approach (ureter, aorta and vena cava, peritoneum, pleura, diaphragm, hypogastric plexus, thoracic duct, oesophagus and so on)[2]. In the posterior surgery, the dural sac can be damaged (particularly if a lesion had been provoked in the first surgery), and the repair can be difficult due to fibrotic lack of elasticity. Before deciding to treat a spine tumor, one should consider that the risk of local recurrence is 5 times higher after the first recurrence. The first treatment is critical on the final result and must be planned by a pluri specialistic team with specific oncologic formation.

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DEGENERATIVE SPINE

(September 7, Saturday;10:30-12:30)

Moderator: *John Leong, Ahmet Alanay*

DS-01 - Withdrawn -

DS-02 The Effect of Continuous Early Childhood Back Stretching in Preventing Adulthood Low Back Pain. A New Theory
Dr. Mohammed Chaarani

DS-03 The endoscopic microdiscectomy
A. Gasbarrini, A. Maresca, L. Mirabile, S. Bandiera, F. De Iure, S. Borisani

DS-04 Comparative study of endoscopic and conventional discectomy for lumbar disc herniation
Tomoaki Toyone, Tadashi Tanaka, Daisuke Kato, Ryutaku Kaneyama

DS-05 Surgical Treatment of Multiple Level Cervical Disc Disease
Kemal Yucesoy, Ercan Ozer, H.Sinan Yilmaz, Pinar Yazici, Semih Petekkaya, M.Nuri Arda

DS-06 A New Spacer for Expansive Open-Door Laminoplasty
Takashi Yamazaki

DS-07 Results of Surgical Treatment for Degenerative Lumbar Spinal Stenosis
Mehmet Tezer, Cuneyt Mirzanli, F.Erkal Bilen, Oguz Karaeminogullari, Ufuk Talu, Azmi Hamzaoglu

DS-08 Results of Surgical Treatment For Degenerative Cervical Myelopathy
Sevki Kabak, F.Erkal Bilen, Mehmet Tezer, Mursel Debre, Ufuk Talu, Azmi Hamzaoglu

DS-09 Transpedicular Decancellation Osteotomy in The Treatment of Peridural Fibrosis
Murat Bezer, Osman Guven, Kemal Gokkus

DS-10 The Influence of Vertebral Instability on Peridural Circulation Impairment and Concomittant Peridural Fibrosis Formation
Murat Bezer, Osman Guven, Kemal Gokkus, Umut Akgun

The Effect of Continuous Early Childhood Back Stretching in Preventing Adulthood Low Back Pain. A New Theory

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Introduction: Low back pain, a common problem in adults, usually results from the inability of the spine's posterior longitudinal ligament and annulus fibrosis to stretch, especially while bending with the knees in a straight position. Thus, it can rupture due to a wrong movement allowing the disc to prolapse. Rupture does not occur in children because their ligament is elastic and stretches on bending.

Objective: If elasticity of this ligament and annulus fibrosis is preserved from childhood, would this reduce the incidence of low back pain and disc prolapse in adulthood? Of the forms of worship in Islam, only praying is compulsory, and is mandatory from age seven. The ritual of Islamic praying causes stretching of the posterior longitudinal ligament and annulus fibrosis at least seventeen times during five-daily prayers. Thus, from an early age, Muslim children habitually stretch their back ligament, which preserves the elasticity.

Method: One hundred eighty eight adults were questioned if they have low back pain, defined as mild if it did not bother them, and severe if the pain was agonizing. These persons were divided into three groups: 78 Moslems who started praying before the age of ten, 50 Moslems who started after age thirteen, and 60 non-Moslems.

Results: In those who began praying before the age of ten, 82% had no pain, 15.4% had mild pain, 2.6% severe pain and 0% had sciatica. In those who began praying after the age of thirteen, 36% had no pain, 16% mild pain, 26% severe pain, and 22% had sciatica. Of the 60 non-Moslems, 20% had no pain, 10% mild pain, 45% severe pain, and 25% had sciatica.

Conclusion: Continuous lower back stretching beginning in childhood preserves ligament and annulus fibrosis elasticity which dramatically reduces the chances of low back pain and disc prolapse in adulthood.

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The Endoscopic Microdiscectomy

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Study Design: The author's experience with a new minimally invasive video-assisted technique in the management of lumbar disc herniation.

Objectives: To describe the history of surgical techniques about the treatment of lumbar disc herniation and to discuss the indications, the surgery, the procedure, the validity, the advantages and disadvantages and the outcome of micro-endoscopic technique as an effective option to the standard laminectomy-discectomy and the microsurgical techniques.

Summary of Background Data: In contrast to standard laminectomy-discectomy and the microsurgical techniques, the mini-invasive video-assisted procedure reduces surgical exposure of the spinal passage and the insult to myoligamentous stabilizing structures and intracanalicular tissues. The enlargement associated with a good illumination reduces the bleeding and it allows a very good sight of the details.

Methods: Since October 1999, 48 patients underwent the micro-endoscopic procedure, mean age 44.5 years. The operated disc levels were mostly L4-L5/L5-S1 (20 patients respectively). Most of the disc herniations were intra-canalar. Each patient had: 1) not responded favorably to nonoperative treatment, 2) a persistent radiculopaty with strength and sensitivity deficit.

Results: All patients had experienced substantial relief of their radiculopaty, and were discharged home within 12-24 h of surgery. The actual results show 95% had excellent or good outcomes. There were no complications, except for two intraoperative cerebro-spinal fluid leaks without consequences. Clinical observation of the other 48 patients more recently submitted to micro-endoscopic technique confirm these results and confirm that in a properly selected patients, a successful outcome similar or better to macro or microdiscectomy may be achieved.

Conclusions: The minimal invasive video-assisted technique has a learning curve. In contrast with the percutaneous discectomy, this technique is target – oriented and capable of retrieving sequestered migrated herniations and also to perform short recalibrage of 1 or 2 spaces. Disadvantages: bidimensional vision, as for any endoscopic surgery and a possible longer duration of surgery, particularly at the beginning of the learning curve.

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Comparative Study of Endoscopic and Conventional Discectomy for Lumbar Disc Herniation

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Objectives: The purpose of this study was to compare the clinical outcome of endoscopic and conventional discectomy for lumbar disc herniation.

Methods: Between 1998 and 2001, 40 consecutive patients with lumbar disc herniation were treated surgically. All patients had persistent or frequently recurring leg pain resistant to active nonoperative treatments for a minimum of 3 months. The first half of the patients underwent conventional discectomy (Group 1), and the second half microendoscopic discectomy (Group 2). Both groups were comparable with regard to age, disk levels, and types of herniation. These patients were prospectively followed and clinical outcomes were evaluated by a follow-up questionnaire regarding pain, function, and patient satisfaction.

Results: All 40 (100%) patients were subject to follow-up evaluation and completed the postoperative questionnaire. The mean follow-up period was 27 months (range, 12-48 months). Improvement of leg pain in the visual analogue scale (VAS) was noted in both groups. The mean VAS was 8.5 before surgery and 0.9 after surgery in Group 1, and 8.9 and 1.0, respectively, in Group 2. Improvement of low back pain was also observed. The mean VAS was 5.4 before surgery and 1.3 after surgery in Group 1, and 4.6 and 1.1, respectively, in Group 2. In regard to pain of surgical wound, the mean VAS was 5.1 in patients who went through conventional technique (Group 1) compared with 3.3 in patients who underwent endoscopic surgery (Group 2). Based on their satisfaction, all 20 patients subjected to conventional discectomy (Group 1) chose "Surgery met my expectations", whereas five of the 20 patients after endoscopic discectomy (Group 2) selected "I did not improve as much as I had hoped but I would undergo the same surgery for the same outcome".

Discussion and Conclusion: There were no significant differences in surgical outcomes between endoscopic and conventional discectomy. Patients that underwent conventional discectomy appeared to be more satisfied. Because endoscopic discectomy is a new procedure, it is assumed that patients' expectations were higher, thus, resulting in lower satisfaction. Significant improvement of low back pain was noted across the entire sample. These findings suggest that lumbar disc herniation might be a possible cause of low back pain.

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Surgical Treatment of Multiple Level Cervical Disc Disease

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Cervical disc disease may occur at multiple levels and in this case, multiple level anterior discectomy with fusion and plating and middle corpectomy with fusion and plating are widely used operative treatment options. In this study, operatively treated multiple level cervical disc patients at our clinic are presented and indications of discectomy and corpectomy are discussed

Between 1998 and 2001, we operated 45 patients with two or more multiple level cervical disc disease. Of patients 29 were female and 16 were male. The mean age was found 48.8 (range 32-72). 87% of the patients admitted with neck and/or arm pain, and various neurological deficists were detected all of the patients. Nine patients showed myelopathy findings in neurological examination. Anteroposterior and lateral x-rays, functional x-rays, and MRI were performed in all patients. Two level disc disease was detected in 35 cases, 3 level in 9 cases and 4 level in one case.

14 of patients were operated using Smith-Robinson technique, corpectomy was done in 29 patients and combination of both in 2 patients. Cervical plating was performed in both discectomy and corpectomy. Mean follow-up time was detected as 21 months (range:4-51 months) No peri-operative complication was observed but one patient due to screw failure and one due to graft slippage were re-operated in early post-operative period. Because of recurrent stenosis one patient was re-operated at the end of first year. Out of these three patients, other patients were relieved and myelopathic signs were regressed in that patients

In the presence of only discal compression, discectomy with fusion and plating is enough without damaging any vertebrate. In the case of any presence of ligamentous compression anteriorly, corpectomy is needed with fusion and plating.

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A New Spacer for Expansive Open-Door Laminoplasty

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Objective: Expansive open-door laminoplasty (ELAP) is one of the prevailing decompression techniques for cervical spinal stenotic myelopathy, whose advantage is not only to be able to preserve the posterior elements but also to reduce the operation time compared with conventional laminectomy. In original technique by Hirabayashi (spine 1983), no spacer was supposed to be used, but recently various types of hydroxyapatite (HA) spacer have been used to prevent the open lamina from being closed. But it needs time-consuming procedure to suture between the spacer and the lamina to keep it in position. We developed a new spacer that needs not be stabilized by suture. We will introduce the preliminary results of ELAP using this new spacer.

Materials and Methods: Our new model of spacer is made of titanium, whose shape is arc, length is about 3cm, and width is 8mm. The conventional spacer is put in the space between the edge of the open lamina, but this spacer is set in the gutters on the lamina drilled with φ1.7mm steel bur. In 57 cases (cervical spondylotic myelopathy(CSM) 39, OPLL 7, trauma 10, tumor 1, follow-up period more than three months) operated on using this spacer, operation time and displacement of the spacer were examined. In 26 cases (CSM 22, OPLL 4, follow-up period 12 months to 36 months), sagittal diameters in lateral X-ray, range of motion, clinical results evaluated by Japanese Orthopaedic Association Score (JOAS) were examined.

Results: The average operation time was 145 minutes, taking 30 minutes per lamina. It took 14 minutes to set the all the spacers (3.5 spacers were set per operation on average). X-ray at the follow-up time showed slight displacement of the spacer in 2 cases, but CT showed they were working to maintain the enlargement of the spinal canal. No major displacement or complications due to the spacer were found. The average sagittal diameter increased from 11.9mm to 16.2mm. The range of motion decreased from 37°to 25°. JOAS changed from 11.6 to 14.7 on average. There was no case in which clinical symptoms worsened except one patient who died of MRSA sepsis.

Discussion and Conclusions: The operation time of our previous method was 213 minutes in which HA spacers on the market that need suture were used. We could save 68 minutes in operation time or 10 minutes per lamina by this spacer. The difference of operation time between "with spacer" and "without spacer" reported by Satomi et al. is 60 minutes. Our result 14 minutes is one fourth of theirs. The increase of sagittal diameter, the decrease of range of motion, and clinical results were almost the same as other reports.
Our spacer is useful because it can reduce the operation time with the same clinical results as others and without any complications due to the spacer.

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Results of Surgical Treatment for Degenerative Lumbar Spinal Stenosis

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Introduction: Degenerative lumbar spinal stenosis (DLSS) is a major cause of low back pain, lower extremity discomfort and disability in the elderly. Surgical treatment is considered to improve function and comfort in these patients. Purpose of this retrospective study was to analyze our indications, preoperative evaluation protocol, surgical technique and moderate term clinical results after decompressive surgery alone and combined with both instrumented and noninstrumented arthrodesis in DLSS.

Methods: 59 patients (18 male, 41 female) with an average age of 62.4 (35-85) years were evaluated. Levels of decompression varied between T12-S1. One level was decompressed in 14, 2 levels in 15, 3 levels in 13, 4 levels in 8, 5 levels in 9 patients. The extent of decompression was determined mainly on clinical symptoms and radiologic findings (plain X-rays, dynamic myelography, myelo-CT and MRI). Surgical treatment consisted of decompression alone in 2 (3 %), noninstrumented arthrodesis in 3 (5 %) and instrumented arthrodesis in 54 (92 %) patients. Titanium mesh cages at varying levels (1 to 4) were used in 19 patients for anterior structural support. 14 (23 %) patients also had either spondylolysis or degenerative spondylolisthesis.

Results: Average follow-up was 38 (24-96) months. At final follow-up all patients underwent physical and radiologic examination and were given an interview. Overall satisfaction according to criteria developed by Japanese Orthopaedic Association was good or excellent in 50 (85 %) patients and fair or poor in 9 (15 %) patients. There was relatively high percentage (25 %) of intraoperative and early postoperative complications (3 deep, 1 superficial wound infection, 2 sterile wound drainage due to allograft, 5 dural tears, 2 transient nerve root paralysis, 1 haematoma and 1 pseudarthrosis) which were all successfully managed. Reoperation was done in only one patient for dural tear repair. Sciatica was the symptom most frequently relieved and back pain was the most frequently persisting symptom after operation.

Conclusion: Decompressive surgery with instrumented and noninstrumented arthrodesis for degenerative spinal stenosis appears to be beneficial, at least in the short or moderate term, for many patients in reducing pain and increasing function but associated with a high rate of complications probably due to relatively advanced age and current comorbidities of the patients and mainly low lumbar location of the surgical field.

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Results of Surgical Treatment for Degenerative Cervical Myelopathy

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Introduction: Degenerative lumbar spinal stenosis (DLSS) is a major cause of low back pain, lower extremity discomfort and disability in the elderly. Surgical treatment is considered to improve function and comfort in these patients. Purpose of this retrospective study was to analyze our indications, preoperative evaluation protocol, surgical technique and moderate term clinical results after decompressive surgery alone and combined with both instrumented and noninstrumented arthrodesis in DLSS.

Methods: 59 patients (18 male, 41 female) with an average age of 62.4 (35-85) years were evaluated. Levels of decompression varied between T12-S1. One level was decompressed in 14, 2 levels in 15, 3 levels in 13, 4 levels in 8, 5 levels in 9 patients. The extent of decompression was determined mainly on clinical symptoms and radiologic findings (plain X-rays, dynamic myelography, myelo-CT and MRI). Surgical treatment consisted of decompression alone in 2 (3 %), noninstrumented arthrodesis in 3 (5 %) and instrumented arthrodesis in 54 (92 %) patients. Titanium mesh cages at varying levels (1 to 4) were used in 19 patients for anterior structural support. 14 (23 %) patients also had either spondylolysis or degenerative spondylolisthesis.

Results: Average follow-up was 38 (24-96) months. At final follow-up all patients underwent physical and radiologic examination and were given an interview. Overall satisfaction according to criteria developed by Japanese Orthopaedic Association was good or excellent in 50 (85 %) patients and fair or poor in 9 (15 %) patients. There was relatively high percentage (25 %) of intraoperative and early postoperative complications (3 deep, 1 superficial wound infection, 2 sterile wound drainage due to allograft, 5 dural tears, 2 transient nerve root paralysis, 1 haematoma and 1 pseudarthrosis) which were all successfully managed. Reoperation was done in only one patient for dural tear repair. Sciatica was the symptom most frequently relieved and back pain was the most frequently persisting symptom after operation.

Conclusion: Decompressive surgery with instrumented and noninstrumented arthrodesis for degenerative spinal stenosis appears to be beneficial, at least in the short or moderate term, for many patients in reducing pain and increasing function but associated with a high rate of complications probably due to relatively advanced age and current comorbidities of the patients and mainly low lumbar location of the surgical field.

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Transpedicular Decancellation Osteotomy in the Treatment of Peridural Fibrosis

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Purpose: To asses the surgical treatment choice of transpedicular decancellation osteotomy for peridural fibrosis accompanied by lumbar kyphosis or hypolordosis

Patients and Methods: From 1992 to 1997 a series of 12 multiply operated (averaging 2.5 previous operations) patients with recurrent peridural fibrosis and postlaminectomy kyphosis underwent surgery at our clinic. The surgery was designed to restore the physiological lordosis, relax tethered cord and epidural veins by transpedicular decancellation osteotomy at a vertebra other than the vertebra with peridural fibrosis.

This paper presents the long-term functional outcome of these 12 patients. Clinical assessments were conducted pre-operatively and at 3-month intervals postoperatively and included X-ray assessment and the assessment of functional status of the patients by Oswestry Disability Index (ODI) and of pain by Visual Analogue Scale (pain VAS).

Results: All symptoms and the pain due to peridural fibrosis disappeared in the early postoperative period. Patients had lower disability and pain scores at their early and long-term follow up (follow-up period 24-74 months, mean 36.3 months).

Conclusion: In-patients with failed medical therapy for peridural fibrosis accompanied by lumbar kyphosis or hypolordosis, transpedicular decancellation osteotomy should be the surgical treatment of choice.

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The Influence of Vertebral Instability on Peridural Circulation Impairment and Concomittant Peridural Fibrosis Formation

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Purpose of the Study: To prove the hypothesis that the vertebral instability is the main cause of impaired peridural venous circulation which leads to peridural fibrosis formation.

Significance: In cadaveric studies of nonoperated spines there is a significant relationship between the peridural venous obstruction and the peridural fibrosis. The vascular damage is significantly related to the severity of degenerative spine. The association between vascular compression, tissue fibrosis, and endothelial injury distant from the compression may be a causal-probably due to ischemia as a result of reduced venous outflow.

Animals and Methods: Five experimental groups (IS1, IS2, IN1, IN2, Control) comprised 50 skeletally mature male rabbits. The L2-L4 segment was used in all surgical groups. Vertebral instability was created by removal of the interspinous ligament, spinous process, tranverse process and the facets between L2-L3 and L3-L4. In control group only the laminae of L2-L3-L4 were exposed. The rabbits in IS1 and IS2 groups were applied a repetitive extension-flexion movement through electric stimulation of the paravertebral muscles (The EMS 8000™ Electrical Neuromuscular Stimulator-intervertebral motion device for dynamic motion at sagittal plane).The lumbar spine movement was controlled within physiologic range by adjusting the voltage of the signal. The frequency of stimulation was 5 cycles/min, and the average time of loading was 10 hr/day. Rabbits in the IS1 and IN1 were killed at postoperative 5th day for the immunohistochemical evaluation for early vascular changes. The rabbits in the IS2, IN2 and the control group were killed at postoperative 3rd week for the histopathological evaluation of peridural fibrosis formation. The vascular changes and the vessel density were evaluated quantitatively.

Results: There was no significant difference between vascular changes and the vessel density at IS1 and IN2. When the peridural fibrosis formation was evaluated, the rabbits at IS2 had more extensive fibrosis formation compared to the IN2 and the control groups.

Conclusion: Vertebral Instability is an important cause of Peridural Fibrosis. In early phase vertebral instability doesn't effect peridural circulation.

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MISCELLANEOUS

(September 7, Saturday;10:30-12:30)

Moderator: *Derya Dincer, Feza Korkusuz*

M-01 The Retrodiaphragmatic Spinal Approach; Leaving The Thoracic Cavity Intact
Iordache Sorin Daniel, Ohana Nissim, Mercado Eial, Soudry Michael

M-02 - Withdrawn -

M-03 An Analysis of All Spinal Fusions in The State of California from 1995 to 1999
Mark A. Vitale, Raymond R. Arons, Joshua E. Hyman, David L. Skaggs, Michael G. Vitale

M-04 Correlation Between Pain, Pelvic Lateral Shift and Positive Walk Test in Sacroiliac Joint Dysfunction
Filiz Can, Zafer Erden, Gursoy Coskun, Irem Duzgun, Ahmet Alanay

M-05 Clinical Follow-up of A New Implant System for Posterior Cervical Spine Insturmentation
Balkan Cakir, Marcus Richter

M-06 A Comparison of MCKenzie's Manual Therapy Approach and Traditional Physiotherapy in Patients with Acute and Subacute Back Pain
Filiz Can, Zafer Erden, Gursoy Coskun, Irem Duzgun, Adil Surat

The Retrodiaphragmatic Spinal Approach; Leaving the Thoracic Cavity Intact

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With advances in surgical technique and instrumentation, the anterior approach to the thoracolumbar spine becomes more popular. Anterior approach is considered particularly when ventral decompression of neural structures is needed, providing optional stability by fusing the involved segment with instruments specially designated for that purpose. The usual approach is done through a 10^{th} or 11^{th} rib thoracotomy, opening of the pleural cavity and a semilunar cut at the periphery of the diaphragm, in order to expose the antero-lateral aspect of the vertebral column. This technique involves the risk of phrenic nerve injury and diaphragmatic paralysis combined with morbidity of the chest tube. A variant of that technique is the retrodiaphragmatic approach, which provides the surgeon with the advantages of ventral exposure, potentially avoiding the morbidity of the standard transpleural thoracotomy.

Methods: During a three year period, all patients with major anterior pathology at the T11, T12 or L1 level, were operated using the retrodiaphragmatic anterior approach. This involved an 10^{th} or 11^{th} rib thoracotomy. Following rib resection, blunt dissection of the diaphragm from the chest wall was performed without its surgical incision. The parietal pleural was mobilized medially and left intact and the thoracolumbar spine was exposed for the procedure. In case of a major pleural defect, a chest drain was inserted.

Results: The study group included fifteen patients, 10 males and 5 females, mean age: 32.6y. Six patients had a thoracolumbar fracture, five patients had idiopathic scoliosis and four patients presented with metastatic disease in the thoracolumbar region. Adequate decompression was achieved in all patients as well as stable fixation of the involved segment. Mean operating time was 4.5 hours. Three patients (20%) required a chest drain following the procedure. In five cases (40%) blood transfusion was required, mainly for the underlying disease. The average decrease in the hemoglobin values, in the patient subgroup not requiring blood transfusion, was 3mg% at discharge comparing to the preoperative level. No intra-operative complications related to the surgical technique or instrumentation, were noted, nor any case of mortality. Complications such as respiratory distress, neurological damage, infection, hardware loosening or failure, pseudoarthrosis or hernia in scar were not observed during the post operative follow-up.

Conclusion: The retrodiaphragmatic approach to the thoracolumbar spine is safe and technically easy to apply in cases where ventral exposure of the spine is needed. This technique spares the need for diaphragmatic incision and in most cases, leaves the pleural cavity intact.

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An Analysis of all Spinal Fusions in the State of California from 1995 to 1999

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Introduction: Spinal fusion is a surgical procedure used to treat a myriad of pathological conditions. The present study was an attempt to broadly describe the patient population, most common disorders treated, associated outcomes, and trends over time for this procedure by analyzing five years of a large statewide hospital discharge database.

Methods: The California Office of Statewide Health Planning and Development (OSHPD) hospital discharge database was used to identify 92,372 discharges coded as spinal fusions (ICD-9 procedure code) from 1995 to 1999. This collection of cases was examined to describe patient and provider trends.

Results: For all spinal fusions, there were 337 deaths (mortality rate=0.4%). The mean Length of Stay (LOS) was 5.3 days (SD=7.4), and mean hospital charges were $40,713.25 (SD=51,676.01). The mean age of these patients was 48.6 years old (range=94). There were equal numbers of male and female discharges. Race data revealed that 86.2% of patients were white, 5.2% were black, 2.7% percent were Asian or Pacific Islander, 0.4% were Native American, 4.4% were of an other race, and 1.2% were of unknown race. Ethnicity data revealed that 10.6% of patients were Hispanic, compared to 86.8% non-Hispanic and 2.6% unknown ethnicity. The 10 most common primary diagnoses associated with spinal fusions were displacement of intervertebral disc without myleopathy (29.6%), spondylosis (14.2%), degeneration of intervertebral disc (10.4%), spondylolisthesis (8.1%), spinal stenosis (6.2%), complication of orthopaedic device (5.6%), intervertebral disc disorder with myelopathy (5.5%), fractures of the vertebral column (4.5%), scoliosis (4.4%), and post-laminectomy syndrome (2.1%). There was a 39.5% increase in the number of spinal fusions from 1995 to 1999, and this was largely a reflection of increased proportion of anterior lumbar fusions, which increased by 201.3% over the 5-year span. Hospital charges increased 34.0% over this period, and this was not a function of LOS, which remained constant. There was a large spread in hospital volume, as 36.9% of facilities performing fusions had a volume of 10 or less per year, while 20.0% of facilities performed 100-500 fusions per year. Hospitals with an annual volume of 10 or less fusions per year had a significantly higher mortality rate than hospitals with an annual volume of 100 or more ($p<0.05$).

Discussion and conclusions: The present analysis represents one of the largest collections of spinal fusions described and provides insight into a number of patient and provider patterns. Our data reveals that patients receiving fusions represent a diverse group both with respect to demographics and spinal pathology. Recent advances in instrumentation, diagnostic imaging, and perioperative care may explain the increases in the number of spinal fusions and in mean hospital charges over this period of study. The large number of centers performing fewer than 10 spinal fusions annually is particularly striking. The disparity between mortality rates in high versus low volume centers is suggestive of a volume-outcomes relationship for spinal fusion operations and warrants a more detailed examination of this phenomenon.

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Correlation Between Pain, Pelvic Lateral Shift and Positive Walk Test in Sacroiliac Joint Dysfunction

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Objective: A departure from the midline causing lateral shift or a lumbar scoliosis is evident in about 52 % of low back patients. There are many reasons for the lumbar spine to depart even slightly from the midline because of some biomechanical problems in lumbosacral region such as pelvic rotation, pelvic obliquity or sacroiliac dysfunction.
The aim of the study was to determine the relationship among pelvic lateral shift and positive walk test which is a manual dynamic test for sacroiliac joint dysfunction.

Methods: Between 2000-2002, 30 patients suffered from sacroiliac joint dysfunction participated in this study. The patients with an average 38.8 years old were 21 female and 9 male. Presence of pain on affected sacroiliac joint using with side-glide test was noed. Walk test which is a special test for sacroiliac joint was performed by asking the patient to flex alternate hips on standing position. Pelvic lateral shift was tested in standing with anterior and posterior observation.

Results: The patients with sacroiliac dysfunction showed significant relationship between positive walk test and pelvic lateral shift (r = 0.38). The pain on affected sacroiliac joint was significantly correlated with positive walk test (r = 0.49).

Discussion and Conclusion: Mechanical deformation in lumbo-pelvic region increases incidence of lateral shift and may cause pain on related segments which may effect. These results will be a guide for treating the patients with sacroiliac joint dysfunction. It can be concluded that correction of the pelvic asymmetry may help relief of pain and restoring of sacroiliac joint mechanics in sacroiliac joint dysfunction.

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Clinical Follow-Up of a New Implant System for Posterior Cervical Spine Instrumentation

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Purpose of Study: The use of rod-screw systems improved posterior instrumentation of the cervical spine significantly due to optimal screw position adapted to the individual anatomic situation. A new modular rod-screw implant system was developed with improved biomechanical properties and cannulated cervical screws. The aim of this prospective clinical study was the clinical evaluation the new implant system.

Methods Used: 38 consecutive patients with post. occipito-cervical or cervical instrumentation with the new implant system operated by one surgeon were evaluated prospectively after a minimum one year follow-up. Indications were instabilities due to rheumathoid arthritis in 10 patients, cervical spinal stenosis in 5 patients, implant failure with non-union in 4 patients, dens non-union in 4 patients, dens # in 3 patients, congenital malformations in 3 patients, cervical spine fractures with ancylosing spondylitis in 3 patients, rupture of the alar ligaments in 2 patients, locked fracture dislocations in 2 patients and iatrogenic instabilities in 2 patients. In 10 patients the occiput was included in the instrumentation, in 16 patients 88 pedicle screws and in 26 patients 52 transarticular screws C1/2 were used. The mean follow-up interval was 15.8 months (12-28), mean age at operation was 53.7 years (19-92). Evaluation included radiological, neurological and clinical follow-up.

Summary of Findings: No implant related complications were observed. One instrumentation-related complication was observed due to a broken k-wire tip during transarticular C1/2 instrumentation with cannulated screws and a 1.5 mm k-wire with threaded tip. After changing to non-threaded k-wires no more k-wire breakages occurred. No neurological or vascular complications were found related to pedicle screws as well as transarticular C1/2 screws. The malplacement rate of the pedicle screws was 11% (10 screws) and in all cases below 2 mm displacement without any neurological or vascular complications, no malplacement of transarticular C1/2 screws was found. Instrumentation with the new system was possible in all cases as planned preoperatively. During the follow-up period no non-union or implant failure was observed.

Relationship Between Findings and Existing Knowledge: This is the first report on the clinical evaluation of neon - a new modular rod-screw implant system for posterior instrumentation of the cervical spine.

Overall Significance of Findings: This study showed that posterior instrumentation of the cervical spine using the new neon occipito-cervical system is versatile and has proven to be both safe and efficient.

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A Comparasion of Mckenzie's Manual Therapy Approach and Traditional Physiotherapy in Patients with Acute and Subacute Back Pain

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Objective: The McKenzie's manual therapy system is a commonly used approach of examining and treating patients who have low back pain, yet there are not enough studies on it with controlled trials. The purpose of this study was to compare the effects of spinal manual therapy using by McKenzie's System and traditional physical therapy in patients with acute and subacute low back pain of herniated disc disease.

Methods: From 1998-2001, a total of 95 patients suffered from L5- S1 disc herniation in acute subacute stage included in the study. The patients were assigned to one of two groups: a manual therapy group (n= 43) and traditional physical therapy group (n= 52). Their mean age was 41.7± 2.1 for the manual therapy group (34 female, 9 male) and 44.7±12.4 for the physical therapy group (33 female, 19 male). The patients in the manual therapy group were treated by using McKenzie Diagnosis and Treatment System. Traditional Physical Therapy for physical therapy group included hot- pack, ultrasound, TENS and exercise. Pain intensity strength of trunk extensor and flexor muscles and functional level were evaluated before and after the treatment.
Results: At the end of the study, all the patient in both groups showed significant improvement in all parameters ($p< 0.05$). Pain level in the manual therapy group diminished dramatically in a short duration in comparation with the physiotherapy group. The manual therapy group showed less pain and less restricted range of movement / pain free movement than the physical therapy group. Functional level was higher ($p<0.05$) in manual therapy group than physical therapy group.

Discussion and Conclusion:
These results agree with the positive effects of spinal manipulative therapy on pain, pain free movements and disability rating reported in other studies.

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ABSTRACTS

POSTER PRESENTATIONS

BASIC SCIENCE

(Poster Presentations)

BS-01 Pedicle Morphology of The Thoracolumbar Junction in a Turkish Population: A Preliminary Study
Abtullah Milcan, Caner Özer, Volkan Öztuna, Metin M. Eskandari, Mehmet Çolak, Fehmi Kuyurtar

BS-02 Posterolateral thoracolumbar spinal fusion with composite of allogenic demineralized bone matrix(DBM) and autologous bone graft
Can Solakoğlu, Cemil Yildiz, Ali Şehirlioğlu, Mehmet Altinmakas

BS-03 Fast low-angle shot MR imaging is a useful strategy for diagnosis of lumbar disc hernia
Norisuke Satori, Akira Tagaya, Ban Mihara, Shintaro Gomi

BS-04 Endoscopically Checked Transpedicular Screw Insertion-Preliminary Report
Tarik Yazar, Sinan Bilgin, Ataç Karakaş, Cengiz Yilmaz

BS-05 A Comparative Study of Behavioral and Immunohistochemical Changes after Spinal Cord Injury between Young and Adult Rats
Jun-Young Yang, June-Kyu Lee, Kyung-Cheon Kim

BS-06 The Changes in Expression of Tumor Necrosis Factor Receptor I after Spinal Cord Injury
Jun-Young Yang, June-Kyu Lee, Sang-Yun Chung, Chang-Hwa Hong

Pedicle Morphology of the Thoracolumbar Junction in a Turkish Population: A Preliminary Study

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Objective: To outline the bilateral pedicle diameter and angulation in the transverse plane at the thoracolumbar junction in a Turkish population

Methods: CT scans of 75 patients with dorsolumbar pain but no radiographic signs of bony disease or deformity were investigated between November 2000 and January 2002. There were 15 males and 60 females. The mean age of the patients were 41years (12-60).

Results: The mean diameter of the right pedicle at T11 was 5,9±1,3mm, and that of the left was 5,8±1,4 mm. At T12 they were 5,9±1,3 mm and 6,2±1,4 mm; at L1 5,5±1,3 mm and 5,6±1,4 mm, and at L2 5,7±1.3 mm, and 5,9±1.3 mm respectively. The angulation of the right pedicle at T11 in the transverse plane was 10,04±3,2° , and that of the left was 10,5±3,6°. At T12 they were 9,4±2,4°, and 10,3±3,1°; at L1 11, 4±2,7°and 12,3±3.2°; and at L2 12, 4±2,9°and 12,9±3,2° respectively.

Conclusion: Accurate placement of the pedicle screws are important in preventing complications such as pedicle fracture, cutting out of the pedicle, and injuring neurovascular structures.

Although the morphometric analysis of the pedicles at the thoracolumbar junction were in accordance with the results of studies performed in Turkish population, they were different when compared with that of American, European and Chinese series.

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Posterolateral Thoracolumbar Spinal Fusion with Composite of Allogenic Demineralized Bone Matrix(DBM) and Autologous Bone Graft

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Autologous bone grafts are often used and accepted as crucial to promote bone mineralization and facilitate solid fusion in spinal surgical procedures. But the necessity of large amounts in spinal surgery and the limitations of the autogenous bone grafts have prompted the investigation of a variety of bone graft substitutes and graft extenders.

Today, DBM is accepted as an effective graft material that functions by induction of osteogenesis through the stimulation of factors, which causes bone formation through the chain of enchondral ossification. We aimed in this study to present our results in spinal cases that were treated with posterolateral fusion by using the composite of DBM and autologous bone graft, thus obviating the need for large amounts of autologous bone grafts.

We included 48 cases (23 female, 25 male) which were treated with posterolateral spinal fusion in our institution between August 2000 and December 2001. Average age of the cases was 41.3 (range:16-65). Fracture in 16 cases (33.3%), scoliosis in 12 cases (25%), spondylolisthesis in 9 cases (18.75%), spinal stenosis in 8 cases (16.6%) and kyphosis in 3 cases (6.25%) were the primary etiologies in our patients. These cases were treated with posterior instrumentation together with posterior fusion which was applied by mixing autologous bone graft and DBM in the form of putty or flex-o-gel. DBM amounts were 5 cc in 5 cases (10.41%), 10 cc in 33 cases (68.75%),and 20 cc in 10 patients (20.83%).

Our average follow-up period was 8.5 (range: 2-16) months. Postoperative anteroposterior and lateral radiographs were taken at 2 month time intervals and the patients were evaluated independently and concurrently by the same orthopedic surgeon and the same radiologist. A four point, semi-quantitative scale was used to judge the apparent radiographic density, a reflection of bone mineralization of the developing bone graft mass at the fusion site. The scale was defined as ABSENT, MILD, MODERATE and EXTENSIVE, indicating the bone mineralization over the operative field. We observed both clinical and radiological union in all cases and the distribution was moderate in 15 (31.25 %) and extensive in 33 (68.75%) cases. Average consolidated union time was 3 (range: 3-5) months. We did not observe any complication due to allogenic DBM usage.

This study showed that using DBM with autologous bone graft increased our success rate, decreased pseudoarthrosis rate to almost zero, decreased the necessity for large amounts of autologous bone graft and also decreased the time needed for consolidated union.

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Fast Low-Angle Shot MR Imaging is a Useful Strategy For Diagnosis of Lumbar Disc Hernia

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Introduction: The information on the herniated form of nucleus in lumbar disc hernia (HNP) is crucial to estimate the prognosis. However, conventional MRI is not always a useful strategy. We examined the patients with lumbar HNP with Fast low-angle shot (FLASH) MRI and assessed its efficacy in the form diagnosis of HNP.
Subject: We studied 12 patients with HNP (31.6 y/o). There were 11 males and 1 female.

Methods: MRI was performed at 1.5 Tesla. T1, T2, and FLASH images at each herniated disc were obtained. In the operated cases, they were confirmed macroscopically.

Results: On FLASH, all the hernia masses were depicted obviously, and the posterior longitudinal ligaments (PLL) were observed as black line. The boundary of the hernia mass was clearer than that on T1. The images of ligamentum flavum were also apparent. In 8 operative cases, we predicted the herniated nucleus form from the continuity of black line on FLASH and these cases were divided into transligamentous (TL) and subligamentous (SL) extrusion. These findings were identical to those obtained during the operation except for one case, in which we could not determine the form on FLASH. However, according to operation finding this case was diagnosed as the TL double-layer hernia. The results were confirmed macroscopically. In 3 with TL on FLASH of 4 non-operative cases, their symptoms were improved and the size of hernia masses was reduced. In one SL case on FLASH, the improvement was less remarkable.

Discussion and Conclusion: On FLASH, the differences in signal density among tissues are remarkable. The form of the herniated nucleus was accurately determined, since the boundary between the hernia mass and PLL is more apparent than on T1. FLASH is less invasive comparing to T1, as it needs no injection of contrast media and shorter scan time. Our findings indicate that FLASH is a useful measure in the diagnosis of HNP form.

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Endoscopically Checked Transpedicular Screw Insertion-Preliminary Report

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Study Design: Transpedicular screws are one of the most important components of the posterior segmental fixation systems. Their most feared complication is the possibility of neural damage both while insertion and after the operation, due to compression of the malpositioned screw on the neural structures. We check the screw hole endoscopically prior to insertion of the screw and directly inspect the pedicle walls.

Objectives: Inspection of the screw hole endoscopically would prevent malpositioning of the transpedicular screws and would thus decrease complications related to them.

Summary of Background Data: There are reports in the literature about complications related directly to malpositioning of the transpedicular screws. Currently the insertion method of the screws is composed of palpation of the pedicle walls by the help of a guide K-wire.

Methods: In 4 cases of spinal stenosis with instability, we endoscopically examined 16 screw holes prior to insertion of the screws.

Results: In one of the cases anterior penetration of the hole through the corpuscular wall was detected and a shorter screw was inserted. In another case osteopenic bone was visualized and the pedicle was grafted before insertion of the screw.

Conclusions: Complications due to malpositioned screws can be prevented by endoscopic visualization of the screw hole. We believe, although it adds to the total operative time, avoiding the unpredictable complications worth the time spent.

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A Comparative Study of Behavioral and Immunohistochemical Changes after Spinal Cord Injury between Young and Adult Rats

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Purpose: Mechanism of the changes in spinal cord injury (SCI) according to age has not been well established. The aim of this study was to compare the behavioral and immunohistochemical changes in SCI between young and adult rats and to clarify differences of the underlying mechanism of the changes in SCI between young and adult rats.

Material & Methods: A total of 25 young and 25 adult male Sprague-Dawley rats (5 weeks and 16 weeks) were used. Rats were anesthetized with pentobarbital and laminectomies at the level of the eleventh and twelfth thoracic vertebra. Using a modified New York University Impactor SCI was induced by dropping a 10 gm weight at a height of 20 mm. Bladders were emptied manually two times every day to prevent urinary problems. Animals that received no surgery were used as normal controls. Behavior tests of rats subjected to spinal cord injury were performed by Basso-Beatti-Bresnahan (BBB) scoring. Testing was done 1, 3, 5 and 7 days after weight drop injury. The difference in the BBB score between young and adult rats were analyzed by paired t-test with significance at $p<0.05$. The injured spinal cords were dissected at 1, 3, 5 and 7 days after surgery. H-E stain and immunohistochemistry for c-Jun and GFAP were performed in the spinal cord sections. Immunoreactions were visualized by incubation for 1 hour at RT in avidin-biotin-peroxidase complex in PBS and 5-10 min in 0.05% 3,3'-diaminobenzidine and 0.01% H_2O_2 in 0.1M PBS.

Results: The hind limbs of young rats were paralyzed 1 day after surgery, but recovered partially 7 days after surgery. However, adult rats were remained in paralyzed status at 7 days after surgery. c-Jun expression increased in the gray matter up to 7 days after weight-drop injury in adult rats. c-Jun expression increased significantly in the gray matter 1 day after injury in young rats. However, c-Jun expression decreased significantly in the gray matter 7 days after injury in young rats compared to 1 day post-injury. GFAP expression in the gray matter increased 1 day after weigh-drop injury in adult rats. However, GFAP expression decreased in the necrotic region 7 days after injury in adult rats. GFAP expression in gray matter increased gradually to 7 days after injury in young rats.

Conclusion: These data suggest that severe neurodegeneration in the spinal cord of adult rats may be related to continuous upregulation of c-Jun expression and/or downregulation of GFAP after weight-drop injury. Inversely, upregulation of GFAP expression and/or downregulation of c-Jun expression in the spinal cord may be related with neuroprotective feature in the spinal cord of young rats after weight-drop injury.

Keywords: Spinal cord, Behavioral test, c-Jun, GFAP

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The Changes in Expression of Tumor Necrosis Factor Receptor I after Spinal Cord Injury

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Introduction: Tumor necrosis factor-α (TNF-α) is a protein that reacts to inflammation or chronic stress and is known to have a role in cell survival and death, although its exact mechanisms have not yet been clarified. Also, it is known to increase in concentration within the neurons, neuroglia, and vascular endothelium after spinal cord injury (SCI), but the expression of TNF-α receptor has not been made clear. In this study, we examined the expression of TNF receptor I (TNFRI) according to time after SCI.

Materials and Method: 45 of the 16 week-old Sprague-Dawley rat were used. After anesthetizing with intraperitoneal injection of 50 mg/kg pentobarbital, laminectomy was performed on the first and second lumbar vertebrae. After exposing the dura mater, spinal cord injury was induced using the neuroimpactor with 200g-mm force. Then on the first, third, fifth, and seventh days, postoperatively, ten rats each were sacrificed, and in situ hybridization for TNFR1 was performed to observe the change in the expression of TNFRI mRNA. 5 rats without SCI were control.

Results: No expression of TNFRI mRNA was observed in the healthy spinal cord, but one day after SCI, TNFRI mRNA expression was clearly increased not only in oligodendrocytes but also in neurons and ependymal cells of the central canal. On the third day after injury, TNFRI mRNA was expressed in a portion of the neurons; fifth day also showed decrease in the expression, and on the seventh day, the expression fell much below the level of the third day.

Conclusion: In this study, we found that in the early stage after spinal injury, various types of cells such as neurons, oligodendrocytes, and ependymal cells of the central canal are influenced by TNF-α. Further studies should be made on the adaptor protein for TNFRI to elucidate the mechanism of apoptosis after SCI.

Keywords: Spinal cord injury, TNF-α

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TRAUMA

(Poster Presentations)

T-01 One Stage Spondylodesis for The Bursting Fracture of The Thoracolumbar Spine. -Technicalnote-
Young-baeg KIM

T-02 Late result of the vertebroplasty
Byungjik KIM, Jeonggook SEO, JinHwan KIM

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Ufuk AYDINLI, Çagatay ÖZTÜRK, Remzi Özgür ÖZER

T-04 Transforaminal Decompression of Burst Fractures of Thoracolumbar Vertebrae (A New Technique)
H. KUTLU, E. MERİH, T. ŞENER, C. MİRZANLI, A.N. KARA

T-05 The Results of The Posterior Surgical Treatment of The Thoracolumbar Unstable Spine Burst Fractures
C. KILIÇKAP, R. DANIŞMAN, V. GÜRKAN, H. GÜZ, T. BERKEL

T-06 Long Segment Posterior Surgical Stabilisation of Unstable Thoracolumbar Spine Fractures
Erbil OĞUZ, Ali ŞEHİRLİOGLU, Bahadir SEYHAN, Mehmet ALTINMAKAS

T-07 Late Decompression in Posttraumatic Syringomyelia: A Case Report with Long-Term Follow up
T. YAZAR, K.C. KÖSE, O. CEBESOY, C. SOYDAN

One Stage Spondylodesis for the Bursting Fracture of the Thoracolumbar Spine. -Technicalnote-

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Objective: The purpose of this study is to report the technical feasibility and the result of one stage operation for the bursting fracture of the thoracolumbar spine.

Method: Three patients underwent corpectomy and replaced the space with titanium mesh cage filled up with autologous bone pieces through unilateral posterior route after removal of the facet joint and the pedicle followed by pedicle screw fixation at the same surgical field.

Result: All patients tolerated the procedures well. Postoperative radiographs showed the effective decompression and well placed instruments. Preoperative neurological deficits disappeared completely in one patient but some deficits persisted in the remainders. In one patient, epidural venous bleeding was troublesome and he needed transfusion of 5 pints of whole blood. To insert the mesh cage through the narrow corridor posterolaterally, it was anavoidable to sacrifice one spinal root.

Conclusion: In spite of technical difficulty, one stage spondylodesis for the bursting thoracolumbar spine seem to be an effective operative procedure.

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Late Result of the Vertebroplasty

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Study Design: Retrograde evaluation of the result of vertebroplasty minimum 18 months follow-up.

Objectives: To evaluate the late result of the percutaneous vertebroplasty for the painful osteoporotic vertebral compression fracture.

Material and Methods: 24 vertebroplasty procedures were done from Dec. 1999 to June 2000 for the painful osteoporotic compression fracture of the thoracolumbar spine. Among them, 14 cases were followed up more than 18 months. Evaluation was done for the pain and function and radiologic examination.

Results: Of the 14 patients, 9 (64,3%) were good and excellent, 2 (14,3%) were fair and 3 (21,4%) were worse.

Conclusion: Vertebroplasty is relatively safe and effective in early and late (mean 18 months after) but development of the new material in stead of bone cement is recommended and further long term follow up is necessary to be used in young patient.

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Treatment Results of Low Lumbar Burst Fractures

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Objective: Low lumbar burst fractures (L3-L5) represents the small percentage of all spine fractures. Treatment of fractures involving low lumbar spine has been controversial. Early studies of operative treatment showed a high complication rate and more recent studies demonstrate adequate outcome with nonoperative treatment.
Methods: Twenty-six patients with low lumbar burst fractures were treated from 1995 through 2001. Medical records, preoperative and last follow-up radiographs were obtained. Loss of anterior vertebral height, kyphotic angulation and amount of bony retropulsion to the spinal canal were calculated at preoperative and last follow up examinations. Functional results for all patients were based on comparison of the patients occupational and recreational status before the injury and after it. These results were classified as excellent, good, fair or poor according to Smiley-Webster Scale.
Results: Twenty-six patients (twenty-eight low lumbar burst fractures) were treated with an average follow-up of 39.5 months (12-80 months). Female to male ratio was 5/21 and mean age was 37 years (17-64). The most common etiological factor was fall from height (24/26).
Five of the patients were treated conservatively by immobilization for averagely 3 months in a thoracolumbar orthosis. The remaining cases underwent surgery. Indications for surgery were neurologic impairment in 9 patients and/or instability/deformity in 14 patients.
Of the surgically treated group, 2 patients were treated with anterior, 10 patients with posterior and 9 patients with combined approach. Seven patients with low lumbar burst fractures had traumatic dural tears and extravasation of the nerve roots outside the dural sac. All patients underwent laminectomy, replacement of the roots within the dural sac and primary dural repair in addition to instrumentation and fusion procedures. Six patients showed complete neurological recovery in follow-up and one was neurologically intact prior to surgery and remained same. Two patients from the surgically treated group required hardware removal due to deep wound infection and migration of screws into the disc space in the postoperative 24 months and 7 months respectively. The functional outcome of the entire study group was assessed using the Smiley-Webster Scale. Good to excellent results were obtained in 24 (92%) of 26 patients (100% for nonoperative group, 90% for operative group).
Discussion and Conclusion: Low lumbar burst fractures occur in a relatively young population affecting the most mobile and highly stressed portion of their spine. If patients are neurologically impaired in association with low lumbar burst fractures, surgical treatment is effective. In the case of dural tear, it is not possible to detect the tear and nerve root entrapment in greenstick lamina fracture before the surgery. So, it must be the rule to expose the dura safely with posterior approach before any reduction maneuver.

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Transforaminal Decompression of Burst Fractures of Thoracolumbar Vertebrae (A New Technique)

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In the burst fractures the middle column of the corpus occupies the spinal canal under the axial loading. It means mechanical and neurological instability. Decompression and the mechanical support of anterior column is the major aim of surgical treatment in this type of the fractures. Here we have to decompress the neurological structures without additional instability and also we have to check the decompression intraoperatively. In the present techniques which are laminectomy, posterolateral and anterior decompression additional instability is created. Similarly anterior support and decompression can not be managed sufficiently in indirect decompression. And also we can not check the decompression intraoperatively in indirect technique.

So we have to need a technique which reconstruct the corpus and decompress the neural structures without any additional mechanical instability. In our technique we remove the one side of the ligamentum flavum and the bony edge of the related lamina creating foramina as in discectomy. The fragments are pushed to anatomic place by using special instruments which are gradual in size. Also we can check the decompression during the surgery by the same instruments.

In our clinic from 1997 to end of the 2001 we treated 12 patients with this method. We had no difficulty during and after the surgery. And also we have no complication related to the technique. And in our prospective study the clinical outcome was ranging from sufficient to excellent.

As a result the transforaminal decompression technique is safe, easy and gives the chance of controlled decompression and reconstruction of the middle column which is important for the anterior support.

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The Results of the Posterior Surgical Treatment of the Thoracolumbar Unstable Spine Burst Fractures

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Objectives: We evaluated early results of treatment of patients with thoracolumbar unstable burst fractures, who underwent posterior fusion with posterior instrumentation.

Methods: Sixty-four patients (39 female, 25 male; mean age 38,3 years; the range of 78.12% of patients 20 to 50 years, mean follow-up 1.9 years) with thoracolumbar burst fractures who have been come to the emergency service were analyzed with their general features, and thirty-eight of them which we have been reached all of their documentation were included in this study. The reasons of the fractures were falling down (70.31%), traffic accident (21.87) and others. We have applied of the instruments two intact vertebrae above and below the fractured segment, and we have fused one vertebra above and below the fractured segment. Frankel classification was used for neurologic status of the patients. Patients have used the thoracolumbosacral orthosis after operation, and they have got permission for walk at fifteenth day after operation with an orthosis.

Results: The mean of the correction of the local kyphosis angle was 8.3^0 at the beginning and 5.6^0 at the end, the correction of the sagittal index was 6.9 at the beginning and 4.8 at the end, the correction of the anterior height of the vertebrae was 23.2^0 at the beginning and 22.8^0 at the end. Four of the eight patients with a neurologic problems were got better one Frankel grade, one have got one Frankel grade worst. We haven't got any changes three of them. The results have been evaluated according to the Dennis work/pain system, and 28 patients were excellent and good, 10 patients were bad (4 patients for bad neurologic status, 4 patients for infection, 2 patients for implant failure).

Conclusion: There is not any comparison study of the conservative treatments of the thoracolumbar unstable burst fractures of the spine, though; we believe that the development of the instrumentation and surgical techniques will be given the best surgical choice of the treatment of the thoracolumbar burst fractures.

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Long Segment Posterior Surgical Stabilisation of Unstable Thoracolumbar Spine Fractures

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Posterior reduction and stabilization is one of the most common methods in the treatment of unstable spine fractures. The purpose of this study to detect the superiority of long segment stabilization of thoracal and thoracolumbar spine fractures in the patients who have preoperatively neurological deficits.

28 patients with thoracolumbar fractures of spine with neurological deficits were surgically treated with long segment posterior stabilization technique within average 15 days from the injury between 1995 and 2001. The number of fractured vertebrae was 37. The levels of fractures between T3 and L2. The applied instrumentation system was Alıcı for 19 cases and Diapason for 9 cases. Average follow up period was 3 years. Rehabilitation started in the postoperatively first day.

We had 4 wound infections. Two of them treated with antibiotics and drainage of the abscess the others there were draining fistulised wound in the long term. In these cases instruments were extracted in 1 year after the surgery. In 3 cases decubitus ulcer developed. In the literature, the complications related with instrumentation such as dislocation of pedicular or laminar hooks, loosening of transpedicular screws, breakage of transpedicular screws, bending of transpedicular screws, breakage of rods, and loosening of telescopically nuts did not seen in our cases except dislocation of pedicular or laminar hooks. During follow-up any increasing in the kyphosis was observed.

The patients with neurological deficits need to rehabilitation for long periods. Long term immobilization causes the osteoporosis. These patients under the risk of other fractures due to secondary osteoporosis. Long segment fixation is the proper method for early mobilization of these patients. In the other hand the complications related with instrumentation such as upper junctional kyphosis and osteoporotic fractures are less then short segmented fixations.

As a result, most safe and rigid fixation for the stabilization of thoracal and thoracolumbar fractures in paraplegics can be obtained with long segment posterior stabilization. Upper segmental three level hook fixation and laminar fusion is essential for best results.

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Late Decompression in Posttraumatic Syringomyelia: A Case Report with Long-Term Follow up

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A case report of a patient with posttraumatic syringomyelia diagnosed 14 years after the initial injury, who had undergone late decompression by an anterior approach to L2 vertebra 17 years after the initial trauma and 3 years after the clinical diagnosis of syringomyelia. Our patient's most motor and sensory symptoms resolved after the operation. This example led us to a conclusion that late decompression can be of benefit for these kinds of patients leading to recovery of both motor and sensory deficits even if performed late after the arousal of symptoms and signs of neural compression.

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DEFORMITY

(Poster Presentations)

D-01 - Withdrawn -

D-02 Manual Contouring of The Spine; A New Technique for Scoliosis Correction
Ohana NISSIM, Iordache Sorin DANIEL, Klir ISRAEL, Sheinis DIMITRY, Sasson ALBERT, Soudry MICHAEL

D-03 Sublaminar Wires with Third Generation Spine Instrumentation For The Treatment of King Type II and Type III Adolescent idipathic Scoliosis
Asım CILIZ, Süleyman PORTAKAL, Güray ÖZKAN, Ali UTKAN, Mehmet Ali TÜMÖZ

D-04 - Withdrawn -

D-05 Posterior Instrumentation and Interbody Fusion for Post Discectomy Instabilities
Onur POLAT, Alihan DERİNCEK, Ayhan ATTAR, Kemal US

Manual Contouring of the Spine; A New Technique for Scoliosis Correction

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Correction of spinal deformities such those seen in idiopathic scoliosis, are one of the challenging aspects of the spine surgeon's routine. A significant progress has made in sense of the surgical approaches, implants design and methods of correction during the last tow decades. Since the pioneer conception of Paul Harrington that a scoliotic curve can be corrected by distraction, other methods such as derotation and translation came out as an alternative ways to get a straight and balanced spine. Recently, a new concept of correction for spinal deformities named *in situ contouring,* has brought to our attention. This method is based on a 6mm Titanium rod (SCS Eurosurgical Inc.) connected to the spine with a multiple hooks and screws system. The rod is bend according to the curve in the coronal plane and loosely secure with setscrews. Following primary application of the rod, the surgeon begins to bend it manually in situ, in a contrary direction to the curve's shape. By applying a combination of a sagittal and coronal plane forces, the surgeon is able to achieve a final result of a straight and nicely balanced spine.

Methods: The medical records of patients with idiopathic scoliosis, who had surgery during the last three years, were reviewed. Patients, whose operation evolves using of the SCS system, enrolled into the study group. Clinical as well as radiographical data were retrieved from the hospital charts. Curves were classified according to King at el.; measurements were taken using the Cobb's method.

Results: There were 10 patients in the study group (7 females, 3 males, mean age: 16.6 years). All curves were primary thoracic from which, 9 were type II and only one was type III. Mean pre-operative angle of the primary curve was 56°, mean post-operative angle was 22° with a 61% correction rate. Patients were followed for an average period of 12 month. No complications related to surgery, correction technique, or neurological status was noted.

Conclusions: The in-situ contouring system has no drawbacks compare to other known methods. Our feeling is that this new technique gives the surgeon an ability to achieve the final position of the corrected spine, by a slow and gradual manipulation. This is taking a crucial advantage of the elastic property of the spine in order to get good correction and to avoid neurological complications or hooks pull out.

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Sublaminar Wires with Third Generation Spine Instrumentation For The Treatment of King Type II and Type III Adolescent Idiopathic Scoliosis

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In our study, we used the third-generation spine instrumentation (Hipokrat, Izmir, Turkey) and sublaminar wires for the treatment of King type II and type III adolescent idiopathic scoliosis. The aim of our study is to demonstrate the safety of sublaminar wiring, better correction and minimal loss of correction.

We report of 24 patients who underwent placement of sublaminar wires with third-generation spine instrumentation for adolescent idiopathic scoliosis from 1998 through 2001. The average age was 17 (range 14-19). There were 15 female, 9 male. The preoperative diagnosis was King type II scoliosis in 15 patients and King type III scoliosis in 9 patients. All of the patients were primary surgeries.

We evaluate the curve type, curve magnitude, number of vertebrae instrumented, level of vertebrae wired, postoperative neurologic deficit and loss of correction.

The average degree of the curves was measured as 63° (range 48-93) using the Cobb method. The average postoperative curve magnitude was 30° (range 12-48) with an average correction of 33°. The average follow-up time was 22,4 months (range 12-36 months). The total of 123 wires were placed and all of them were in the thoracic region. The average of sublaminar wiring segments was 5 (range 4-7). The average loss of correction was 2° (range of 0-6). We didn't use intraoperative spinal cord monitoring, wake-up test was performed in all patients. There were no permanent neurological sequelae in our series. We use the external support until solid fusion has been obtained. The average use of external support was 3 months.

Despite the complexity of segmental spinal instrumentation system, sublaminar wiring with third-generation spinal instrumentation is safe and provides strong fixation with proper training and experience is relatively easy to apply.

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Posterior Instrumentation and Interbody Fusion for Post Discectomy Instabilities

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Introduction: Musculoskeletal complications after discectomy are intervertebral instability, kyphosis, scoliosis, lordosis and combined spinal deformity. Of these possible deformities, kyphosis and instability are most common. Also there is an increased incidence of post-operative spinal deformity in patients who have more than two lamina removed or a facetectomy performed at the time of the initial operation. There is no association between the occurrence of the deformity and sex, neurologic condition after discectomy.

Material and Methods: 5 patients (3 female, 2 male) underwent multilevel discectomy because of lumber disk herniations. Their ages were 21-36 (mean age 30 years). After 6-18 months, lumbar pain developed and there were no symptom associated. From the lumbosacral x-rays (while flexion-extension and neutral), all of them had increased mobility between the vertebral bodies, 4 had mild kyphosis and spondylolysthesis.

Results: Between June 1998-February 2000, 5 patients were underwent posterior interbody füsion and posterior instrumentation for the instability in Ibn-I Sina Hospital Orthopaedic Department. No brace treatment was used.after surgery. At a mean follow up period of 20 months (range 14-25 months), 4 patient were well prognosed and there were no complication except one who had lumbar pain according to the reason of pseudarthrosis.

Conclusion: Spinal deformity or instability after lumbar or thoracolumbar total discectomy is not uncommon. Limiting lamina removal and facet destruction may decrease this incidence and also posterior instrumentation interbody fusion is required to correct postdiscectomy deformity and to stabilize the spine.

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TUMORS / INFECTION

(Poster Presentations)

TI-01 Management of vertebral Osteomyelitis
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TI-12 - Withdrawn -

Management of Vertebral Osteomyelitis

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Background: Mainly a retrospective study of a 49 cases of spinal infection unrelated to an open procedure on the spine, including patients with drug addiction.

Objectives: To analyze the results of treatment using a diagnostic and therapeutic algorithm to achieve a systematic and comprehensive approach to the management of this disease. In fact, despite advances in imaging, diagnosis of vertebral osteomyelitis is easily missed and treatment is often delayed.

Method: we retrospectively reviewed 49 consecutive patients aged 15-83 (average 54y) with vertebral osteomyelitis who were treated between January 1990 and March 2001. All patients received plain radiographs, gadolinium enhanced magnetic resonance imaging, Ga-67 and Tc-99 scintigraphy. A total of 29 patients underwent CT-guided fine-needle aspiration biopsy. The coltures of spinal specimen were positive in 41% (12/29) of cases. Bacteriology and haematology factors were analysed: blood coltures were positive in 65% (13/20).

Results: Mycobacterium tuberculosis was the main organism followed by Staphylococcus aureus and epidermidis. All patients received intravenous antibiotics. Neurologic impairment was present in 13 (26%) patients who underwent surgery. All patients with paresis recovered completely after surgical decompression. Patients with spondylodiscis who were treated nonsurgically, with bed rest and bracing, reported residual back pain not frequently 22% (8/36) than patients treated surgically 38%(5/13).

Conclusion: the outcome of patients with vertebral osteomyelitis in general is favorable when appropriate treatment is picked even if vertebral osteomyelitis is a rare condition and because of is often overlooked initially. Delay in diagnosis may results in spine impairment, more hospitalization time and more cost. We suggest diagnostic criteria in order to simplify the diagnosis.

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Thoraco-lumbar Spine Tuberculosis: Our Experience in Posterior Debridement, Reconstruction and Internal Fixation

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Tuberculous spondylitis or Pott's disease remains an important pathological entity in developing countries and it's treatment controversial.

We present 9 cases of pathologically confirmed thoraco-lumbar spine tuberculosis surgically treated in our department between 1998 and 2000. There were 7 men and 2 women, ranging in age from 44 to 61 years. All patients underwent surgery: posterior debridement, autologus bone grafting and internal fixation using transpedicular screws. The 6 patients with preoperative neurological deficit (Frankel Grades C, 2 patients; D, 4 patients) improved one grade. There was one superficial infection.

Postoperativelly, all patients were immobilized in a light brace for 3 months. Fusion was obtained after 4-5 months.

We believe that surgical treatment using posterior approach is a good option for non-advanced tuberculous spinal lesions.

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Transpedicular Decancellation Osteotomy in the Treatment of Pott's Kyphosis

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Purpose: To analyse long term functional outcome of the patients with Pott's kyphosis.

Patients and Methods: 16 patients with Pott's kyphosis who underwent transpedicular decancellation osteotomy with posterior instrumentation and fusion were evaluated preoperatively and post operatively with assessment of functional status by Oswestry disability index. Average age was 45.1 (27-65; SD:12.3). Radiologic assessment was made in measurement of kyphosis angle preoperatively and postoperatively. Average follow up time was 71,4 month (36-108, SD:37.14)

Results: All symptoms and pain disappeared in postoperative period. The preoperative average kyphosis angle 29.2° (7°-97°; SD: 22.1) decreased to average 12.2° (0°-43°; SD: 14.4).The preoperative average osswestry disability index value 45.5 (41-50; SD:3.02) decreased to avereage 7.1 (3-18, SD:4.81).

Conclusion: In selected cases of pott's kyphosis, transpedicular decancellation osteotomy with posterior instrumentation and fusion could be surgical treatment of choice.

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The Surgical Treatment of Tuberculous Spondylitis and Its Consequences in Adults

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The known methods of surgical treatment of tuberculous spondylitis as a closing stage of therapy have considerably changed outcomes of that disease. We conduct the analysis of surgical treatment of 39 patients at the various stages of tuberculous spondylitis in the age from 18 to 56 years old. The process was located in thoracic part of vertebral column at 2 (5,1 %), in thoracolumbar part – at 5 (12,8 %), in lumbar part – at 32 (82 %) patients. The availability abscess, as a complication of process, was observed at 28 (71,8 %) patients. Neurology symptoms as a radicular syndrome, the destructions of membrana spinalis, weakness in the lower extremities were notices in 29 (74,4 %) cases. At 3 (7,7 %) patients, it was marked lower paraplegia. All patients have passed the integrated examinations, including CT, MRI, Ultrasound, immunologic, bacteriological and morphological investigations. All patients before operation received a course of conservative treatment.

In according to the character and purposes all operations were unified into 4 groups:
1. Radical – restoration operations (including abscessotomy, necroctomy and resection of body of a vertebra) were made in 22 (56,4 %) patients.
2. Reconstructive operations on anterior parts, vertebral canal and posterior elements of vertebral column were made in 6 (15,4 %) patients.
3. Correction operations were made in 2 (5,1 %) patients with the purpose of correction of deformation of vertebral column.
4. The curative-subsidiary operations (posterior osteoplastic fixation of a backbone, abscessotomy, fistulotomy) were made in 9 (23,1 %) patients.

To perform above mentioned operations were used poster lateral, anterolateral extra peritoneal and Tran thoracic access.

Outcomes of treatment were followed till 5 years. The good outcomes were reached at 25 (64,1 %), satisfactory – at 11 (28,2 %) patients. One patient has died by reason of thromboembolism. The neurology symptoms has passed completely in 23 (59 %), were partially restored in 13 (33,3 %) patients. Available in 2 patients paraplegia remained constant. There were not indications of a relapse at the patients, observed by us.

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Thigh Abscess as a Late Complication of Pott's Disease

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Objective: To show thigh abscess as a late complication of Pott's disease without any lumbar signs.

Methods: We demonstrated two patients who had thigh abscesses. Both of these patients had been operated because of psoas abscess at least one year ago. Chemotherapy was continued for 9 months. A thigh abscess was observed three and 12 months later consecutively. Neither x-rays nor pelvic ultrasonographies revealed any abnormalities in lumbar regions. A Ludloff incision was done and abscess was drained.

Results: Patients are symptom free and have got ten kilograms after drainage.

Discussion: It has to be kept in mind that, because of gravity, a psoas abscess can migrate to the thigh following tissue planes and especially in chemotherapy resistance, which is not uncommon in tuberculosis; it can recur in here after sometime. In all the cases with psoas abscess the thigh region has to be palpated and investigated by ultrasonography before the surgery. During anterior decompression of the psoas abscess surgeon has to control the inguinal canal to see if there is an abscess and thigh has to be stroked to see any pus coming through. If there is any doubt a Ludloff incision has to be done to drain the abscess in thigh, to prevent any recurrences.

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A Case with Lumbosacral Tuberculosis

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Low back pain may arise from many different reasons which include degeneration, malignancies, infections, metabolic and inflammatory disease. A case with low back pain who turned into chronic infection is presented in this study.

A seventy years old woman presented with 5 years old history of low back pain. Radiating towards to right leg. Her pain alleviated with but did not disappear by bed rest. Clinical examination at the time of hospitalization showed reduced range of spinal extension and lateral bending but no tension signs from the sciatic nerve. Right extansor hallucis longus muscle strength was tested as 4/5 and she reported reduced sensation at L4, L5 and S1 dermatomes. Magnetic resonance imaging showed multilevel spinal stenosis bilateral S1 root indentation and partial compression of the S1 endplate. Biochemical and bacteriological blood analysis were normal. Patient complaints didn't subside with medical treatment. Five months later MRI was repeated due to left sciatic nerve irritation which was positive at 40' and accompanied with extansor hallucis longus weakness of 2/5. MRI showed discitis at L5-S1 disc and anterior soft tissue involvement. Electromyographical studies pointed to chronic partial axonal degeneration of the L4-5 radixes. Formerly, normal sedimentation rate was elevated to 72 mm/hr, PPD test was 20 mm., where as Gruber-Widal and Wright (with Coombs) tests were negative. Three months later anterior decompression, posterior instrumentation and fusion with allograft were performed to the patient who had required paraparesis below L2 level 10 months after being hospitalized, biopsied material when combined with clinical findings was diagnosed as tuberculosis.

Although spinal tuberculosis most usually occurs at thoracolumbar vertebrae, lower lumbar vertebrae may be involved as well. Definitive diagnosis can be made by biopsy. In cases with neurological deficit, surgical decompression and stabilization is an effective and preferred approach.

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Paravertebral Fibromatosis

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Introduction: Benign fibrous tumours are common. They may have a character varying from small, self-limited to aggressive, invasive tumours. A paravertebral fibromatosis located just in the midline at the back is presented in this study.

Patient history: 59-year-old female patient noticed a swelling in her back 4 months ago. A mass was detected within the soft tissues at lower dorsal region on MRI with normal laboratory findings. Mass was hypointense in T1 weighted sequences and hiperintense in T2 weighted sequences. It was significantly visible after contrast material administration. Triple-phase bone scan revealed no metastases and the lesion was considered as benign. Fine needle aspiration biopsy result was reported as fibromatosis or low-grade sarcoma. Wide excision was performed for treatment as the lesion was defined as a benign soft tissue mass after clinical, radiological, laboratory and histopathological findings. Histopathological study of the excised tumour mass revealed benign fibromatosis.

Conclusion: Fibromatosis can be seen in any localization within the skeletal system. It is a benign tumour which may also become locally aggressive and invasive. Differential diagnosis of malignant mesenchymal tumours should be done. Excision should be as wide as possible to prevent local recurrence.

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A Solitary Osteochondroma in the Spinous Process of the Lumbar Spine

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Objective: The objective of this study is to describe a case of a solitary osteochondroma in the spinous process of L4 and the imaging methods used for the diagnosis.

Methods: The clinical history, plain radiographs, bone scintigraphy, computed tomography, magnetic resonance imaging and pathologic findings of the reported patient were reviewed.

Results: The 13 year-old boy was treated with surgery in an attempt to remove the tumor. The intraoperative findings and the histologic examination indicated the diagnosis of a solitary osteochondroma. The result was satisfactory with no recurrence in two years period.

Discussion and Conclusion: Osteochondromas are the most common benign tumors of the appendicular skeleton but they occur less frequently in the axial skeleton with an incidence of 1.3% to 4.1%. They usually give rise to clinical symptoms during growth in the second or third decade of life. Frequently diagnosis and treatment are delayed because of poor visibility of the tumor in the column but our current patient had a palpable mass in the lumbar region. Solitary osteochondroma of the spine most frequently involve the cervical column, particularly the atlantoaxial region and rarely seen in the lumbar region. The favorite location of osteochondroma in the column is at an eccentric position in the neural arch with or without protrusion into the spinal foramen but the current case had centric position in the neural arch.

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Osteoid Osteoma of Sacrum Mimicing Sacroileitis

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Objective: We report the case of a 23 years old female who complained of sacroiliac pain for several months and was treated as sacroileitis.

Methods: The patient was suffering a continuous pain at her left sacroiliac joint for four months. She failed to respond to NSAIDs. She was first evaluated with plain radiographs, bone scintigraphy and laboratory tests (ESR, CRP, leukocyte count and brucella agglutination test) which were reported as normal. MRI showed a non specific edema of the bone marrow at the posterior corner of the sacrum. Computed tomography showed a nidus located posteriorly at the S2 level neighboring sacroiliac joint. Pathological examination after en bloc surgical excision revealed the diagnosis.

Results: Surgical resection of the osteoid osteoma through a direct incision located at the sacroiliac joint brought an immediate relief of the symptoms.

Discussion and Conclusion: Primary tumors of the spine are relatively infrequent lesions. It was reported that, the diagnosis of osteoid osteoma in the sacrum delays compared to other sites of skeleton. In our patient the diagnosis was delayed and treated as sacroileitis. Direct radiography and MRI and even scintigraphy are not valuable for the diagnosis of osteoid osteoma of sacrum. Excision through a posterior approach is the treatment of choice. Prognosis is generally good with a low incidence of local recurrence (<10%).

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A Case of Chondrosarcoma Localized to the Lumbar Spine, Sacrum and Iliac Wing

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Objective: Chondrosarcoma of the pelvis is relatively common, comprising approximately 25% of all chondrosarcomas in most large series. In contrast, chondrosarcoma of the sacrum and spine is rare, constituting less than 5% of all cases. Because of the rare incidence of primary chondrosarcoma of the lumbar spine, we report a case of chondrosarcoma that localized to lumbar spine, sacrum and iliac wing.

Case: A thirty-six years old, female patient presented with pain at the lumbar region and right hip and her symptoms were progressed over 1.5 years period. During the physical examination, numbness at the L4-L5 dermatomas, motor weakness of the extensor hallucis longus and tibialis anterior muscles and positive straight leg rising test at the right side were found. Magnetic resonance imaging of the lumbosacral and pelvic areas showed a mass that originated from right side of the posterior elements and bodies of L3-S3 vertebrae and spreading to the sacroiliac joint and iliac wing at right side. There was no metastasis. Open biopsy was performed and histological diagnosis was established as the chondrosarcoma grade II. For the total resection of the mass, we performed hemivertebrectomy on the L2-L5 levels, partial resection of sacrum and sacroiliac joint including 1/3 of posterior part of ilium with simultaneous posterior and anterior approach. Because of the soft tissue defect, right gluteus maximus transposition flep, V-Y advancement gluteal skin flep and latissimus dorsi flep were performed. Intraoperative bleeding was approximately 8500cc and patient was observed in the intensive care unit 16. days postoperatively because of adult respiratory distress syndrome which developed in early postoperative period.

Discussion and Conclusion: The surgical treatment of chondrosarcoma is particularly complicated. Therefore, surgical excision of chondrosarcoma that localized to the sacrum and lomber spine is dictated by the tumor's proximity to vital structures as well as the risk of jeopardizing axial stability. Because of this reasons, the surgical expertise required to remove axial chondrosarcomas and need careful preoperative planning and postoperative care.

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Clinical Results of Total en Bloc Spondylectomy for Metastatic Vertebral Tumors in Thoracolumbar Spine

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Objective: Total en bloc spondylectomy (TES) introduced by Tomita has become one of the surgical interventions for the patients with metastatic tumor arising in thoracolumbar spine. The purpose of this study was to investigate the clinical results of patients who underwent TES for the metastatic thoracolumbar spinal tumor.

Methods: The study group consisted of the consecutive four patients with metastatic vertebral tumors in thoracolumbar spine. There were three females and one male with a mean age of 62.3 years (ranging 60 years to 65 years). The mean follow-up period was 22.5 months, ranging 11 to 38 months. The primary lesions consisted of two breast cancers, one lung cancer, and one renal cell cancer and were resected successfully before consulting to our department. All of the patients underwent TES in the procedure that Tomita introduced, which consisted with en bloc corporectomy and en bloc laminectomy combined with anterior reconstruction and posterior instrumentation. One of the patients required the anterior approach added due to the extra-vertebral tumor extension. All patients were evaluated postoperatively with plain x-rays, activity level including ambulatory period, the presence of back pain, and neurological findings.

Results: Postoperatively, all of the patients gained the pain relief and became to be ambulatory. The mean duration that the patients could walk was 18.3 months (ranging 5 to 36 months). At the time of our evaluation, one patient was alive with no recurrence of tumor and returned to her job. Remaining three patients were dead and the causes of death were as follows; recurrence of lung cancer, cachexia with multiple metastases, and local recurrence of spinal lesion. The mean period from operation to death was 25 months in these three cases. There was no deterioration in neurological status except for one case with renal cell cancer who developed local recurrence.

Conclusion: TES has the great advantage of possible en bloc resection for the metastatic spinal tumor compared with palliative surgical interventions. On the other hand, an application of this procedure to the patients with metastatic spinal tumor is still controversial in terms of being invasive procedure and cost effectiveness. In our series, all of the patients gained the ability to walk along with pain relief and their neurological status was well maintained postoperatively. TES seemed to become one of the effective procedures to improve the quality of life in patients with metastatic spinal tumor.

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DEGENERATIVE SPINE

(Poster Presentations)

DS-01 Degenerative Cervical Spondylolisthesis
Fujita KYOSUKE, Hirabayashi HISASHI, Takahashi SEIKEN

DS-02 - Withdrawn -

DS-03 - Withdrawn -

DS-04 The Determinants of Spondylolisthesis
Hayal GÜLER, Abtullah MİLCAN, Gunsah ŞAHİN, Selda BAĞİS, Canan ERDOĞAN

DS-05 Direct repair of lumbar pars interarticularis defect
Haluk BERK, Ömer AKÇALI, Emin ALICI

DS-06 The Clinical Importance of Magnetic Resonance Imaging in Degenerative Lumbar Spine
Metin ÖZALAY, Ayşin POURBAGHER, Sercan AKPINAR, Murat Ali HERSEKLİ, Gürkan ÖZKOÇ, Reha TANDOĞAN

DS-07 - Withdrawn -

DS-08 Individual and occupational determinants of low back pain according to various diagnosis of low back problems
Gül BALTACI, Nevin ERGUN, Ayşenur BESLER, Volga Bayrakçı TUNAY, Magsoud EIVAZI

DS-09 Percutaneous Disc Decompression Using Nucleoplasty
Lewis SHARPS

DS-10 - Withdrawn -

DS-11 - Withdrawn -

DS-12 Nucleoplasty: A Novel Approach to Percutaneous Disc Decompression
Robin D. MCMAHON, Duran N. YETKİNLER, Norman R. SANDERS

DS-13 Long Term Results of Wide Laminectomy for Lumbar Spinal Canal Stenosis without Fusion
Atsushi IWATA, Masahiko MATSUSAKI, Kohei TAKATA, Mitsuo OCHI, Tadahiko YOTSUMOTO

DS-14 Bed Rest Prevents Collapse of The Lumbar Vertbral Body in Case of Postoperative Sinking of Titanium Threaded Fusion Cage
Kosuke KURIBAYASI

DS-15 Longitudinal length of the spinal cord after cervical laminoplasty
Toru YOKOYAMA, Akihiro OKADA, Takashi TOMITA, Kazunari TAKEUCHI

Degenerative Cervical Spondylolisthesis

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Objective: Cervical subaxial spondylolisthesis due to rheumatoid arthritis (RA) or destructive spndyloosteoarthropathy (DSA) is sometimes observed. However, degenerative spondylolisthesis of osteoarthritic etiology is very rare. In this article, we represented 7 cases about their radiological and clinical investigation and reviewed the literature. We also discussed about their pathogenesis and results of the operated cases.

Methods: All patients were women, who ranged in age from 70 to 86 years old. Diagnostic studies were done by cervical plain films with flexion / extension. We evaluated the level of spondylolisthesis, degree of slippage, change of disc height and clinical symptoms. Results of the operated cases were also surveyed.

Results: Spondylolisthesis was found at from C3 to C5, mostly occurred at the C4 on C5 levels. Dynamic radiography showed instability at the involved level in all patients. At least 2 mm of slippage at one or more levels were existed. Maximum spippage was 7 mm. Four of the 7 patients had neurological signs and three had neck pain alone. Two of the patients with 7 mm slip required surgery.

Dicussion and Conclusion: Spondylolisthesis is thought to be occurred at immediately above a stiff lower cervical spine. However, this theory can not nesessarily be adopted in our cases. Structures and strength of posterior ligamentous complex can be related to the occurrence of slippage. Post- operative courses were good at the time of follow-up (mean 4.5 years). Instrumentation was useful for sequring bone union and stability.

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The Determinants of Spondylolisthesis

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Objective: To assess the determinants of spondylolisthesis in middle aged women.

Design and Methods: We evaluated 181 patients with back pain who were diagnosed as spondylolisthesis by means of plain films of the lumbar spine. (anterior-superior and lateral radiographs). Body mass index (BMI) as a determinant of obesity and visual analog score (VAS) for pain evaluation were studied. Spondylolisthesis was graded according to Meyerding's classification.

Results: The mean age of patients was 59.02±9.9 years. The mean BMI was 29.07 ±4.8 Kg/m^2. The mean VAS score was 6.1 ±2.5 cm. The duration of history of back pain was 6.4±6.4 years. Grade 1 spondylolisthesis was present in 47 patients, grade 2 in 33 and grade 3 only in one patient. Only 10 patients had spondylolysis (unilateral) together with spondylolisthesis on oblique radiography. The spondylolisthesis involvement was most common at L4-L5 region (49.17%) in the lumbar spine. Degenerative disk and spondylolisthesis was present in 47 (25.96%) patients

There was a statistically significant positive correlation between VAS score and the grade of spondylolisthesis (r=0.170; p=0.02). There was also a significant correlation between VAS score and BMI (r=0.196; p=0.02).

Conclusion: BMI and VAS score are important determinants of patients with back pain due to spondylolisthesis.

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Direct Repair of Lumbar Pars Interarticularis Defect

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Objective: The objective of this study is to evaluate functional outcome of patients operated on lumbar pars interarticularis defect.

Materials and Method: Direct repair of the pars interarticularis defect using pedicular screw hook fixation was carried out in 6 spondylolysis patients. There were 4 female and 2 male patients. The site of pars defects involved L5 in 5 cases and L4 in 1 case. Low back pain and/or radicular pain were the main symptoms, one patient presented with L5 hypoesthesia and right toe dorsiflexor motor power loss (4/5). All the patients except one were treated conservatively (dynamic lumbar stabilization exercises) prior to surgery at least for three months. Pars defects were confirmed by oblique views of the lumbosacral spine and computerized tomography taken in "reverse gantry" technique. Clinical outcomes were assessed by pre- and post-operative pain, union of the pars defects as demonstrated by CT images, functional status (SF-36).

Results: The mean follow-up was 36.7 months (13-50 months). Implants were removed in three patients. In one patient left side implant was removed 3 months postoperatively due to intractable radicular pain. Implants were removed in two and three years postoperatively in two other patients. Follow up CT scans revealed bilateral fusion in five and unilateral fusion in one patient. Two male patients were elite sportsmen who returned to their preoperative activity level at one year postop. All but one patient were free of pain during activity. One patient had occasional pain.

Conclusion: We conclude that direct repair of pars interarticularis defect with pedicle screw-hook technique is feasible and effective technique. Functional outcomes are favorable. However major drawback of this study is the limited number of patients.

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The Clinical Importance of Magnetic Resonance Imaging in Degenerative Lumbar Spine

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Objective: The objective of this study is to describe the magnetic resonance imaging features of the intervertebral discs and interspinous ligaments in relation to the patient age and low back scores. Intervertebral discs were also correlated with interspinous ligaments.

Methods: 37 patients (27 female and 10 male), average age 55 (34-74) who underwent lumbar magnetic resonance imaging were included in the study. Patients were examined clinically by use of the Japanese Orthopaedic Association's Evaluation System for lower back pain syndrome (JAO Score).

Results: Type 1B (normal disc height with dehydration) disc was predominated at L4-L5 and L5-S1 (p=0.000, p=0.002 respectively). Type 1A (low intensity on T1- and T2- weighted images without hypertrophy of the spinal process) was predominated at L3-L4 and L4-L5 interspinous ligament (p=0.001, p=0.000 respectively). Type 3 (high intensity on both T1- and T2- weighted images) was predominated at L5-S1 interspinous ligament (p=0.000). Negative correlation was found between age and JAO Score. L5-S1 disc degeneration was decreased with increasing JAO scores. There was positive correlation between L3-4 and L4-5 interspinous ligaments changes. There was no correlation between disc degeneration and interspinous ligament changes.

Discussion and Conclusion: The number of patients seen by orthopaedic surgeons for degenerative conditions of the lumbar spine is increasing. Imaging studies are an integral part of the evaluation of the patient with signs and symptoms of a lumbar spine disorder.

The latest modality used to evaluate the spine is MR imaging. Degenerative changes occur in the intervertebral disc, facet joints and spinal ligaments. Although MRI has been used to evaluate disc degeneration, not much is known about the correlation between MRI findings of interspinous ligament and disc in degenerative spinal disease. In the previous studies, Type 2 ligament was found mostly at L4-5 interspinous level which is generally regarded as the most unstable motion segment at the lumbar spine but in our study, Type 1A ligament was found mostly at L4-5. At L5-S1 interspinous level, Type 3 ligament was found mostly in our study although L5-S1 level is more stable than L4-5 because of the iliolumbar ligament and the deep-seated location below the pelvis. MRI may be helpful in assessing normal and pathologic changes in disc and interspinous ligament.

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Individual and Occupational Determinants of Low Back Pain According to Various Diagnosis of Low Back Problems

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The purpose of this study was to investigate the prevalence of back pain in general population aged between 16 and 86 years. A retrospective chart review analysis with recent follow-up was performed on 443 patients diagnosed by orthopaedic surgeons from different hospitals through clinical examination and plain radiographs from 1991 to 2002. 36 building problems, 38 protrusion problems, 46 patients with herniated lumbar disc, 56 patients with spondylolysis, 129 patients low back pain, 96 patients with lumbar strain, 21 patients spinal stenosis, 11 patients with facet fracture, 5 patients with spina bifida, 5 patients with scoliosis were attended to physiotherapy and rehabilitation in sports physiotherapy unit at various sessions. Data were compiled on 443 patients (221 men and 222 women) with changes in functional physiotherapy examination and evaluations. We report age-standardized prevalence estimates stratified by age, gender, occupation and spinal pain severity. Questionnaire data on 78 men (35% non-working) and 98 women (44% non-working) gathered over the period 11 years. Larger differences were found for chronic low back problems, and activity limitation and use of health services due to low back problems. When those unable to work because of disability (work disabled) were excluded, the prevalence and consequences of low back pain were still higher in the non-working group in comparison with the working population. Most of the non-working women are housewives and this group was both large in size and had a high prevalence of low back problems. Psychosomatic problems, bending or carrying loads were often associated to low back pain, whereas other risk factors were related some specific dimensions of the disorder. Among the men studied, more than a quarter of total burden of low back problems in those aged 20-59 years were found in the non-working population, among women this was 50%. Both research on causes and determinants of low back pain and the development of preventative actions should also be translated to the non-working population.

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Percutaneous Disc Decompression Using Nucleoplasty

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Objective: The objective of this study is to illustrate the effectiveness of NucleoplastyTM (ArthroCare® Corporation, Sunnyvale, CA), a minimally invasive procedure for disc decompression which has been developed to treat symptomatic patients with contained herniated discs. This is a prospective, non-randomized, single center study.

Methods: A total of forty-eight patients underwent the Nucleoplasty procedure. Nine of these patients had prior surgeries. Four patients had prior fusions, four had prior percutaneous disc procedures, and one patient had undergone a prior lumbar laminectomy. Questionnaires were filled out pre-procedure, and at one month, three months, six months and one year post-procedure. A Visual Analog Scale (VAS) was administered to measure pain symptoms at all visits. The procedures were done on an outpatient basis under local anesthesia with a 17-gauge introducer needle inserted through the annulus and into the nucleus. As part of the standard protocol for interventional spinal procedures, patients were placed on a routine rehabilitation program.

Results: Forty-eight out of forty-eight patients have been followed for one month, with thirty-eight followed for three months, twenty-four followed for six months and eleven patients followed at twelve months. The mean age was 38 years old, with ages ranging between 30-61 years old. No post-surgical complications were recorded. The mean VAS scores at the time of surgery were 7.9, 3.7 at one month, 3.4 at three months, 3.3 at six months, and 4.2 at twelve months Success is measured by a minimum 2-point reduction on the VAS scale, patient satisfaction and absence of narcotic usage. Overall, there was a 79% success rate. In the group that had previous surgery, the success rate was 67%, versus 82% in the group that had no previous surgical intervention.

Discussion and conclusions: These results indicate that Nucleoplasty is a promising and efficacious minimally invasive procedure for the treatment of symptoms associated with contained herniated discs. No adverse events have been observed in patients enrolled to date in this study. There was a substantial decrease in post-procedure VAS scores. Although long-term data are not available, initial data indicates that the Nucleoplasty is a promising option for symptomatic patients with contained herniated discs.

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Nucleoplasty: A Novel Approach to Percutaneous Disc Decompression

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Several techniques have been used successfully to achieve Percutaneous disc decompression for back and radicular pain over the last several decades. Chemonucleolysis uses chymopapain to decompress disc enzymatically, automated percutaneous Lumbar discectomy (APLD) using the Nucleotome and Percutaneous laser disc decompression (PLDD) have also been performed with reported successes. Nucleoplasty, uses Coblation technology (ArthroCare® Corporation) to percutaneously decompress contained herniated discs, and is the newest addition to current practices. Nucleoplasty employs Coblation technology by using the common technique (discogram) of inserting a needle into the annulus of the herniated disc. The needle remains intact within the outer annulus and allows the minimally invasive thoroughfare for Coblation to be introduced into and ablate the tissue for decompression. Tissue ablation is achieved at temperatures of approximately 40-70°C, thereby thermal damage to surrounding tissue is minimized. The procedure is performed under local anesthetic, with fluoroscopic guidance and done on an outpatient basis. To date, there have been no known adverse events reported. Clinical results up to one-year post procedure have revealed a substantial reduction in patient's pain and narcotic usage, as well as high overall patient satisfaction ratings. Although patients with a variety of symptoms report satisfaction with the procedure, recent clinical data reveals that the greatest clinical benefits are being reported by patients who's leg pain is greater than or equal to their back pain, patients who have a contained disc protrusion as evidenced by MRI, and a failed selective nerve block. Patients with severe degenerative disc disease, disc extrusion or moderate to severe spinal stenosis are proving less likely to benefit long term from the procedure. Information learned from clinical data has helped better understand the most appropriate patient selection criteria for optimum results. One-year clinical data confirms the benefits and safety of the procedure. Further investigation is necessary to understand the procedure's benefits long-term.

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Long Term Results of Wide Laminectomy for Lumbar Spinal Canal Stenosis without Fusion

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Introduction: Laminectomy for lumbar canal stenosis (LCS) causes instability due to the loss of posterior components of the vertebral column. In this study, we followed patients who underwent laminectomy without fusion and investigated prognostic factors for surgical outcome.

Materials and Methods: 58 patients underwent laminectomy without fusion for the treatment of LCS were followed for more than ten years. Age at the time of surgery ranged from 43 to 77 years. The length of follow-up ranged from 10 to 17 years .The following items were investigated: number of excised vertebral laminas, intervertebral mobility, and preoperative intervertebral joint morphology, et al. Clinical results were assessed using Japanese Orthopedic Association (JOA) scores.

Results: The average degree of improvement in JOA scores was 54.2%. That for patients in whom one lamina was excised was 69.7%, two laminas (40.3%) or more (27.6%). In addition, the average improvement degree in JOA scores for patients with more than 10 degrees of intervertebral mobility was 49.2%, while that for those with less than 10 degrees was higher, at 78.6%. The degree in JOA scores for patients with W-type intervertebral joint was 39.2%, whereas that for those with M-type joint was higher, at 54.2%.

Conclusions: Surgical outcomes were favorable more than ten years after undergoing laminectomy. Nonetheless, these were affected by many factors, such as the number of excised laminas, range of intervertebral mobility, and joint morphology. These findings support the notion that laminectomy leads to instability due to the loss of posterior components.

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Bed Rest Prevents Collapse of the Lumbar Vertebral Body in case of Postoperative Sinking of Titanium Threaded Fusion Cage

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Objective: Titanium threaded fusion cages are commonly used in surgery for degenerative lumbar spine disease. Non-unions are few, but the cages sometimes slip into the spinal canal due to collapse of the vertebral body. I present how to avert the lumbar vertebral body collapse when sinking of titanium threaded fusion cage occurred in early postoperative period.

Methods: Since 1997 I have done the posterior lumbar interbody fusion using titanium threaded fusion cages without pedicle screw systems at 338 levels in 219 patients; 133 men and 86 women. Ages ranged from 18 to 87 (mean 53.5) years. One hundred and twelve patients had one level fused, 95 had two levels and 12 had three levels.

Results: Satisfactory disc height was restored and the symptoms improved in all patients but four. Sinking of the cage occurred in these four patients 7 to 17 days after operation. In a 67-year-old man the cage placed on the right side at L4-L5 showed a slight sinking 12 days postoperatively. He had no symptoms, and was allowed ambulatory. In 2 months the cage was found entirely into the canal. He was reoperated. Three other patients (67,73 and 73 years old) had minor sinking, and one of them had an accompanying pain. They were treated with bed rest for one month. No further sinking occurred, and solid union was achieved in all patients.
Discussion and conclusions: Sinking of a cage with collapse of the vertebral body could occur within 3 weeks after surgery. Immediate bed rest for one month will do and solid union will be achieved.

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Longitudinal Length of the Spinal Cord after Cervical Laminoplasty

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Introduction: In cases of cervical myelopathy, the relationship between surgical outcome after laminoplasty and the sagittal alignment is controversial. In our cases with unexpected poor surgical outcome, we often found a straight, tense spinal cord on postoperative MRI. So we tried to measure a longitudinal length of the cervical spinal cord (LSC) as a new parameter. The purpose of this study is to prove our hypothesis that an increase of LSC after cervical laminoplasty may be a risk factor for poor surgical outcome.
Methods: Thirty-six patients (24 male and 12 female) with cervical myelopathy were operated on at the age from 33 to 76 (average 59y/o). The follow-up period was from 12 to 86 months (average 39 months). There were 25 patients in the laminoplasty group (group LP) (13 cervical spondylotic myelopathy (CSM) and 12 ossification of posterior longitudinal ligament (OPLL)) and 11 in the anterior fusion group as control (group AF) (8 CSM and 3 OPLL). There were no significant differences in the age, sex and follow-up period between two groups. We evaluated surgical outcome with the recovery rate of scoring system for cervical myelopathy of Japanese Orthopedic Association (JOA score). We used the sagittal T2 weighted MRI, and computed LSC that was a summation of the distance of each spinal cord midpoint at intervertebral line between the C1 upper line and the T1 vertebral upper line. We defined the LSC gap as the subtraction value from preoperative to last follow-up LSC. A plus quantity of LSC gap represents an increase of LSC after surgery. Mann-Whitney U test was used statistically and P values less than 0.05 were considered statistically significant.
Results: In the group LP, LSC gaps ranged from -21mm to +4mm (average -1.0, standard deviation; SD 4.9mm). In the group AF, LSC gaps ranged from -5mm to +7mm (average 0mm, SD 3.4mm). There was no significant difference in LSC gaps and recovery rate between the 2 groups. In the group LP, 7 cases (28%) had under -2mm LSC gaps and 6 cases (24%) had over +2mm LSC gaps, and recovery rate in 7 cases under -2mm LSC gaps ranged from 13% to 67% (average 47%) and in 6 cases over +2mm LSC gaps from -200% to 20% (average -53%). There was a significant difference between the cases under -2mm LSC gap and the cases over +2mm LSC gap (P=0.025). Of 6 cases over +2mm LSC gap, 5 cases had straight alignment and 5 cases had OPLL. In the group AF, 4 cases (36%) had over +2mm LSC gaps and recovery rate in the 4 cases ranged from 0% to 100% (average 75%). There was a significant difference between 6 cases over +2mm LSC gaps in the group LP and 4 cases over +2mm LSC gaps in the group AF (P=0.049).
Discussion: Chiba proposed a new concept that the shortening in the longitudinal distance of the cervical spine caused by multiple disc space narrowing may have a certain impact on the postoperative results. We agreed with their hypothesis, because of our first result that the patients with over +2mm LSC gaps had worse surgical outcomes than with under -2mm LSC gaps. Moreover, 5 of the 6 cases with over +2mm LSC gaps had OPLL and straight alignment. From the second result, anterior mass and dynamic motion played important roles in impeding the neurological recovery in the cases over +2mm LSC gaps.
Conclusion: An increase of the longitudinal length of the spinal cord after cervical laminoplasty is a risk factor for poor surgical outcome.

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MISCELLANEOUS

(Poster Presentations)

M-01 Surgery for patients with bow hunter's stroke: usefulness of intraoperative head rotation
Michihiro KOHNO, Hiromu SEGAWA, Keiji SANO

M-02 Spondylolysis of lumbar spine in athletes : Comparison of two different nonoperative treatments
Gül BALTACI, Nevin ERGUN

M-03 Accidental Peroperative Lumbar Durotomy: Forty Dural Tears out of 842 Operations
François DUBUC

M-04 Intraspinal Metallosis as a Cause Late Period Paraparesis Secondary to Posterior Spinal Instrumentation
Mehmet TEZER, Ünal KUZGUN

M-05 The Effects of Haemostatic Agents on Graft Donor Site
Erol YALNIZ, Selçuk ERCAN, Misel KOKINO

M-06 Different Continuous Total Intravenous Anesthesia Technique is Recommended for Wake-up Test (A Preliminary Study)
Rıza KURUEFE, Aysun YILMAZLAR, Berrin ÖZCAN, Ufuk AYDINLI,Çağatay ÖZTÜRK

M-07 A change in blood flow of the spinal cord artery due to the cervical laminoplasty
Koji SATO M.D., Toshihiro ANDO, Kazuyoshi MIYASAKA, Yukihiro MATSUYAMA, Taichi TSHUJI

M-08 Interlaminar Osteotomy in Surgical Correction of The Kyphosis of Anchylosing Spodilitis(AS)
H. KUTLU, E. MERİH, F. HATİBOĞLU, K. ÇETİNER, O. ORTAL, A.N. KARA

M-09 Surgical Treatment of Cervicothoracic Pathologies
Şükrü ÇAĞLAR, Ayhan ATTAR, Ali O. TAŞCIOĞLU, Ahmet ERDOĞAN, Tarık YAZAR

M-10 Cost and Effectiveness Analysis of Manual Therapy and Physiotherapy For Low Back and Neck Pain
Gül BALTACI, Volga Bayrakçı TUNAY, Nevin ERGUN, Ayşenur BESLER, Magsoud EIVAZI

M-11 Lumbal Spinal Stenosis: Assessment of Outcomes One-Year After Operative and Conservative Treatment: A Pilot Clinical Study
Magsoud EIVAZI, Gül BALTACI, Ali Kemal US, Nevin ERGUN

M-12 Effectiveness of Manipulative Physiotherapy for The Treatment of Whiplash Injuries
Volga Bayrakçı TUNAY, Gül BALTACI, Nevin ERGUN, Ayşenur BESLER

M-13 The Pain Intensity Level and Physical Function in Patients with Cervical Disc Herniation: Effectiveness of Manual Therapy
Volga Bayrakçı TUNAY, Gül BALTACI, Nevin ERGUN, Ümmühan Baş ARSLAN

Surgery for Patients With Bow Hunter's Stroke: Usefulness of Intraoperative Head Rotation

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Introduction: For patients with the rare condition of bow hunter's stroke, which causes vertebrobasilar insufficiency due to narrowing of the upper cervical vertebral artery (VA) upon rotation of the head, some kinds of operations have been reported and the treatment hasn't unified yet.

Methods: We operated on four patients with bow hunter's stroke. Every patient showed narrowing of VA at the level of C2 transverse foramen, on the side opposite to the direction of head rotation. Most patients showed hypoplasia of the other VA and posterior communicating arteries. In every operation, opening of single C1 transverse foramen and freeing of VA without touching C2 structures was done, and backward mobility of VA was confirmed during intraoperative head rotation. We placed a pedicled fat graft on the freed VA to prevent postoperative adhesion.

Results: In all of the four patients, the symptoms associated with head rotation were completely resolved postoperatively and no symptom recurrence was recognized in the follow-up period (mean: 3 years and 3 months). Also, no postoperative VA occlusion / stenosis caused by adhesional entrapment occurred.

Discussion and Conclusions: We consider that the C2 level narrowing of VA is caused by stretching of VA associated with forward migration of C1 transverse foramen during head rotation. Therefore, opening of single C1 transverse foramen and freeing VA is considered sufficient to resolve the C2 level narrowing of VA, and in this series gave excellent operative results. Confirming the effects of surgery for bow hunter's stroke using intraoperative head rotation is considered very useful and important.

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Spondylolysis of Lumbar Spine in Athletes: Comparison of Two Different Nonoperative Treatments

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The purpose of this study was to compare the results of two different nonoperative treatments for athletes with spondylolysis of the lumbar spine. A retrospective study with recent follow-up was performed on 56 patients treated with conventional physiotherapy (36 patients) (Group 1) and manual therapy (20 patients) (Group 2). All of the patients were involved in sports at first onset of symptoms. Activities involving repetitive hyperextension and/or extension rotation of the lumbar spine were described as painful in 98% of the patients. In Group 1, 26 (72%) had an L5 defect and 10 (28%) an L4 defect. 18 patients had bilateral defects, and 18 had unilateral defects. In Group 2, 12 (60%) patients had an L5 defect and 8 (40%) and L4 defect. 12 had bilateral defects and 8 had unilateral defects. Group I received conventional physiotherapy including infrared lights, ultrasound therapy, and interferential therapy and home exercise program and Group 2 manual therapy involving mobilization and manipulation techniques according to Cyriax and dynamic stabilization exercises. Average treatment sessions were 20.88 days for Group I and 10.65 days for Group 2. Average follow-up was 1.8 years. In Group 2, 18 (90%) had excellent results, two had good results. In Group 1, 22 (71%) had excellent results, eight (22%) had good results, four had fair results, and two had poor results. Based on our results, we postulate that a course of nonoperative treatment including mobilization and manipulation may be effective, successful and safe for the treatment of spondylolysis.

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Accidental Peroperative Lumbar Durotomy - Forty Dural Tears out of 842 Operations

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469 patients sustained 842 operations at their lumbar spine in the course of the last 15 years such as discectomy, decompressive laminectomy with or without grafts and with or without instrumentation.

Forty dural tears (durotomy) occurred with injury to the root or its rootlets in 6 patients. Three developed an LCR fistula and had to be reoperated at 7, 13 and 16 days post original operation. Root or rootlets sectioning occurred in 0,5% and overall accidental durotomy in 4,76%.

The durotomy occurred at a first operation 19 times (4%), a second operation 13 times (5,7%), a third 5 times(5,9%), a fourth 3 times(7,7%) and not with the 12 patients who were at their fifth low back operation. Average age of these 40 patients was 47,1 years 25 being men and 15 females.

Occurrences were during the hernia dissection to free it from the root, followed by the use of the Kerrison rongeur to remove the ligamentum flavum or the lamina. Five injuries occurred during wiring or screw placement. Discs were found to be sequestered in 23 patients (no stenosis in 6 and having to have a laminectomy in 17).

The root involved was:

L5	18 (45%)
S1	8 (20%)
L4	4 (10%)
Above L4	3 (7,5 %)

At a subsequent operation in 5 patients, a pseudomeningocele was found and repaired without having identified a cerebro-spinal fluid leak at the previous operation.

Types Of Operations In The 842 Done						
	D	S	G	L	Pout	Ant
First 469 (55.7 %)	176	131	79	69	-	14
Second 229 (27.2 %)	57	29	60	43	29	11
Third 93 (11%)	9	4	22	31	24	3
Fourth 39 (4.6 %)	3	-	11	9	16	-
Fifth 12 (1.5%)	1	2	1	3	5	-

D=Discectomy, S=Sequestrum, G=Graft with or without instrumentation, L=Laminectomy as the principal procedure, Pout=Removal of Roy-Camille plates, Ant=Trans-peritoneal anterior graft.

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Intraspinal Metallosis as a Cause Late Period Paraparesis Secondary to Posterior Spinal Instrumentation

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Introduction: Metallosis is not a rare situation after orthopaedic surgeries in which implantation takes place. It is seen especially when massive steel implant materials are used. But it has been rarely reported after spinal instrumentations.

Patient history: 57 years old male patient was admitted to our clinic after fall from high. He underwent posterior spinal surgery with pedicle screw-hook combination system made of steel with a diagnosis of T8-9 compression fracture. In early postoperative period no clinical or radiological abnormality was detected. Patient went out of follow-up and attended some other physicians for the following three years without any abnormality. He performed his daily activities and continued doing his job. In the end of third year, progressive paraparesis has developed beginning in the left lower extremity first. In the last follow-up deep tendon reflexes were found be increased with muscle strength of 2-3. X-rays revealed caudal migration of pedicle hook in T6. MRI, CT, EMG and myelography were all performed and distinguished an intraspinal mass at the level of T6. Peroperative findings, in which material extraction, expioration, and decompression were performed, included the metallosis around left T6 pedicular hook. This intraspinal mass which made the medullary canal severely narrower was pushing spinal cord to the opposite side and anteriorly. All the instruments and space occupying mass were extracted. Patient showed a progressive increase in muscle strength (4) in 6 month after the surgery.

Conclusion: Intraspinal metallosis is not frequently seen after spinal surgery. Although intraspinal metallosis due to laminar hooks is present in literature, our case is unique for it's being the first case as intraspinal metallosis secondary to pedicular hook placed far from the medullary canal.

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The Effects of Haemostatic Agents on Graft Donor Site

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Objective: The purpose of the study is to investigate the effects of haemostatic agents on donor site in spinal surgery.

Methods: A prospective clinical study was carried out in a group of 53 patients who underwent spinal operations at Trakya University Hospital. Bone wax and curaspon were used as haemostatic agents. The patients were divided into 4 groups. We applied bone wax in 17 patients (group 1) and curaspon in 14 (group2). In 12 patients donor site was covered with curaspon for 5 or 10 minutes then removed (group 3). No agent was used in 10 patients (group 4). The age, sex and diagnosis of the patients and shape of incision were not taken into consideration. In 27 patients, donor site were exposed from the main incision and in 26 patients separate incision were performed. Closed suction drainage system were used for 48 hours or until the amount of drainage below 30 cc daily.

Results: In group 1 the amount of drainage was 6.6 cc, in group 2 12.8 cc, in group 3 10.3 cc and in control group 18.6 cc per 1 cc bone graft. The difference between study and control groups was statistically significant ($p<0.5$) except group 3 ($p>0.5$). Also the difference between group 1 and 2 was statistically significant ($p=0.17$). We haven't seen any complication such as infection or delayed wound healing related to haemostatic agents. There is no statistically significant differences between the using same or separate incision ($p>0.5$)

Discussion: In spinal surgery, autogenous bone grafts improves fusion. On the other hand the potential exists for morbidity at the donor site. After removing cortical and cancellous bone, outer surface of iliac bone remains open, and bleeding continue after wound closing. Hematoma is one of the reason for donor site morbidity. It may be responsible for donor site pain postoperatively, delayed wound healing and infection. Using haemostatic agents and closed suction drains prevent this complication. Both curaspon and bone wax are foreign materials. Although bone wax is said to retard bone healing, and curaspon in large amounts has been associated with sterile serous drainage from wounds, we haven't seen any complications such these.

Conclusion: Our study demonstrates that bone wax and curaspon are reliable and effective haemostatic agents to diminish amount of drainage from the iliac donor site in spinal surgery. In comparison to curaspon bone wax shows better haemostatic effect.

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Different Continuous Total Intravenous Anesthesia Technique is Recommended for Wake-Up Test (A Preliminary Study)

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Objective: Total intravenous anesthesia (TIVA) is one of the most recommended anesthetic method for wake-up test.

Methods: Thirty-eight (8 males, 30 females, ASA class I-II patients whose ages ranged 9-31years, weight ranged 20-85 kg) scoliosis surgery cases were received TIVA consist of midazolam, mivacurium, alfentanil infusions. Infusion rates were decreased in each surgery phase until wake-up (Table 1)

At the surgeon's request midazolam and mivacurium infusions were discontinued, flumazenil was given, patients were asked to move hands and feet.

Results: The median intraoperative wake-up times were 5.7 minutes. The protocol the authors set up allowed a very rapid intraoperative neurological examination without pain and no complication releated to the test was observed

Discussion and Conclusion: Authors concluded that decreasing infusion rates of total intravenous anesthetics until wake-up test seems to be a safe and practitical method. This report describes preliminary experience with this technique.

INFUSION	PHASE 1 (EXPOSURE)	PHASE 2 (INSERT)	PHASE 3 (RODIMPLANTATION)	PHASE 4 (CORRECTION)	PHASE 5 (WAKE-UP)
Midazolam (mg/kg/hour)	0.3	0.225	0.15	0.075	0
Mivacurium (mg/kg/hour)	0.5	0.375	0.25	0.125	0.03
Alphentanyl (mg/kg/hour)	0.03	0.03	0.03	0.03	0.03

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A Change in Blood Flow of the Spinal Cord Artery Due to the Cervical Laminoplasty

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Objective: We usually operate cervical laminoplasty for cervical myelopathy due to canal stenosis. On that occasion, as for the decompression of the spinal cord, it can be confirmed by the intraoperative ultrasonography. But, all the reports about a change in blood flow of the spinal cord are nothing. It considered how the blood flow of the spinal cord changed at the time of the cervical laminoplasty.

Methods: Since August 2001, we were performed 30 operations for laminoplasty (Kurokawa method modified bilateral open door). They are 19 cases of men, 11 cases of women and the average age 61 years old. Before both openings lamina, an anterior spinal artery was examined about nineteen cases that it could be measured. After the processus spinosus of C3 to 7 was removed, then central groove was dug, and a anterior spinal cord artery was observed for the sagittal with the ultrasonography. An anterior spinal cord artery was visualized with Power Doppler, and PI (Pulsatility index) and RI (Resistance index) were measured with Pulse Doppler. After lamina opened, we measured again PI and RI.

Results: A spinal cord was decompressed favorably as to every case, and the visualization of the anterior spinal cord artery turned good. PI and RI which become the index of the blood flow due to the decompression decreased from 1.67 to 1.34. RI decreased from 0.60 to 0.53.

Discussion and conclusion: The absolute value of consideration PI and RI takes an influence in the blood pressure and the age as well. Though generally a decrease in vascular resistance can't be said as the increased vascular flow again, it can be said that PI and RI show a tendency to decrease due to the decompression. It confirmed that the blood flow of the spinal artery right after the laminoplasty changed in the increase tendency.

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Interlaminar Osteotomy in Surgical Correction of the Kyphosis of Ankylosing Spodilitis (As)

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In achylosing spondylitis the fixed kyphosis of the spinal column is the resulting deformity in general. Pain and inability of the physical outcome are the main complains of the patients. Surgical correction is the only choice of the treatment in this type of deformity.

Interlaminar osteotomy is one of the surgical techniques used in surgical correction of AS. This technique was applicated in three patients in our clinic in 2000. All the patients were male, aging 22, 30, 31 years and all had thoracolumbar kyphosis of major lomber kyphosis. Multilevel interlaminar osteotomy was performed from T12 to S1. Restoration of lomber lordosis was achieved by pushing the column to fracture the anchylosis between the corpus vertebrae to close the osteotomized space up to sitting of upper vertebrae to adjacent one. Stabilization was performed by posterior transpedicular fixation from T11 to S1. Although it was simple and easy technique, the surgeon must keep in mine the dural adherence and rather long lasting surgery time, the mean was 6 hours in our cases. We had no complication both intraoperatively and post operatively. The patients were mobilized in the 2nd day of operation.

After the mean of 1.5 years of follow up, the patients have full activity and both physical and psychosocial results are excellent.

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Surgical Treatment of Cervicothoracic Pathologies

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Surgical Access to cervicothoracic junction pathologies is one of the common problems in spinal surgery, especially if the lesion compromise spinal canal. The surgical approaches to this region have been traditionally divided into anterior, anterolateral, posterolateral and posterior approaches. Posterior approaches, such as lamiectomy are applied frequently and are well known by all neurosurgeons. However lamienctomy provides poor exposure to the anterior vertebral elements and, access to ventral pathologies through laminectomy may be difficult.

In our series, 10 patients with profund neurological deficit, and 2 patients with pain underwent anterior, anterolateral or posterolateral approaches. 6 patients with neurological deficit and 2 patients with pain underwent lamienectomy through posterior approach, and 1 patient with neurological deficit underwent combined (anterior and posterior) approach. The results suggest that corpectomy, spinal cord compression and spinal stabilization with anterior, anterolateral and posterolateral approaches can improve the quality of life considerably in patients with spinal lesions by restoring or preserving ambulation and by controlling intractable spinal pain with acceptable rates of morbidity and mortality. The patients who underwent solely laminectomy may develop progressive deformity. However, appropriate choice of surgical approach depends on the exact location of the pathologic process.

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Cost and Effectiveness Analysis of Manual Therapy and Physiotherapy for Low Back and Neck Pain

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A randomized, clinical trial was conducted in which patients with back/neck problems, visiting an orthopaedic and neurosurgeon, were allocated to manual therapy or physiotherapy as primary management. The aim of the study was to compare outcome and costs of the effects of two-treatment techniques-manual therapy and physiotherapy- in managing patients with low back and neck pain. Earlier studies on the treatment of back pain by spinal manipulation have shown inconsistent results. Two hundred forty-four patients with neck pain and four hundred forty-three patients with low back pain aged 18-65 years who had not been treated within the previous month were included in the study. Treatment was carried out at the discretion of the therapist. Two groups were divided into group I-physiotherapy and group II-Manual therapy. Manual therapy involved stabilization exercises and mobilization techniques. Physiotherapy involved TENS, US and a home exercise programme. Group I was taken for 20 sessions and group II for 10 sessions. Pain intensity and cervical movements were evaluated before and after treatment. One session cost was 35 million Turkish Liras for these patients treated with conventional physiotherapy and 19 million Turkish Liras for manual therapy. Outcome measures were primarily changes in pain intensity and general health, both assessed with visual analog scale and Oswestry pain disability questionnaire. Both treatment strategies were efficient in patients with back/neck pain but manual therapy technique was found more effective in decreasing pain and increasing cervical movements and also cost effective because of short treatment period in these patients.

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Lumbal Spinal Stenosis: Assessment of Outcomes One-Year After Operative and Conservative Treatment: A Pilot Clinical Study

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The present study focuses on the one-year prognosis of radiographically verified stenosis of the lower lumbar spine. The purpose was to describe the outcomes from Roland-Morris, Oswestry, SF-36 Quality of Life Scales and Lumbal Examination Form after diagnosis of spinal stenosis and to identify factors predicting disability after operative (n=6) or conservative (n=7) treatment. Data were compiled on 13 patients (7 women and 6 men) with changes in patients with lumbar spinal stenosis diagnosed by MRI. Their mean age at the interview was 46 years. In the interview, subjective outcome assessment was obtained with a structured questionnaire, and the low back disorder was scored using the Roland-Morris Scale, Oswestry Disability Index, SF-36 Health Survey. The severity of the stenosis significantly predicted disability, even the effects of age, sex, therapy regimen, treatment sessions and body mass index were adjusted for stenosis type according to operative or conservative. Randomized clinical trials are needed to establish the indications for surgical and conservative treatment. Radiographic severity of lumbar spinal stenosis should be considered as an effect-modifying or confounding factor in clinical trials and other studies focusing on the outcome of lumbar spinal stenosis.

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Effectiveness of Manipulative Physiotherapy for the Treatment of Whiplash Injuries

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The purpose of this study was to determine the effects of physiotherapy and rehabilitation programme in patients with whiplash injury. Fifty-three patients with chronic symptoms associated with whiplash injury were treated with physiotherapy and rehabilitation programme included TENS, manual therapy techniques, stretching and stabilization exercises. The therapeutic effects were evaluated with pain intensity by the visual analogue scale and muscle testing according to Cyriax. Mean pain intensity was 8/10 and muscle strength was fair before treatment. After treatment pain intensity was 3/10 and muscle strength was good. In chronic whiplash injuries, early physiotherapy and rehabilitation has been shown to reduce pain and increase cervical movements.

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The Pain Intensity Level and Physical Function in Patients with Cervical Disc Herniation : Effectiveness of Manual Therapy

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The purpose of this study is to determine the effectiveness of manual therapy for patients with cervical disc herniation. Forty-five patients with complaining of neck pain with radiation of pain, tingling into the upper extremities and complaining about problems during daily life activities were included in the study. The patients were prescribed a treatment including mobilization techniques and stabilization exercises. The mean of pain intensity was 8/10 before treatment; it was decreased to 3/10 after treatment ($p<0.05$). Patients with cervical disc herniation were responded well to the treatment programme and they were return to their daily living without any complaints. We recommend a multidisciplinary rehabilitation with cognitive behavioral therapy and psychological interventions.

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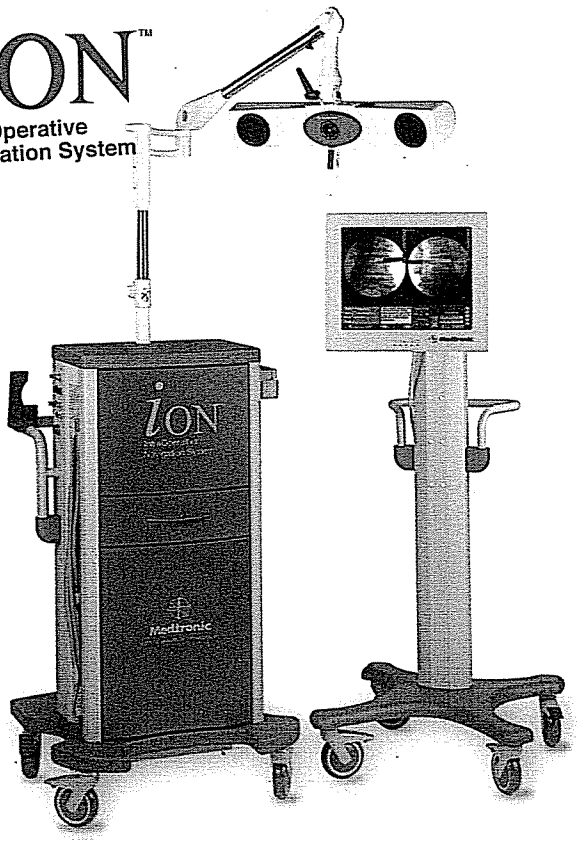

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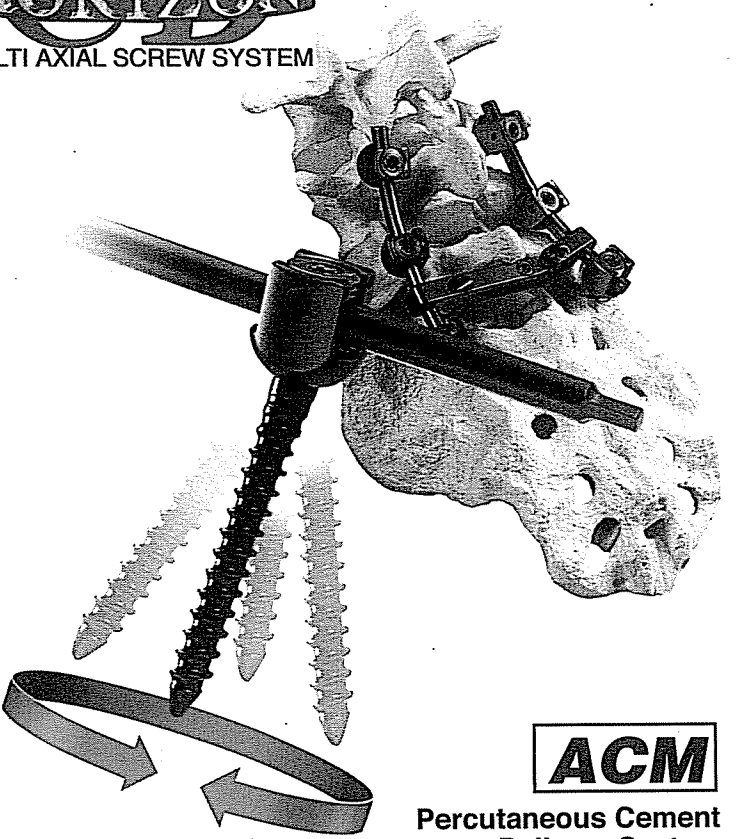
MULTI AXIAL SCREW SYSTEM



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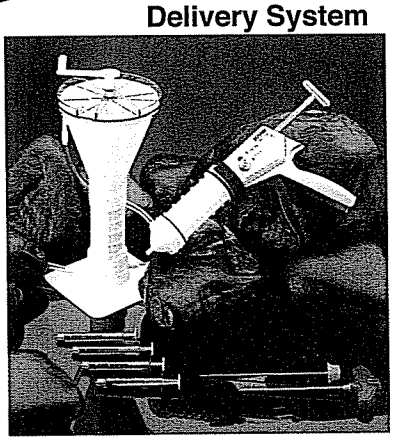

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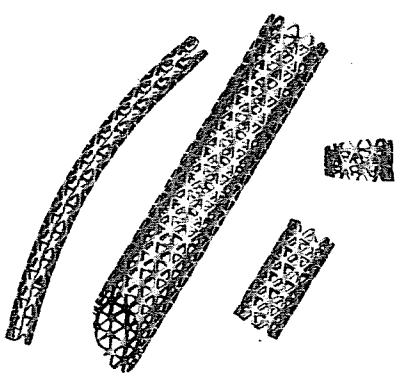

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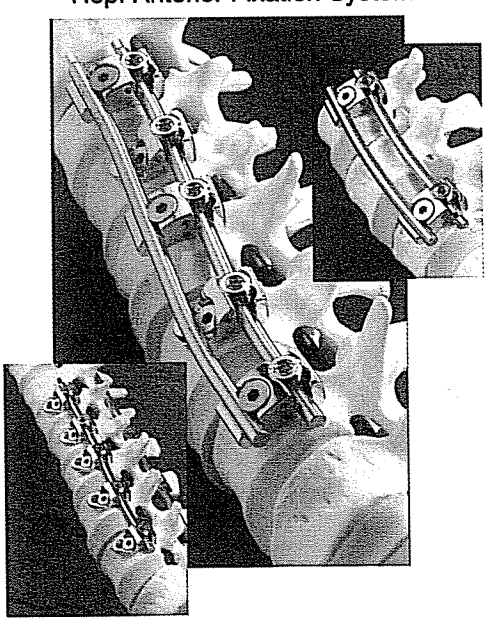
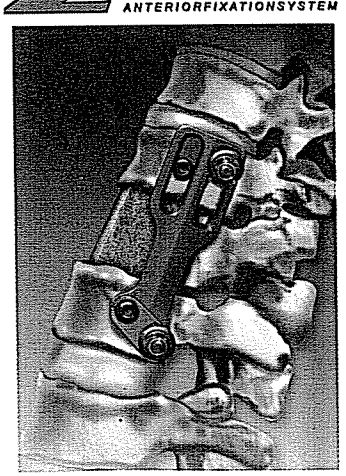
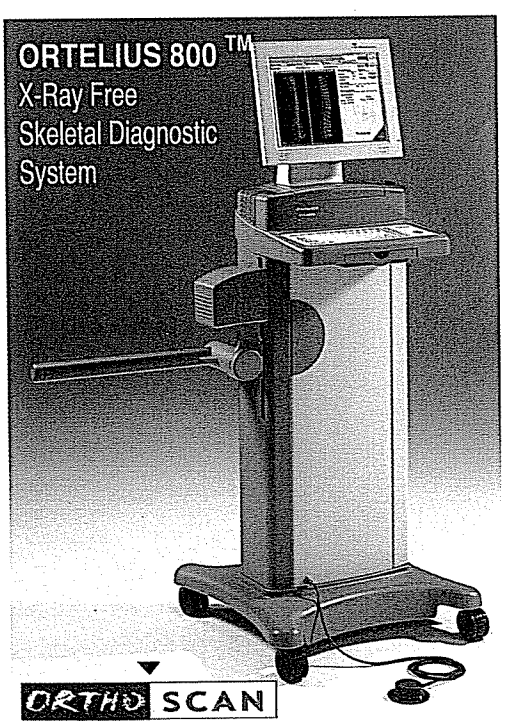
Hopf Anterior Fixation System



ZPLATE II
ANTERIORFIXATIONSYSTEM





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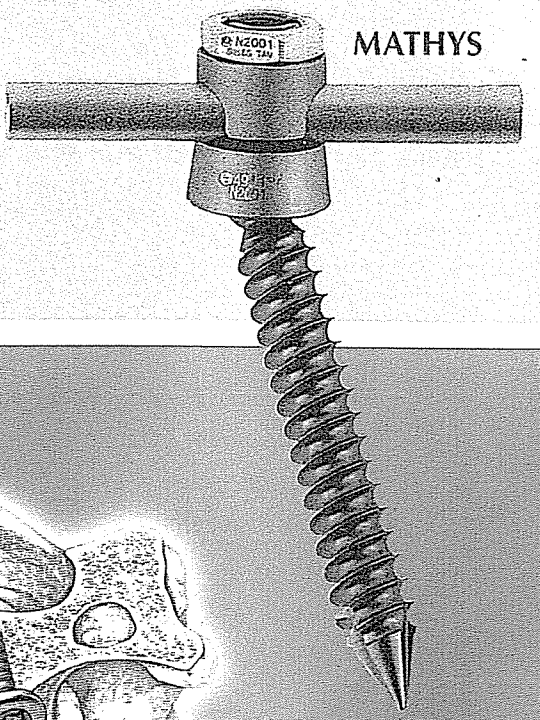

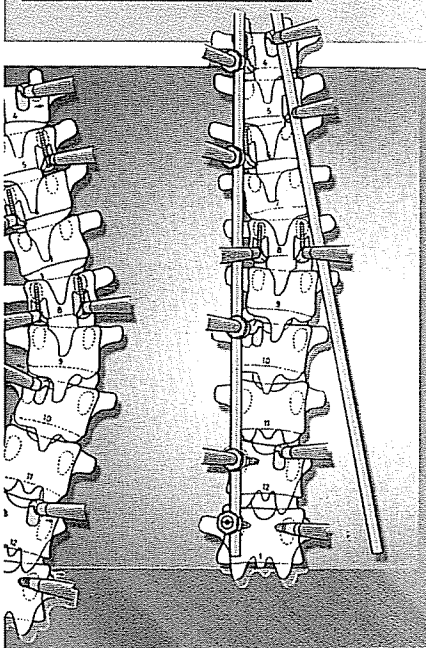

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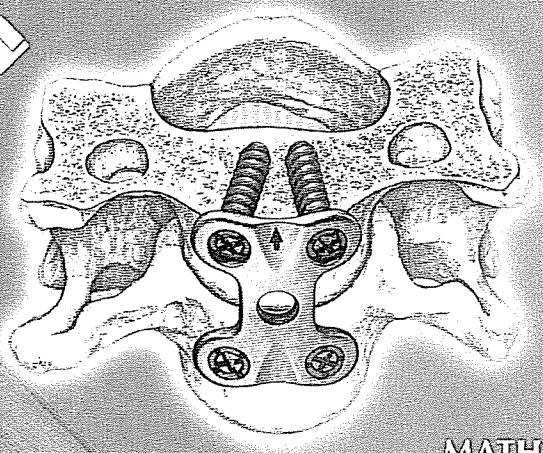

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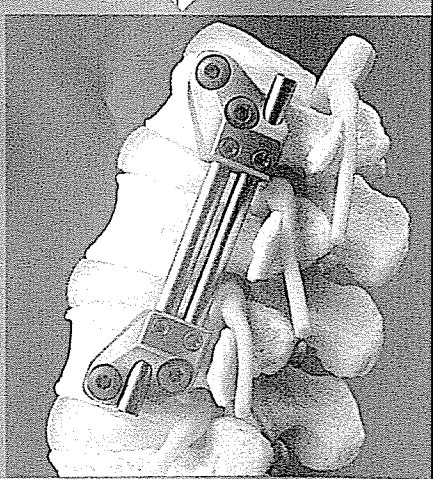

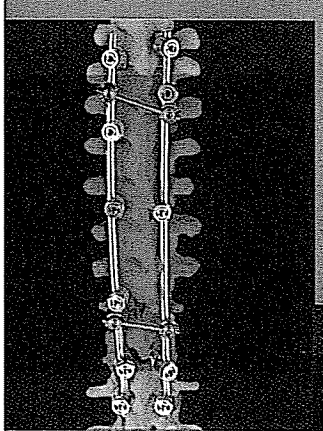

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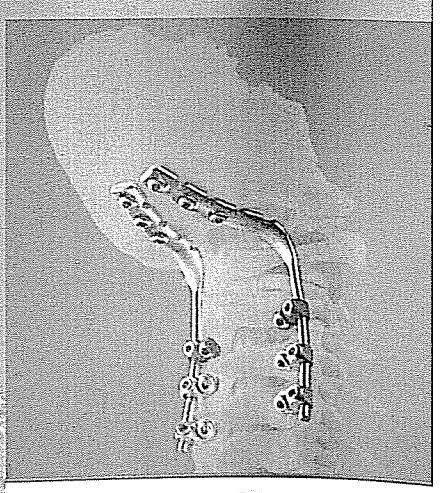

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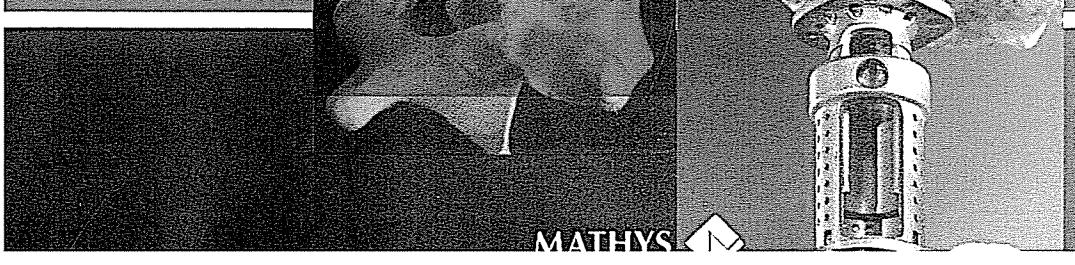

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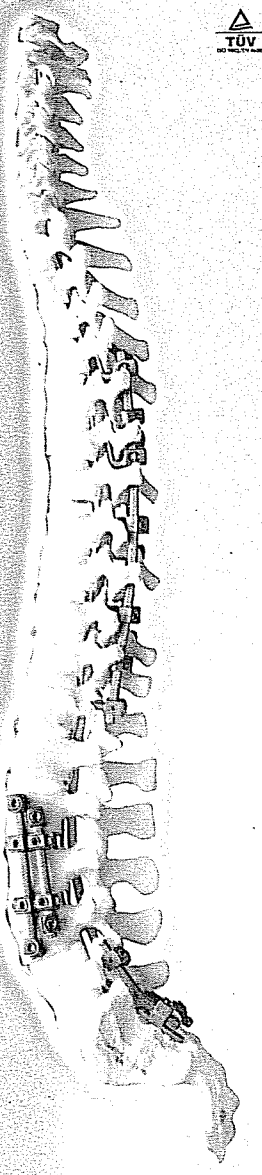

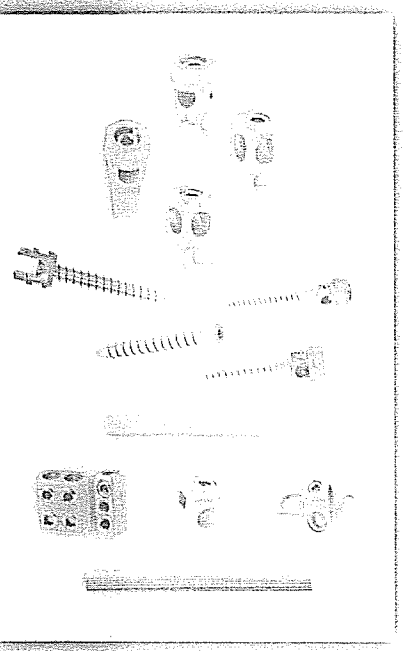

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