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Dear Colleagues,

We sincerely wish the new season of 2016 brings peace, happiness and health to all my colleagues and their families. We are happy to accomplish the second issue of 2016.

There are 6 research articles in this issue. The first article is about the anterior instrumentation and fusion of cervical dislocations. The second one is also about spinal trauma. Posterior impaction of the retropulsed bone fragments in the thoracolumbar fracture was discussed in this article. The third study is about the tuberculosis spondylitis of the spine. In the forth study, sagittal balance of the patients treated with posterior segmental instrumentation for AIS was evaluated. The last two article are about the microdiscectomy and kyphoplasty. We believe that all those studies will quietly interest the readers.

In this issue, a review article about the pediatric thoracolumbar spine fracture and a technical note about extended lumbar laminectomy were also presented.

In this issue, in the "Frontiers of the Spinal Surgery" section, the biography was presented about the Prof. Mahir Gülşen. The author of the this article is me.

The "Marmara Spinal Group Meetings", which includes İstanbul and neighboring cities and which is conducted to increase the interests of especially assistants and new specialist on spinal surgery and to contribute to their trainings and to transfer the experiences of experienced colleagues and will be organized each month regularly by the regulatory board, and which Assoc. Prof. Dr. Mehmet Aydoğan will perform the headship this year and Yunus Atıcı performs the secretariat, will be continued. You can find the other meeting contents from the announcements section.

We wish healthy, successful and peaceful days to Turkish Spinal Surgery family and we present our deepest respects.

Prof. Dr. İ. Teoman BENLİ
JTSS Editor

Volume: 27, Issue:2, April 2016 pp: 63-70 ORIGINAL ARTICLE / ORJİNAL MAKALE

IS OPEN REDUCTION AND ANTERIOR STABILIZATION EFFECTIVE AND SAFE FOR CERVICAL FRACTURES AND DISLOCATIONS? SINGLE INSTUTION EXPERIENCE WITH 21 CASES

SERVIKAL KIRIKLI ÇIKIKLARDA AÇIK REDÜKSİYON VE ANTERİOR STABİLİZASYON ETKİLİ VE GÜVENLİ MİDİR? 21 VAKALIK TEK MERKEZ DENEYİMİ

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SUMMARY:

Objective: To present our clinical outcomes with open reduction and stabilization method via anterior approach in patients with cervical fracture and dislocation.
Methods: This retrospective study was based on data derived from medical files of 21 patients surgically treated in the neurosurgery department of our institution between 2011 and 2015. Preoperative evaluation was made by means of American Spinal Injury Association (ASIA) and Subaxial Cervical Spine Injury Classification (SLIC) scores as well as radiological data obtained from computerized tomography (CT) and magnetic resonance (MR). Stabilization via anterior approach in supine position was performed routinely within 24 hours after admission. Postoperative controls carried out on 1st, 3rd and 6th months consisted of ASIA impairment scales and Bridwell grades extracted from radiological data.
Results: Vast majority of the fractures and dislocations were encountered at the levels of C5-6 (9/21; 42.8%) and C6-7 (8/21; 38.1%). Cervical spines were involved bilaterally in 12 (57.1%) patients. Mortality occurred in 3 cases (14.3%) due to acute respiratory distress syndrome and multiple organ failure within 1 month postoperatively. ASIA impairment scales on 1st and 6th months revealed a gradual recovery, while no difference was observed in terms of Bridwell grades on 3rd and 6th months. Majority of our cases (18/21; 85.7%) were devoid of any remarkable neurological deficits and they were discharged without any complications within 1 week postoperatively.
Conclusion: Our results indicate that open reduction and stabilization via anterior approach may be safe and effective operative technique in the management of cervical fractures and dislocations.
Key words: Cervical; dislocation; fracture; open reduction; stabilization; anterior approach.
Level of Evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Servikal kırıklı çıkıklarda anterior yaklaşımla açık redüksiyon ve stabilizasyon metodu uygulanan hastalardaki klinik sonuçlarımızı sunmayı amaçladık.
Yöntem ve Gereç: Bu retrospektif çalışmada 2011 ile 2015 yılları arasında hastanemiz beyin cerrahisi kliniğinde ameliyat edilen 21 servikal kırıklı-çıkık tanısı ie yatırılan hastanın tıbbi dosya ve bilgileri kullanılmıştır. Preoperative değerlendirme American Spinal Injury Association (ASIA) ve Subaxial Cervical Spine Injury Classification (SLIC) skorları ve bilgisayarlı tomografi (BT) ve magnetik rezonans görüntüleme (MRG) kullanılarak yapılmıştır. Başvuru sonrası 24 saat içinde supin pozisyonda anterior stabilizasyon rutin olarak yapılmıştır. Postoperatif dönemde birinci, üçüncü ve altıncı aylarada ASIA düşüş skalsı ve radiolojik verilerden elde edilen Bridwell dereceleri ile hastaların kontrolleri yapıldı.
Sonuçlar: Kırıklı çıkıkların büyük çoğunluğu C5-6 (9/21; 42.8%) ve C6-7 (8/21; 38.1%) seviyelerinde gözlenmiştir. Servikal vertebra 12 (57.1%) hastada bilateral etkilenmiştir. 3 vakada (14.3%) postoperative bir aylık sürede akut respiratuar distress sendromu ve çoklu organ yetmezliğine bağlı mortalite gelişmiştir. Ameliyat sonrası birinci ve altıncı aylarda ASIA skorlarında kademeli bir düzelme gözlenirken Birinci ve altıncı aylarda Bridwell derecelerinde bir farklılık gözlenmemiştir. Vakalarımızın çoğunda (18/21; 85.7%) belirgin bir nörolojik defisitleri yoktu ve ameliyat sonrası dönemde komplikasyonsuz olarak bir hafta içinde taburcu edilmiştir.
Yorum: Servikal kırıklı çıkıklı vakalarda anterior girişim ile açık redüksiyon ve stabilizasyon cerrahi tekniğinin güvenli ve etkili bir yöntem olduğu sonucuna varılmıştır.
Anahtar Kelimeler: Servikal omurga; çıkık; kırık; açık redüksiyon; stabilizasyon; anterior yaklaşım.
Kanıt Düzeyi: Retrospektif klinik çalışma, Level III

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INTRODUCTION:

Cervical dislocation and fracture is common and may occur secondary to distraction-flexion type of injuries in the subaxial cervical spine[4,13]. Unilateral facet injuries can result in increased range of motion and remarkable soft tissue damage including facet capsules, ligamentum flavum, annulus fibrosis and nucleus pulposus. The surgical treatment of cervical facet dislocations is highly variable including anterior alone, posterior alone, anterior-posterior, posterior-anterior, and anterior-posterior-anterior approaches[4,13]. Some authors support that the anterior only approach including closed or open reduction, discectomy and instrumental fusion is recommended, especially in case of a traumatic intervertebral disc herniation and without spinal cord injury[7,9]. However, it must be remembered that achievement of satisfactory reduction can be unfeasible in some cases with bilateral locked facets. Clinical and biomechanical evidence supports the use of anterior cervical discectomy and fusion with plating (ACDFP) for effective stabilization[13]. On the other hand, some publications suggest that ACDFP was less stable than some posterior approaches, especially in axial rotation[3].

In some cases with bilateral facet dislocation, anterior instrumental fusion followed by posterior fusion was recommended as a treatment modality. There is a debate for the ideal approach and treatment modality in the management of cervical fracture and dislocation. Open reduction and stabilization through anterior approach can eliminate the need for additional posterior supplementation. Moreover, patients may suffer from a high incidence of complications related to trauma, underlying disease process and management of the fracture regardless of the cause. Common complications consist of challenges associated with surgical stabilization and neurological deficits[14].

The objective of the current study was to present our clinical outcomes with open reduction and stabilization method via anterior approach in patients with cervical fracture and dislocation.

PATIENTS AND METHODS:

Study design:

This retrospective study was carried out on data derived from the medical files of 21 patients treated surgically in the neurosurgery department of our tertiary care center between 2011 and 2015. The approval of the local Institutional Review Board had been obtained prior to the study. Diagnosis of cervical fracture or dislocation was confirmed with radiological imaging modalities such as computerized tomography and magnetic resonance imaging. Surgical treatment was performed within 24 hours after admission. Preoperative neurological examination was comprised of American Spinal Injury Association (ASIA) and Subaxial Cervical Spine Injury Classification (SLIC) scores[11,12]. Postoperative assessment included ASIA impairment scales as well as Bridwell grades[10].

Surgical procedure:

All patients were operated uniformly in supine position via anterior approach. Anatomical alignment was restored and stabilization was accomplished in a single surgical session. Intraoperative neuromonitorization (IONM) was routinely used after 2013 except for patients with ASIA impairment scales of A and B.

Surgical intervention was initiated with a right paramedian transverse skin incision followed by blunt dissection. Esophagus and trachea were retracted medially, whereas sternocleidomastoid muscle and carotid sheath were drawn laterally. Bipolar cauterization was used to dissect longus colli muscles.

For bilateral locked facets, Caspar self-drilling distraction pins of 14 mm *(Aesculap surgical instruments Systems, PA,USA)* were placed in the midline of the upper and lower vertebra body. Subsequent to a slight distraction after this procedure, macroscopic discectomy was performed. After emptying the disc space, convex side of sedillot periosteal elevator *(Aesculap surgical instruments Systems, PA,USA)* was placed to the lower half of vertebral corpus. The concave part of elevator was used to compress the lower part of upper vertebra and convex part of the elevator was used for elevating the lower vertebra body. Simultaneous distraction of Caspar distractor provided achievement of normal configuration by restoration of the alignment of the facets.

For unilateral locked facets, unlocking was achieved with distraction and controlled rotation. Caspar self-drilling distraction pins were placed in the midline of the upper vertebra body and lower vertebra body pin was placed towards the locked side of facet with a angle of 35°-40°. After macroscopic discectomy sedillot periosteal elevator was used for compressing the upper vertebra body and for elevating lower vertebra. For unlocking unilateral locked facets distraction and controlled rotation was performed. Microscopic discectomy was followed by placement of PEEK (Polyetheretherketone) cage filled with 1 cc of allograft demineralized bone matrix (DBM) putty. Stabilization was provided by fixation using anterior cervical plate and screws. Layers were sutured and drain was maintained for 1 day after the operation. Gardner or Crushfield traction was not required in any of our patients. Use of Philadelphia cervical collar was recommended for 6 weeks and no infection was observed in any patients postoperatively.

Sample Case-1:

A 84-year-old male patient was referred to our clinic with a complaint of quadriplegia. In the history it was mentioned

that the patient fell from height and admitted to another hospital. Radiological examination revealed C5-6 dislocation with bilateral locked facet joints and pulmonary contusion with multi-rib fractures (Figure-1a, 1b). The patient's ASIA score was ASIA-A, SLIC score was 7. He was operated on 20th hour after trauma via anterior approach. Normal configuration by restoration of the alignment of the facets was achieved as described above (Figure-1c, 1d). In the intensive care unit the patient died because of multi organ failure.

Sample Case-2:

A 65-year-old male patient admitted to our emergency clinic with a complaint of severe neck pain after fall from height without any neurological deficit. Radiological examination revealed C5-6 dislocation with left locked facet joint (Figure 2a, 2b). The patient's ASIA score was ASIA-E, SLIC score was 5. He was operated on 12th hour after trauma via anterior approach. After unlocking unilateral loced facet with the help of Caspar self-drilling distraction pins and sedillot periosteal elevator normal alignment of the cervical spine was achieved (Figure 2c, 2d).

RESULTS:

An overview of descriptive, clinical and radiological data is demonstrated in **Table 1**. The average age of patients was 46.24 ± 15.55 (range: 19-84). Fifteen cases (71.4%) occurred due to a traffic accident, while 6 patients (28.6%) had cervical fracture / dislocation due to fall from height. Levels of the lesions were at C5-C6 (9, 42.9%); C6-C7 (8, 38.1%); C4-C5 (3, 14.3%) and C3-C4 (1, 4.7%). The mean preoperative SLIC score was 6.28 ± 1.42 (range: 5-9) and bilateral involvement was diagnosed in 12 cases (57.1%). The vast majority of the fractures and dislocations were encountered at the levels of C5-6 (9/21; 2.8%) and C6-7 (8/21; 38.1%).

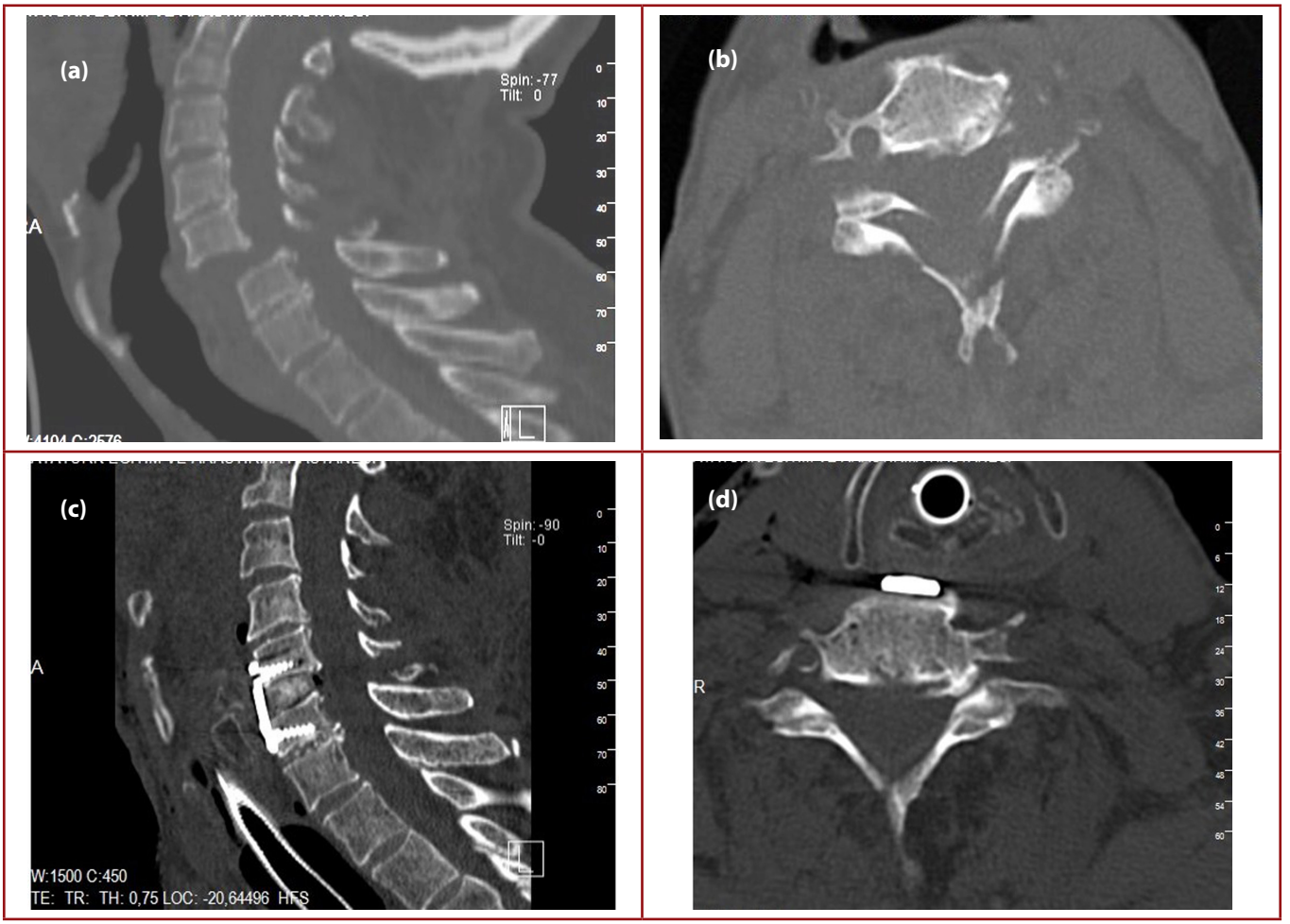

Figure-1. a) Sagital Computed Tomagraphy scan showing C5-6 dislocation. **b)** Axial Computed Tomography scan showing bilateral locked facet joints at C5-6 level. **c)** Postoperative sagital Computed Tomography scan. **d)** Computed Tomography scan showing normal facet joint configuration at C5-6 level.

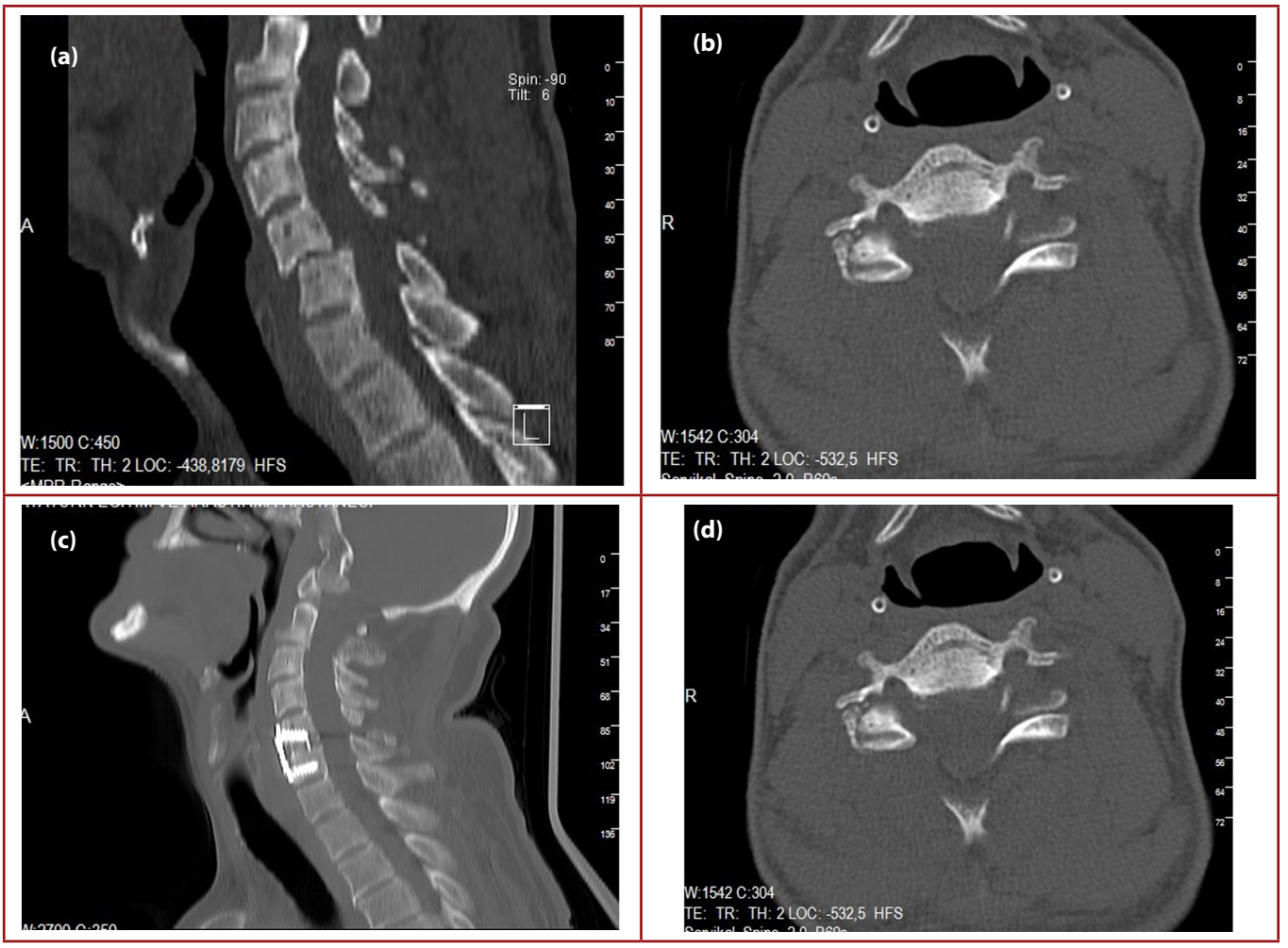

Figure-2. a) Sagital Computed Tomagraphy scan showing C5-6 dislocation. **b)** Axial Computed Tomagraphy scan showing left locked facet joint at C5-6 level. **c)** Post operative sagital Computed Tomagraphy scan. **d)** Computed Tomagraphy scan showing normal facet joint configuration at C5-6 level.

Facet locks in the cervical spines were bilateral in 12 (57.1%) patients and IONM was performed in 11 cases (52.4%). Number of patients with preoperative ASIA impairment scales of A, B, D and E were 3 (14.3%), 3 (14.3%), 3 (14.3%) and 12 (57.1%), respectively. The average duration of hospitalization was 12.67 ± 2.37 days (range: 4-38).

Mortality occurred in 3 cases (14.3%) due to acute respiratory distress syndrome and multiple organ failure within 1 month postoperatively. ASIA impairment scales on 1st and 6th months revealed a gradual recovery, while no difference was observed between Bridwell grades on 3rd and 6th months. Approximately ¾ of our cases had minor or no neurological deficits and they were discharged without any complications within 1 week postoperatively.

DISCUSSION:

The current study presents our experience with open reduction with stabilization through anterior approach for cervical fracture and dislocations. Results of the present study demonstrated that both unilateral and bilateral facet locks due to dislocation or fracture can be effectively treated by this method. Intraoperative neuronal monitorization can be a useful adjunctive measure that facilitates the procedure.

Monitorization of the clinical improvement and radiological recovery can be made reliably by ASIA impairment scales and Bridwell grades.

Fractures and dislocations of the spine are among the most challenging entities in the clinical practice of trauma. Vertebral column injuries can occur in these patients and approximately half of these cases have either co-existent spinal cord injuries or neurological deficits of nerve roots[1]. The main causes of traumatic spinal cord injury are motor vehicle-related accidents, violence, falls and sports injuries[8].

In our series, traffic accidents and falls were reported in the etiology of cervical dislocations or fractures.

Table-1. An overview of descriptive, clinical and radiological variables of our series.

No.	Sex	Age	Type of trauma	Level of lesion	SLICpreop.	Facet lock	ASIA preop.	IONM	Duration of hospitalization	ASIA 1st month	Bridwell grade 3rd month	Bridwell grade 6th month	ASIA 6th month
1	M	43	TA	C6-C7	7	Bilateral	A	-	34	B	II	I	B
2	M	67	TA	C6-C7	8	Bilateral	B	-	33	N/A	N/A	N/A	N/A
3	M	38	TA	C5-C6	6	Unilateral	E	-	4	E	I	I	E
4	F	57	Fall	C4-C5	5	Unilateral	E	-	5	E	II	I	E
5	M	30	TA	C5-C6	5	Bilateral	E	-	7	E	II	I	E
6	F	49	TA	C6-C7	8	Bilateral	B	-	10	C	I	I	C
7	M	51	TA	C5-C6	6	Bilateral	D	-	6	E	II	II	E
8	M	26	TA	C6-C7	5	Bilateral	E	+	8	E	II	I	E
9	M	50	TA	C6-C7	5	Bilateral	E	+	5	E	I	I	E
10	M	38	TA	C5-C6	6	Unilateral	E	+	4	E	I	I	E
11	F	47	Fall	C6-C7	6	Unilateral	E	+	9	E	II	II	E
12	F	26	TA	C3-C4	5	Bilateral	E	+	4	E	I	I	E
13	M	63	Fall	C5-C6	5	Unilateral	E	+	5	E	II	II	E
14	F	46	TA	C6-C7	8	Bilateral	D	+	6	D	II	II	E
15	M	53	TA	C5-C6	5	Unilateral	E	+	7	E	II	II	E
16	M	84	Fall	C5-C6	7	Bilateral	A	-	38	N/A	N/A	N/A	N/A
17	M	65	Fall	C5-C6	5	Unilateral	E	+	4	E	II	II	E
18	M	19	TA	C4-C5	7	Unilateral	D	+	7	D	II	I	D
19	F	40	TA	C6-C7	5	Bilateral	E	+	5	E	I	I	E
20	M	35	Fall	C4-C5	9	Unilateral	A	-	32	N/A	N/A	N/A	N/A
21	M	44	TA	C5-C6	9	Bilateral	B	-	33	B	II	I	B

(**Hint:** M: male; F: female; TA: traffic accident; Fall: fall from height; N/A: not applicable due to mortality; SLIC: Subaxial Cervical Spine Injury Classification; ASIA: American Spinal Injury Association; preop: preoperative; IONM: Intraoperative neuromonitorization;)

Lack of other causes such as violence and sports trauma may be due to defects may ensource from lacking or false information gathered from the patient.

Cervical region is the most common site of spinal cord injury and almost half of these lesions are linked with a neurological deficit[2].

The cervical region of the spine is comprised of 7 vertebrae and the lower cervical spine includes the third to the seventh vertebrae (C3 to C7). Relative movement of the vertebrae occurs primarily via the facet joints and intervertebral discs lie between the cylindrical parts of adjacent vertebrae. These discs act both as shock absorbers and allow movement. Allen et al. have classified subaxial cervical spine injuries into 6 categories including compression-flexion, vertical compression, distraction-flexion, compression-extension, distraction-extension and lateral flexion. Facet dislocations and fractures may exist due to distraction-flexion injuries and make up 10% of all subaxial cervical spine fractures. They may occur unilaterally or bilaterally[2]. Management of dislocations or fractures of cervical vertebra include controversial aspects. Reduction and internal fixation can be accomplished through anterior or posterior approaches. Selection of the mode of reduction as well as determination of the route of intervention such as anterior or posterior are crucial to achieve successful therapeutic outcomes[6]. The choice of surgical approach for the management of subaxial cervical spine facet dislocations and fractures is a debateful issue in spinal surgery. The causes of this controversy comprise the differences in the technical facilities and familiarity as well as the experience of surgeons with various surgical modalities. Moreover, differences in interpretation of the imaging studies for the extent of injury and the neurological status of the patient contribute to this variability. Therefore, attributed to the differences in surgical approaches, important variations may exist in terms of neurological, radiographical and clinical outcomes[2].

Even though cervical dislocations have been stabilized posteriorly; there is currently a trend for anterior surgery. This may be related with the concern regarding the potential for any disc herniation to lead to compression of spinal cord[2,5]. The anterior approach is initiated with decompression and discectomy at the level of the spine affected by the injury. This

intervention is followed by the reduction maneuver that may be carried out using Caspar vertebral pins[2].

Recent data indicated that there was little difference in long-term neurological status, pain or patient-reported quality of life between anterior and posterior surgical approaches to the management of individuals with subaxial cervical spine facet dislocations. Sagittal alignment can be accomplished via the anterior approach. There was insufficient evidence available to demonstrate differences between groups with respect to medical adverse events, rates of instrumentation failure and infection. Disorders related with voice and swallowing that were encountered in the anterior approach group resolved by three months. Thus, superiority of one approach over the other could not be confirmed and further higher quality multicentre randomized trials are warranted[2].

Our results imply that fractures and dislocations of cervical vertebra were encountered at the levels of C5-6 and C6-7. Mortality occurred within 1 month postoperatively and the causes underlying demise were acute respiratory distress syndrome and multiple organ failure. ASIA impairment scales reflected the insidious recovery on 1st and 6th months. On the other hand, radiological improvement was not remarkably noted in terms of Bridwell grades. Vast majority of our series displayed healing without any significant neurological deficits and complications within 1 week postoperatively.

Immediate reduction, realignment of the cervical spine and relief of pressure on the spinal cord are main goals in the treatment of cervical fracture and dislocations. Achievement of reduction must be followed by the most appropriate method of stabilization. Further trials must be performed to establish the main principles of treatment algorithm in the lesions of cervical spine.

Main restrictions of the present study include retrospective design, relatively small sample size and lack of a control group. Moreover, this data reflects the experience of a single institution. Lack of a powered statistical analysis and absence of evaluation of correlation constitute significant limitations. Results of the present study demonstrated that open reduction and stabilization via anterior approach is safe and effective in the management of cervical fractures and dislocations with loceked facets. Further prospective, randomized, multicentric, controlled trials on larger series are deemed necessary to establish the algorithm for management of cervical fracture and dislocations in spinal surgery.

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Conflicts of interest: None.

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EFFICACY OF IMPACTION OF RETRO-PULSED BONY FRAGMENTS IN LUMBAR BURST FRACTURES: COMPARISON WITH LIGAMENTOTAXIS

LOMBER PATLAMA KIRIKLARINDA KANAL İÇİNE GÖÇ ETMİŞ KEMİK PARÇALARININ ÇAKILMA YÖNTEMİNİN ETKİNLİĞİ VE LİGAMENTOTAKSİS İLE KIYASLANMASI

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SUMMARY:

Aim: Traumatic thoracolumbar burst fractures remain a challenge that have highly financial and social expenses. Burst spinal fractures are frequently related with neurologic deficit and in the young age group incidence of burst fractures is more frequent. We aimed to determine if the impaction of retropulsed fragments of burst fracture as a safe and effective method by the help of clinical and radiographic results.

Material and Method: 47 patients with thoracolumbar injury classification and severity score 4 or more, lumbar burst spinal fractures who underwent surgery in our clinic either posterior trans-pedicular stabilization and decompression with only ligamentotaxis (Group-1) (n= 28) or posterior trans-pedicular stabilization and decompression with ligamentotaxis and impaction of retropulsed fragments (Group-2) (n=19) were reviewed.

Results: The mean difference between preoperation and postoperation measurement of the retropulsed fragment in the only ligamentotaxis group was 1,189 ± 0,882099 mm and for the group ligamentotaxis with impaction was 4,752 ± 2,851291 mm. There is a significant difference between the two groups (p<0,05).

Conclusion: We conclude that for suitable patients impaction of retropulsed fragments of burst fracture can have better spinal canal restoration and decompression of neuronal elements.

Keywords: Burst Fractures, Impaction, Ligamentotaxis

Level of Evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Travmatik trokolomber patlama kırıkları yüksek finansal ve sosyal uğraşlar gerektiren bir sorundur. Spinal patlama kırıkları sıklıkla nörolojik defisitlerle karşımıza çıkar ve genç yaş grubunda spinal patlama kırığı görülme oranı daha yüksektir. Bu çalışmada kanal içine göç etmiş patlama kırığı parçalarının çakılma yönteminin güvenli ve etkili bir metod olduğunu klinik ve radyolojik verilerle ortaya koymayı amaçladık.

Yöntem ve Gereçler: Torako-lomber hasarlanma sınıflanması ve ciddiyeti skoru 4 ve üzeri olan 47 lomber patlama kırığı olan ve kliniğimizde ameliyata alınan hastalar çalışmamıza dahil edilmiştir. Hastalar posterior trans-pediküler stabilizasyon ve dekompresyonla birlikte sadece ligamentotaksis yapılan grup (Grup-1, n=28) ve posterior trans-pediküler stabilizasyon ve dekompresyonla birlikte ligamentotaksis ve kanal içine göç etmiş patlama kırığı parçalarının çakılması yöntemi uygulanan grup (Grup-2, n=19) olarak iki grupta incelenmiştir.

Sonuçlar: Kanal içine göç etmiş patlama kırığı parçalarının ölçüm ortalamalarının preoperatif ve postoperatif ortalama değerleri arasındaki fark sadece ligamentotaksis uygulanan grup 1'de 1,189 ± 0,882099 mm iken ligamentotaksis ve parça çakılması uygulanan grup 2'de bu değer 4,752 ± 2,851291 mm idi. İki grup arasında istatistiksel olarak anlamlı fark bulundu (p<0,05).

Yorum: Uygun hastalarda kanal içine göç etmiş patlama kırığı parçalarının çakılma yöntemi ile daha iyi spinal kanal restorasyonu ve nöral doku dekompresyonu sağlanabileceği görüşüne varılmıştır.

Anahtar Kelimeler: Patlama Kırığı, Çakılma, Ligamentotaksis

Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

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INTRODUCTION:

Spinal fractures are one of the leading problems in the Modern World Era that have highly financial and social expenses. Spinal fractures mostly occur in the thoraco-lumbar region (approximately 60%) and 15% of them are burst fractures[10]. Burst spinal fractures are frequently related with neurologic deficit and in the young age group incidence of burst fractures is more frequent[7].

The injury mechanism of burst fractures could be illustrated as axially loaded adjacent inter vertebral disc transfer the energy to the superior end plate, which causes fracture of superior end plate and transfer of inter vertebral disc to the vertebral body. This shift reasons displacement of bony parts in to central canal. The retro-pulsed bony structures could endanger the neuronal elements[3,12].

The gold standard treatment strategy of thoracic and lumbar vertebrae fractures is an unanswered problem of spinal surgery. There are many controversies such as non operative bracing or operative management with or without fusion, timing of surgery, anterior approach or posterior approach. If the surgery is indicated, there have been debates about the management of the fracture (anterior management or posterior management)[3].

Table-1. Thoracolumbar injury classification and severity score (TLICS)

TLICS scoring	
Parameter	**Points**
Morphology	
Compression fracture	**1**
Burst fracture	**2**
Translational/rotation	**3**
Distraction	**4**
Neurologic involvement	
Intact	**0**
Nerve root	**2**
Cord, conus medullaris	
Incomplete	**3**
Complete	**2**
Cauda Equina	**3**
Posterior ligamentous complex	
Intact	**0**
Injury suspected/intermediate	**2**
Injured	**3**
Management as per TLICS score	
Nonoperative	**0-3**
Nonoperative or operative	**4**
Operative	**≥5**

Thoracolumbar injury classification and severity score (TLICS) is a classification system based on the morphology of the injury, posterior ligamentous complex integrity, and neurologic examination. TLICS are summarized in Table 1. The patients who had thoracolumbar injury classification and severity score 4 or more were included in this study[5].

Some of the thoraco-lumbar fractures are observed as fracture of anterior column without failure of posterior osteoligamentous complex. These types of fractures can be categorized in stable fractures and can be treated without surgical intervention. When unstable burst fracture is observed, generally surgical intervention is chosen treatment modality. Surgically treated burst can be characterized as posterior osteoligamentous column failure with extensive spinal canal compromise, loss of height in the anterior part of the vertebrae and frequent rate of neurological deficits[11].

The indirect reduction of retro-pulsed bony structures by application of distraction forces by the help of intact ligaments and capsule is called as ligamentotaxis[4]. Both in spinal fractures and also in some of the other skeletal fractures as like distal radius fractures, tibial pilon fractures etc. skeletal restoration can be achieved by the help of ligamentotaxis[2,4].

There have been reports about the impaction of retropulsed fragments of burst fracture in the literature. It can be concluded that restoration of posterior wall of the burst fractured vertebrae by using impaction can improve the healing of bone and reduction of future kyphosis[1,8].

We planned a retrospective matched cohort study between posterior trans-pedicular stabilization and decompression with ligamentotaxis only group and posterior trans-pedicular stabilization and decompression with ligamentotaxis and impaction of retropulsed fragments group was conducted to determine the impaction of retropulsed fragments of burst fracture was a safe and effective method by the help of clinical and radiographic results.

METHODS:

From May 2010 to December 2014, 47 patients with TLICs score 4 or more, lumbar 1, lumbar 2 or lumbar 3 burst spinal fractures who underwent surgery in our clinic either posterior trans-pedicular stabilization and decompression with only ligamentotaxis (Group-1) (n= 28) or posterior trans-pedicular stabilization and decompression with ligamentotaxis and impaction of retropulsed fragments (Group-2) (n=19) were reviewed.

The causes of the burst fracture were falling from height (n=17) and motor vehicle accident (n=30). The patients female/male ratio was 18/29.

The levels of injury in group 1 were lumbar 1 (n=19), lumbar 2 (n=6) and lumbar 3 (n=3). The levels of injury group 2 were lumbar 1 (n=13), lumbar 2 (n=4) and lumbar 3 (n=2).

All patients were operated within 36 hours after injury. The neurologic assessments were performed before surgery and a day after and 3 months after surgery and ASIA assessment score was used.

For the radiological assessment direct x ray graphs, computed tomography scans, and magnetic resonance imaging scans were used to determine the type of burst fracture and spinal canal measurements.

As complication three wound infections, one iatrogenic cerebrospinal fluid (CFS) leakage and two revision surgeries due to screw malposition were observed. The mean follow up time for group-1 was 25 ± 11,81 months and for group-2 24,85 ± 10,85 months. For this period of time, No evidence of implant breakage or pseudoarthrosis was detected.

Figure-1. Standard central canal impactor.

Operative technique:

In Group-1, thoracolomber midline incision was performed approximately extending two vertebral levels above and below the fractured vertebra. The fracture level was determined by using intraoperative fluoroscopy. Posterior lumbar instrumentation was performed by using pedicular screw system. We used pedicule screws 2 levels above and 2 levels below the fractured vertebra. Total laminectomy of posterior bony structures with facetectomy was performed and then distraction obtained with the help of the distractor. In group 2 the same procedure is performed and with the help of a standard central canal impactor the retropulsed fragments are impacted (Figure-1).

The harvestered autologous bone grafts were used to achieve the dorsolateral spinal fusion with the help of decortication of the transverse process, pars interarticularis and lamina. Before the incision closed drainage tube is left in the operation field. The day after operation patients without extremity fracture are mobilized with the help of thorocolumbar orthesis.

Radiologic Assessment:

Preoperative and postoperative compromise of the fractured vertebra level spinal canal was investigated on the Computed Tomography scans. We used a calculation system based on the retropulsed fragments initial and after surgery displacement by either ligamentotaxis or ligamentotaxis and impaction.

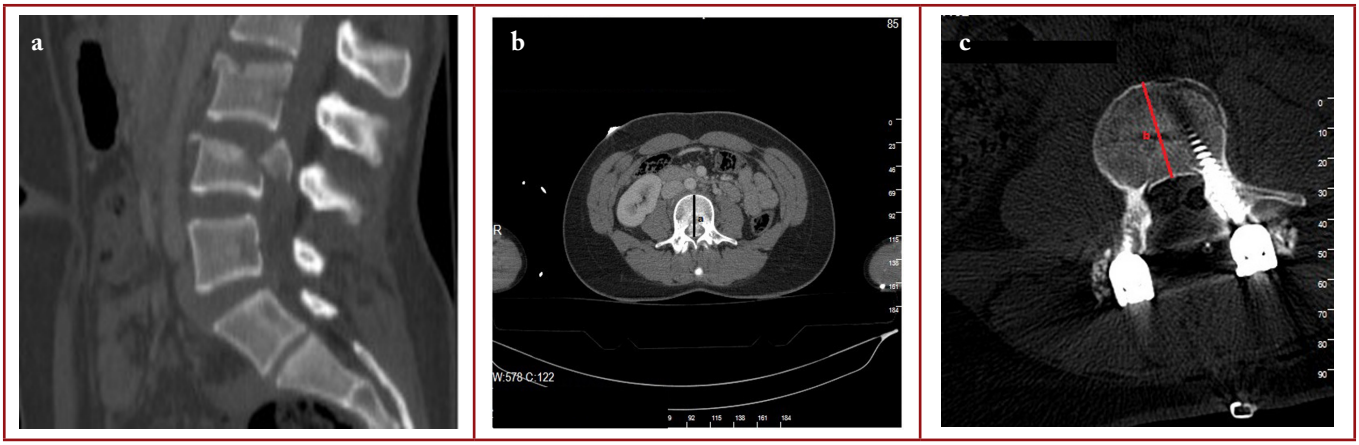

Figure-2. a) Preoperative sagital computed tomography scan of Lumbar 3 burst fracture **b)** Preoperative axial computed tomography scan of Lumbar 3 burst fracture. a: The distance between the most fore part of the vertebra body and most hind part of the retropulsed fragment. **c)** Postoperative axial computed tomography scan of Lumbar 3 burst fracture. b: The distance between the most fore part of the vertebra body and most hind part of the retropulsed fragment after ligamentotaxis with impaction.

We performed total laminectomy for all the fractures and there was no posterior margin to measure spinal canal so it was impossible to measure the exact anterio-posterior diameter of the spinal canal at the traumatic level. We used a new measurement technique. At the fractured level the most fore part of the vertebra body was used as a landmark. And the distance was measured between this landmark and most hind part of the retropulsed fragment (Figure-2.a, b, c).

After the selected operative procedure we performed the same calculation method for the postoperative measurement and the difference between the preoperative and postoperative measurements were used in the statistical analysis.

Clinical Assessment:

By the help of a blind observer who did not performed the operation, immediately preoperative and postoperative 1 and 3 days visual analog scores (VAS) were obtained. Also intraoperative blood loss was measured for the groups. Postoperative blood drainages of the groups were also investigated.

Stastical Analysis:

The data obtained from the study were evaluated using Statistical Package of Social Sciences for Windows 17.0. For the comparison of the groups non-parametric Wılcoxon signed rank test was used and $p<0.05$ was considered as a significant result.

RESULTS:

The mean follow up time of the only ligamentotaxis group was 25 ± 11,81 months and for the group ligamentotaxis with impaction was 24,85 ± 10,85 months.

The mean operation time of the ligamentotaxis group was 216,07 ± 46,54792 minutes and for the group ligamentotaxis with impaction was 237,36 ± 54,46 minutes. The difference between the two groups is not significant (p>0,05).

The average volume of intraoperative blood loss in the ligamentotaxis group was 1167,857 ± 218,0327 ml and for the group ligamentotaxis with impaction was 1286,842 ± 245,9365 ml. The difference between the two groups is not significant (p>0,05).

The mean difference between preoperation and postoperation measurement of the retropulsed fragment in the only ligamentotaxis group was 1,189 ± 0,882099 mm and for the group ligamentotaxis with impaction was 4,752 ± 2,851291. There is a significant difference between the two groups (p<0,05).

In group-I preoperative, postoperative first day and post operative third day mean VAS scores were 8,5 ± 0,86, 2,92±0,75 and 1,64±0,66 respectively. In group-II preoperative, postoperative first day and post operative third day mean VAS scores were 8,21 ± 0,76, 2,71 ± 0,73 and 1,63 ± 0,66 respectively. There was no significant difference between groups in terms of VAS (p>0,05).

Over all we can conclude that the ligamentotaxis with impaction of retropulsed fragments group had slightly more peroperative blood loss and longer operation duration. But no significant difference was observed in terms of these parameters. On the other hand the ligamentotaxis with impaction of retropulsed fragments group had significantly better radiological fragment measurements.

DISCUSSION:

Traumatic thoracolumbar burst fractures remain a challenge to treat and caused by a vertical load, with or without flexion. Kyphotic deformity, and spinal canal occlusion caused by retropulsion of the fracture segment mostly causes neurological deficit.

The aims of the surgical treatment are stabilization and restoration of vertebral column, decompression of neuronal elements, and early mobilization of the patient as soon as possible[7]. To achieve these goals, numerous studies have investigated different diagnostic, prognostic, and management approaches. For lumbar burst fractures, distraction and lordosation using transpedicular screws contribute to this restoration mostly by the way of ligamentotaxis. Ligamentotaxis can be helpful when only the retro-pulsed bony parts are connected with posterior longitudinal ligament and disc capsule. Posterior longitudinal ligament has superficial layers, which pulled back the bony fragments localized in the center of central canal and deep layers that pulled back the laterally localized fragments[2,4]. In the literature, the extent of spinal widening by ligamentotaxis shows a variation from 14% to 30% [6].

Dislocated fragments of the posterior vertebral body may cause spinal stenosis to some extent. Although tension on the ligament by distraction and ligamentotaxis may lead to repositioning, especially of smaller fragments, large fragments may resist reduction. Some studies are carried out to widen the spinal canal for large trapezoid-shaped fragments[6]. Scapinelli reported in 1995 on five adult patients with thoracolumbar spinal fractures with associated intracanal displacement of a large bone fragment[9].

In our study the mean difference between preoperation and postoperation measurement of the retropulsed fragment in the ligamentotaxis with impaction group was significantly higher. Widening of the spinal canal aim was achieved more in the ligamentotaxis with impaction group. There were no significant differences between two groups in terms of blood

loss and operation duration. VAS scores of impaction group were slightly higher at postoperative first day but there was no significant difference at postoperative third day.

Reposition of retropulsed fragments was achieved by the help of a standard central canal impactor in this study. Some authors argue that for such patients the risk of iatrogenic injury to the spinal cord is higher than the risk of suffering neurologic symptoms due to the accident. But in our study no additional neurological deficit was observed after operation. We suggest that because we performed total laminectomy of posterior bony structures with facetectomy the risk of iatrogenic spinal cord injury was minimal.

We believe that decompression of neuronal elements, restoration of spinal canal and stabilization of vertebral column are indispensable for the treatment of burst fractures. We conclude that impaction can have better spinal canal restoration and decompression of neuronal elements statistic data revealed that there has been a significant difference between these two groups.

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Volume: 27, Issue:2, April 2016 pp: 77-84 ORIGINAL ARTICLE / ORJİNAL MAKALE

LUMBAR LORDOSIS AFTER POSTERIOR SPINAL FUSION IN ADOLESCENT IDIOPATHIC SCOLIOSIS: A RETROSPECTIVE ANALYSIS OF 22 PATIENTS

ADÖLESAN İDİOPATİK SKOLYOZDA POSTERİOR SPİNAL FÜZYON SONRASI LOMBER LORDOZ: 22 HASTANIN GERİYE DÖNÜK DEĞERLENDİRİLMESİ

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SUMMARY:

Study Design: Retrospective single-center clinical study

Objective: We aimed to evaluate lumbar lordosis after posterior spinal fusion and bilateral segmental instrumentation for AIS. We also evaluated patients' satisfaction with treatment.

Methods: Twenty-two AIS patients treated with posterior spinal fusion and followed at least two years after the operation were evaluated retrospectively. Radiographic parameters for changes on frontal and sagittal planes were measured on anteroposterior and lumbar lordosis X-rays, and patients' satisfaction was assessed by Scoliosis Research Society (SRS)-22r Patient Questionnaire preoperatively, at sixth month postoperatively, and at final visit which was at 43.6 months on average (range, 24-66 months).

Results: The mean thoracic or thoracolumbar curve correction rate was 74.6±11.8%. The lumbar lordosis decreased from 51.3°±13.1° to 42.8°±12.6° (p=0.014) and sacral slope angle from 40.9°±5.7° to 27°±8.7° (p<0.001) after the operation. Mean pelvic tilt angle increased from 7.9°±7.6° to 20.2°±9.9° (p<0.001). Thoracic kyphosis was within normal limits and did not change significantly throughout the follow-up. Total SRS-22r score improved from 3.4±0.6 to 4±0.3 after AIS surgery.

Conclusions: AIS surgery had no significant effect on throcal kyphosis and lumbar lordosis on sagittal plane; even insignificant decrease in lumbar lordosis reduces sacral slope, thus keeps sagittal C7 plumbline within normal limits, and as a result provides sagittal balance.

Keywords: Spine; Adolescent idiopathic scoliosis; Posterior spinal fusion; Bilateral segmental instrumentation.

Level of evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Bu çalışmamızda, AİS tedavisinde posterior spinal füzyon ve bilatarel segmental füzyon sonrasında lomber lordozun ve hastaların memnuniyetinin değerlendirilmesini amaçladık.

Materyal ve metod: AİS nedeniyle porterior spinal füzyon ile tedavi edilen ve operasyondan sonra en az iki yıl takibi olan 22 hasta retrospektif olarak değerlendirildi. Anteroposterior ve lomber lordoz direkt grafilerinde, frontal ve sagittal plandaki radyografik parametrelerdeki değişiklikler ölçüldü. Ameliyat öncesinde, ameliyat sonrası 6. ayda ve son takiplerinde (ortalama 43.6 ay, 22-66 ay) Scoliosis Research Society (SRS)-22r hasta değerlendirme anketi ile hasta memnuniyeti değerlendirildi.

Bulgular: Ortalama torasik ve torakolomber düzeltme % 74.6±11.8 idi. Ameliyat sonrası lomber lordoz 51.3° ± 13.1°'den 42.8° ± 12.6°'ye geriledi (p=0.014) ve sakral slop açısı 40.0° ± 5.7°'den 27° ± 8.7°'ye geriledi (p<0.001). Ortalama pelvik tilt açısı 7.9° ± 7.6°'den 20.2° ± 9.9°'ye yükseldi (p<0.001). Torasik kifoz normal sınırlar içerisinde idi ve takipler sürecinde anlamlı bir değişiklik göstermedi. Ameliyat sonrasında toplam SRS-22r puanı 3.4 ± 0.6 'dan 4 ± 0.3'e yükseldi.

Tartışma: AİS cerrahisi, lomber lordozda bir miktar azalma sakral slopu azaltsa bile, sagittal planda torakal kifoz ve lomber lordoz üzerinde anlamlı bir etki yapmamaktadır. Böylece sagittal C-7 çekül ipi çizgisi normal sınırlarda kalmakta ve sonuç olarak sagittal balansı korumaktadır.

Anahtar kelimeler: Omurga; Adelösan idiopatik skolyoz, posterior spinal füzyon, bilateral segmental enstrümentasyon

Kanıt düzeyi: Retrospektif klinik çalışma, Düzey III

INTRODUCTION:

Adolescent idiopathic scoliosis (AIS) is a three-dimensional torsional deformity of the spine that arises in otherwise healthy children around puberty. It is a complex disorder involving other bony structures such as the rib cage and often characterized by preoperative hypokyphosis[9,15,16]. It may lead to significant pain and functional disability; therefore, surgical correction is often required. In a successful AIS surgery, the main focus is the coronal curvature correction for achievement of shoulder level to have a proper balance of the spine on both the sagittal and coronal planes to prevent further deformity, to improve cosmesis, and to prevent back pain and subsequent cardiac and pulmanory problems[6,10,17,18].

Modern posterior segmental instrumentation systems, using a combination of hooks, wires, and pedicle screws, have enhanced a surgeon's ability to improve thoracic sagittal alignment and to maintain normal sagittal balance compared to previously used Harrington distraction instrumentation[1,3-5,7,11,13,14,19,21-24]. Despite advances in techniques and newer implants, avoiding persistent thoracic hypokyphosis can still be difficult, and posterior instrumentation systems tend to be more lordosing than anterior instrumentation[5,18].

Thoracic hypokyphosis as a surgical outcome of AIS have been well described in literature[4,15,22,23]; however, to our best of knowledge, there is no study evaluating the effect of posterior spinal fusion with segmental pedicle screw instrumentation on lumbar lordosis. Thus, we primarily aimed to evaluate the frontal and sagittal parameters, especially lumbar lordosis, after posterior segmental pedicle screw instrumentation and spinal fusion in AIS. We also evaluated patients' satisfaction with treatment.

MATERIALS AND METHODS:

Study design and patients:

Twenty-two patients with AIS (female/male ratio, 17/5; mean age, 14.2; age range, 12 to 22 years) treated with posterior spinal fusion and bilateral segmental pedicle screw instrumentation between 2010-2012 and followed at least two years after the operation were included in this retrospective study. Patients with neuromuscular scoliosis, congenital scoliosis or with prior scoliosis surgery were excluded.

This study was approved by the Institutional Ethics Committee and conducted in accordance with the Helsinki Declaration. All patients or legal represantatives signed a written informed consent form.

Clinical assessment:

Patients were examined preoperatively, at sixth month postoperatively, and at final visit which was at 43.6 months on average (range, 24-66 months). AIS was classified according to the amount of thoracic kyphosis: hypo, hyper and normokyphotic as described by Lenke et al[11]. The presence of secondary sex characters (axillar and pubic hair, breast development) and limb length discrepancy were recorded. Radiographical maturation was scored according to Risser sign[19]. Shoulder balance, pelvic balance, and 7th cervical vertebra C7-gluteal interval balances were evaluated with plumb line and costal and lumbar gibbosities with forward bending test in follow-up examinations.

Surgical technique:

Two senior surgeons (A.A.U. and M.Y.) performed one-stage posterior surgical correction and fusion with the same surgical correction technique by only posterior approach with derotation maneuver after placement of hybrid (screws/hooks) or all screws construct, without neuromonitorization. Posterior pedicular screws were applied at every level through standard paravertebral approach. Reduction technique was rod derotation, cantilever or simultaneous translation of two rods with spondylolisthesis screws.

Radiographic parameters

The radiographic measurements were obtained by the same orthopedic surgeon for all case (M.Y.) on entire vertebral column anteroposterior and lateral 36" cassette radiographs in standing position. In anteroposterior radiographs, distance of vertical line drawn from the C7 to the midsacral line (C7-midsacral), upper thoracic, thoracic, and lumbar Cobb angle[3], thoracic and lumbar rotation[14], 1st thoracic vertebra (T1) and pelvic parameters in the coronal plane[3] were measured (Figure-1).

The pelvic parameters were pelvic incidence, pelvic tilt angle, and sacral slope. Pelvic incidence is a morphological parameter defined as the angle between the line perpendicular to the middle of the cranial sacral endplate and the line extending from the middle of the cranial sacral endplate to the center of the bicoxofemoral axis (the line between the geometric centers of both femoral heads) (Figure-2).

Pelvic tilt angle is the angle between the vertical line and the line joining the middle of the superior sacral plate and the center of the bicoxofemoral axis. Pelvic tilt angle is a positional parameter acting as one of the regulator of the standing posture; pelvic retroversion (i.e., the posterior rotation of the pelvis) has been demonstrated to correlate with clinical outcomes in the setting of adult with spinal deformities[9]. Sacral slope is also a positional parameter and completes to geometrical relationship among pelvic parameters, where pelvic incidenceis equal pelvic sum of tilt angle and sacral slope, and defined as the angle between the horizontal line and the superior sacral end-plate tangent.

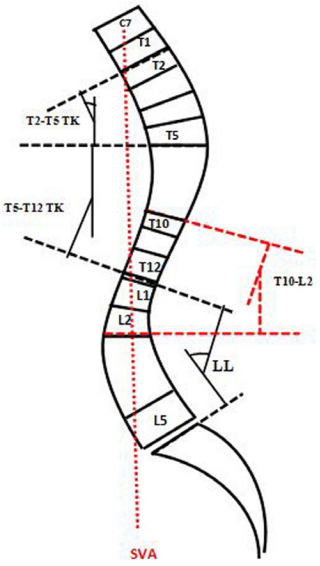

Figure-1. Radiographic pelvic parameters. PT; Pelvic tilt, the angle between the vertical line and the line joining the middle of the superior sacral plate and the center of the bicoxofemoral axis. PI; Pelvic incidence, the angle between the line perpendicular to the middle of the cranial sacral end-plate and the line extending from the middle of the cranial sacral endplate to the center of the bicoxofemoral axis (the line between the geometric centers of both femoral heads). SS; Sacral slope, the angle between the horizontal line and the superior sacral end-plate tangent.

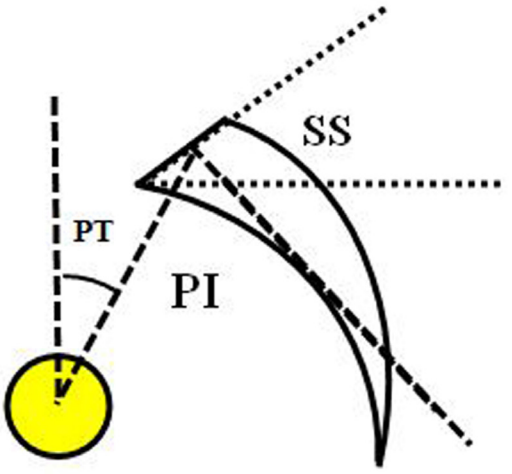

Figure-2. Sagittal spinal radiographic parameters. SVA; Sagittal vertical axis, the horizontal offset from the posterosuperior corner of S1 to the vertebral body of C7. TK; Thoracic kyphosis, is measured from the superior endplate of T4 to the inferior endplate of T12. LL; Lumbar lordosis is measured from the superior endplate of L1 to the superior endplate of S1.

Distance of C7 vertebral body midpoint plumb line to the posterosuperior corner of 1st sacral vertebra (S1) body, angles between T2-T5, T5-T12, T10-2nd lumbal vertebra (L2), and T12-S1 were measured in the sagittal plane and sagittal profile of the patients were generated accordingly[3].

Patient satisfaction

For the assessment of patients' satisfaction with AIS surgery, Scoliosis Research Society (SRS)-22r Patient Questionnaire was used. The SRS-22r is a valid instrument for the assessment of the health related quality of life of patients with scoliosis. It has five domains, each scoring between 1 (worst) and 5 (best): function, pain, self-image, mental health, and satisfaction with management. Turkish version of SRS-22r has been shown to be valid and reliable[21].

Statistical analysis

Statistical analysis was performed by the SPSS software package for Windows (Statistical Package for Social Sciences, version 12.0, SPSS Inc., Chicago, Illinois, USA). Categorical variables of the study groups were given as numbers and percentages and quantitative variables as mean±standard deviation (SD), median, minimum and maximum values. Student's t-paired test was used for parametric variables that followed a normal distribution. Pearson correlation was used to determine the relationship between variables. For comparison of more than two groups, Friedman test followed by post-hoc analysis with Wilcoxon signed rank test were used. The level of significance was set at $p<0.05$.

RESULTS:

Study population

The mean age at the onset of deformity was 12.1±2.5 years. Secondary sex characteristics were found only in one patient. Two female patients did not have menarche at the time of AIS surgery. Physical examination of the study patients showed distribution among several AIS classification types[13] and radiographical maturation grades (Table-1)[19].

Ten patients had type A, two had type B and the other ten had type C lumbar modifier. Five patients were hypokyphotic and one was kyphotic, whereas 72.7% of the patients had 10°-40° of kyphosis. Two patients had leg length discrepancy less than 2 cm and five patients had received orthotic treatment before surgery. Proximal fusion level was T2 in all patients, and distal fusion level was T12 in seven, L2 in seven, L3 in three, T11 in two, L1 in two and T10 vertebrae in one case. Four patients developed pulmonary complications like prolonged ventilation and pneumothorax but no significant relation was noted between development of pulmonary complications and coronal or sagittal parameters.

Table-1. Demographic and clinical characteristics of the study patients

		Total (n=22)
Age (mean±SD, years)		14.2±2.4
Gender (n, %)	Male	5 (22.7%)
	Female	17 (77.3%)
AIS classification (13) (n, %)	Type 1	7 (31.8%)
	Type 2	6 (27.3%)
	Type 3	3 (13.6%)
	Type 4	1 (4.6%)
	Type 5	2 (9.1%)
	Type 6	3 (13.6%)
Radiographical maturation (14) (n, %)	Grade 0	1 (4.6%)
	Grade 1	1 (4.6%)
	Grade 2	5 (22.6%)
	Grade 3	1 (4.6%)
	Grade 4	11 (50.0%)
	Grade 5	3 (13.6%)

Changes in clinical and radiographic parameters after AIS surgery

There were significant improvements in preoperative shoulder balance, pelvic balance, costal gibbosity and lumbar gibbosity values after AIS surgery and at the last follow-up ($p<0.05$ for all, Table-2).

The mean postoperative frontal plane correction compared to preoperative value was 74.6±11.8%, whereas correction percentage at the last follow-up was 75.5±12.5%. No significant correction loss was observed in any study patients. There were significant improvements in the upper frontal, thoracic and lumbar deformity parameters after surgery ($p<0.05$ for all, Table-3).

However, no significant increase in thoracic kyphosis values, all of which were within normal limits, was observed at sagittal plane ($p=0.702$, Table 3). Three patients developed hypokyphosis after surgery. There was no significant difference between preoperative and postoperative kyphosis degrees in either patients with or without hypokyphosis ($p>0.05$ for both).

The mean postoperative lumbar lordosis decreased from a mean of -51.3°±13.1° to -42.8°±12.6° at the final follow-up examination ($p=0.014$). With respect to preoperative pelvic measurements and measurements at the last follow-up, there was a significant decrease in sacral slope angle from 40.9°±5.7° to 27°±8.7° ($p<0.001$), and pelvic tilt angle was found to be significantly increased from 7.9°±7.6° to 20.2°±9.9° ($p<0.001$).

The preoperative total SRS-22r scores of the patients significantly improved in the last follow-up after surgery (3.4±0.6 to 4±0.3, $p<0.001$).

DISCUSSION:

In this retrospective study involving 22 AIS patients treated with posterior pedicle screw instrumentation and fusion, postoperative coronal plane curve correction at the last follow-up examination was found to be about 75%.

Table-2. The change in physical examination findings of the patients before and after AIS surgery

	Preoperative	Postoperative6 months	Last follow-up(24 to 66 months)	p[a]
C7-gluteal space (cm)	1.5±1.8	0.7±0.9	0.5±0.7	0.150
Shoulder balance (cm)	1.3±1.1	0.4±0.8	0.4±0.5	*0.004*
Pelvic balance (cm)	0.3±0.7	0±0	0±0	*0.018*
Costal gibbosity (cm)	3±1.8	0.2±0.4	0.6±1	*<0.001*
Lumbar gibbosity (cm)	0.5±1	0±0	0±0	*0.002*

[a]Friedman test for comparison of preoperative versus postoperative 6 months values.
The results are given as mean±SD.

Table-3. The change in radiographic parameters of the patients before and after AIS surgery

	Preoperative	Postoperative	Last follow-up (24 to 66 months)	p[a]
Frontal C7-midsacral line (cm)	1.9±1.3	1.2±1.2	1±1	0.190
Frontal T1 tilt angle (°)	6.2±6.1	2.3±3.2	2.3±3.7	*0.001*
Frontal upper thoracal curve (°)	16.4±16.2	3.2±7.6	3.3±6.6	*<0.001*
Frontal thoracal curve (°)	59.6±16.6	15.1±7.6	14.1±8.8	*<0.001*
Frontal lumbar curve (°)	33.7±30.2	12.3±12.2	13.6±11.3	*0.002*
Upper thoracal rotation	0.6±0.7	0.2±0.5	0.2±0.4	*0.003*
Thoracal rotation	1.9±0.8	0.8±0.6	0.9±0.5	*<0.001*
Lumbar rotation	1.1±1.1	0.7±0.8	0.6±0.7	*0.013*
T2-T12 kyphosis (°)	31.6°±18.8°	30.5°±10.2°	28.5°±8.5°	0.702
Sagital C7-plumb line (cm)	1.7±2.3	3±2.1	2.2±2.3	0.225
Sagital T2-T5 (°)	10.1°±9.4°	11.4°±7.6°	10.4°±6.9°	0.688
Sagital T5-T12 (°)	21.5°±16.8°	20°±10°	18.1°±6.8°	0.781
Sagital T10-L2 (°)	7.1°±20.2°	1.1±11.8	-1±9.6	0.272
Lumbar lordosis (°)	-54.9±19.4	-51.3±13.1	-42.8±12.6	0.232
Sacral slope angle (°)	40.9±5.7	39.7±4.3	27±8.7	*<0.001*
Pelvic tilt angle (°)	7.9±7.6	8±5.2	20.2±9.9	*<0.001*

[a]Friedman test for comparison of preoperative versus postoperative 6 months values.
The results are given as mean±SD.

Although there was no significant increase in thoracic kyphosis, preoperative, postoperative and the last follow-up kyphosis values of the study patients were in the normal limits. In addition, postoperative T1 tilt angle was significantly improved with AIS surgery.

Maintaining or restoring sagittal balance and sagittal plane parameters within the normal values is important in maintaining the long-term health of the spine[18]. Patients with AIS are characterized by preoperative thoracic hypokyphosis, and it is generally accepted that surgical treatment should aim to improve sagittal plane deformities and to restore thoracic kyphosis to normal values while maintaining lumbar lordosis and good overall sagittal balance[10,18]. The use of pedicle screws with posterior instrumentation construct was shown to allow a stronger correction of spinal deformity[1,7,24].

The main aim of AIS surgery is the correction of trunk distortion, along with the cosmetic deformity[8,12,15]. The unleveled shoulders and costal gibbosity are commonly observed in AIS patients with distorted thoracic curve[16]. In addition, lumbar gibbosity and pelvic imbalance are observed in patients

with defects in lumbar and thoracic lumbar curve. Hong et al.[6] reported that fusion from T1 or T2 including proximal end of the curvature were more effective in correction of T1 tilt angle and postoperative shoulder balance. In the present study, a significant improvement in postoperative shoulder balance was observed in all patients, which resulted from the fusion of T2 and the proximal end of the curvature. However, since thoracic curve was derotated and involved in the fusion, no postoperative improvement was observed in costal gibbosity. The main reason in significant improvement in pelvic balance and lumbar gibbosity was, therefore, the correction of lumbar curve. We also found that sacral obliquity angle was correlated with preoperative sacral gibbosity and lumbar Cobb angle. However, there was no correlation between postoperative values. The extension of the instrumentation to L3 in three patients might have affected the decrease in lumbar lordosis; thus, insufficient number of cases might cause this unexpected observation.

The importance of obtaining a good sagittal alignment in the AIS surgery is well studied, whereas there is only few studies in the literature focusing on the effect of surgical correction of the deformity on spinopelvic parameters, although recent publications reported the importance of considering the sagittal spinal and pelvic alignments in AIS surgery outcome[2,20]. Clément et al.[20] reported a positive correlation between distal lumbar lordosis and sacral slope, and distal lordosis and pelvic incidence, in their study on evaluation of spinal and pelvic sagittal parameters on lateral radiographs of 86 patients with thoracic AIS. The results obtained in a radiographic retrospective study of 76 patients with AIS undergoing posterior only surgical correction and fusion suggested that the increasing amount of pelvic tilt after surgery enables the activation of pelvic compensation mechanism to try to restore the spinal balance[6]. The same study reported a slight further posterior imbalance, especially in Lenke type 1 curves, in AIS patients with hypokyphosis[10]. In this study, we found no increase in thoracic kyphosis despite the decrease in lumbar lordosis and sacral slope. Considering the pelvic compensation mechanism, our results suggested that the decrease in sacral slope consequently resulted an increase in pelvic tilt to balance C7-plumb line in position.

It should be also noted that although there was a lordosing effect of surgery on the thoracalumbar junction at final follow-up compared to preoperative values, the difference was not statistically significant (p=0.272). This lordosis was probably due to the lordosing effect of pedicle screws, since change in T10-L12 angle was more remarkable at early postoperative assessment than at final-follow-up (from 7.1˚±20.2˚ to 1.1˚±11.8˚ vs. from 1.1˚±11.8˚ to -1˚±9.6˚, respectively). Furthermore, lordosis on the thoracalumbar junction at long-term may contribute to the decrease in lordosis in the lumbar region, because both the thoracalumbar junction and the lumbar region include T12-L1-L2 segments.

Limited patient size and retrospective design are the main limitations of this study. The distribution of the study patients in AIS classification (Lenke types) and radiographical maturation (Risser grades) further limits us to reach a definitive conclusion. Additional prospective, large-scale studies are still required to evaluate the improvement in frontal and sagittal profile in patients after AIS surgery by posterior approach with derotation maneuver after placement of hybrid (screws/hooks) or all screws construct.

In conclusion, the AIS management by posterior spinal fusion and bilateral segmental instrumentation provides radiological and clinical improvement on frontal plane and patients' satisfaction. Although AIS surgery had no significant effect on throcal kyphosis and lumbar lordosis on sagittal plane; even insignificant decrease in lumbar lordosis reduces sacral slope, thus keeps sagittal C7 plumbline within normal limits, and as a result provides sagittal balance. For surgical treatment of AIS, the relationship between lumbar lordosis and frontal and sagittal profile parameters should be considered.

CONFLICT OF INTEREST AND FUNDING

Authors declared no conflicts of interests. The study was not funded.

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Volume: 27, Issue:2, April 2016 pp: 85-90 ORIGINAL ARTICLE / ORJİNAL MAKALE

SURGICAL TREATMENT OF TUBERCULOUS SPONDYLITIS

TÜBERKÜLOZ SPONDİLİTİN CERRAHİ TEDAVİSİ

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SUMMARY:

Purpose: There is consensus on medical management of tuberculous spondylitis (TBS); however, literature is quite divided on surgical management of TBS. We aimed to illustrate surgical indications and treatment modalities for TBS in the management of selected patients.

Materials and Methods: A total of 19 patients with different vertebral tuberculosis were treated with surgical intervention. There were 10 male and 9 female patients, mean age was 48±18.1 years and mean follow-up time was 59.9±27.7 months. There was avarage 1.2±0.5 disc and 2.2±0.5 vertebral body involvement.

Results: 15 cases were surgically debrided through anterior approach, 4 were surgically debrided through posterior approach, 1 patient treated with anterior screw fixation and 17 patients treated with posterior pedicle screw fixations. Mean corpectomy level was 1.7±1.2 and mean fusion level was 6.8±3.8. Postoperatively, 4 patients had suffered from complications which were significantly higher in cases with more intervertebral disc involvement (p=0.005), with more vertebral body involvement (p=0.033), with more number of corpectomies (p=0.003) and with more fusion levels (p=0.023).

Conclusions: Debridement should be performed in cases of neurological impairment, multilevel involvement or severe abscess formation. Posterior instrumentation should be added to prevent anterior implant failure in multilevel involvement.

Keywords: pott's disease, tuberculous spondylitis, kyphosis

Level of evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Tüberkülöz spondilodiskitin medikal tedavisi konusunda görüş birliği olmasına rağmen cerrahi tedavi konusunda literatürde farklı görüşler vardır. Olgularımızda cerrahi tedavi endikasyonlarını ve tedavi metodlarını göstermeyi amaçladık.

Materyal ve Metod: Farklı vertebral tüberkülozu olan toplam 19 hasta cerrahi olarak tedavi edildi. 10 erkek ve 9 bayan hasta, ortalama yaşları 48±18.1 ve ortalama takip süresi 59.9±27.7 aydı. Ortalama 1.2±0.5 disk ve 2.2±0.5 vertebral korpus tutulmuştu.

Sonuçlar: 15 hastaya anterior 4 hastaya posterior yaklaşımla debritman yapıldı, 1 hastaya anterior vida ile 17 hastaya posterior vida ile tespit yapıldı. Ortalama korpektomi seviyesi 1.7±1.2 ve ortalama füzyon seviyesi 6.8±3.8 idi. Postoperatif 4 hastada komplikasyon mevcuttu. Komplikasyonlar daha fazla disk tutulumu olan (p=0.005), daha fazla korpus tutulumu olan (p=0.033) ve daha fazla füzyon seviyesi olan (p=0.023) olgularda fazlaydı.

Çıkarımlar: Debritman tedavisi nörolojik defisit varlığında, çoklu seviye tutulumunda yada ciddi apse varlığında yapılmalıdır. Anterior implant yetmezliğinden kaçınmak için posterior enstrümentasyon uygulanmalıdır.

Anahtar kelimeler: pott hastalığı, tüberküloz spondilodiskit, kifoz

Kanıt Düzeyi: Retrospektif klinik çalışma

INTRODUCTION:

Tuberculosis is still a common infectious disease in the world. Every year, 10 million people are newly infected, with about 95 % of cases being in developing countries. The incidence of the disease would rise from 143 to 173 per 100,000 and deaths due to tuberculosis would climb from 2.5 to 3.5 million or more per year[3,11,14]. The spine is the most common site for osseous involvement of tuberculosis. Tuberculous spondylodiscitis (TBS), known also as Pott's disease, was first described in 1779 by Percival Pott[5]. There are many morphological forms of TBS. In its most common form TBS involves the anterior column of a single motion segment[6]. Sometimes TBS involves more than single motion segment and this form is called multilevel (three or more vertebrae)[9].

There is consensus on medical management of TBS; however, literature is quite divided on surgical management of TBS. Some people recommend conservative treatment others focus on anterior, posterior or combined surgeries[9,11,14]. Goals of surgical management include radical debridement, decompression of spinal cord or cauda equina, prevention or correction of deformity, bone grafting to achieve solid fusion, stable internal fixation to allow early ambulation and return of patient back to society and occupation as soon as possible[9,14]. Purpose of this study is to evaluate the indications and treatment of surgically treated TBS.

MATERIALS AND METHODS:

19 patients who were diagnosed with tuberculous spondylodiskits and treated surgically in 3 different training hospitals were examined retrospectively. 10 patients were male (%53.6) and 9 (%46.4) were female. Average age was 48±18.1 years (range 23-75).

Neurological examination was carried out according to Frankel classification. All patients went through rutine blood tests, X rays, CT and MRI. Radiological findings were classified acording to Saggital index and extent of initial vertebral loss.

Depending on the extent of initial vertebral loss, three types of collapse and healing of the anterior column are noted[15]. Type-A healing involves partially destroyed vertebral bodies coming into contact with a large contact area between them, in the presence of intact facet joints. Type-B healing is seen in patients with loss of one or one and a half vertebral body. Type-C healing occurs when more than two vertebral bodies are lost[15].

21.1 % of the patients had history of contact with tuberculosis. Definitive diagnosis was made upon pathological evaluation of the debridement material in all patients. 42.1% of the patients had biopsy prior to operation. As soon as the diagnosis was verified, multi-agent antituberculous treatment was admitted for 1 year.

Statistics:

Statistical analyses were performed with the SPSS (ver19) software. Results were evaluated with descriptive statistical methods such as mean and standard deviation. t test was used to comparison of two groups. Pearson correlation was used to determine the relationship of variables with each other. The significance level was set at $p<0.05$.

RESULTS:

Mean follow up time was 59.9 (range 12 to 106) months. According to preoperative neurological evaluation, one patient was Frankel A, one patient was Frankel C, 17 patients were Frankel E. Postoperatively one patient was Frankel A, 18 were Frankel E. The patient who was Frankel A both pre and postoperatively was paraplegic due to prior thoracolumbar trauma. One patient who was Frankel C preoperatively had complete recovery postoperatively in 4 months following the operation.

Radiogically one cervical (C5-6), 9 thoracal, 9 lumbar (4 upper lumbar, 3 lower lumbar, 2 lumbosacral) involvement was noted. During the operation, all patients except for one had abscess formation. 89.5% of the patients had corpus involvement, 10.5% of patients had more than 20 degrees angulation in sagittal index and there was no isolated discitis. All patients had at least one disc involvement with mean disc involvement of 1.2±0.5 (range 1-3).

Mean corpus involvement was 2.2±0.5 (range 2-4). Two patients had kyphotic collaps. According to classifcation of initial vertebral loss, one patient was Type-A, two patients were Type-C and 16 patients were Type-B.

Drainage of the the abscess and debridement without instrumentation was performed via posterior approach for the patient who had Type-A involvement. One patient with persistent pain without abscess went through debridement and screw fixation via only anterior approach. Posterior debridement without instrumentation and corpectomy was performed for 3 patients. 11 patients went through anterior debridement, drainage of the abscess and interbody cage stabilization, combined with posteror instrumentation (Figure-1).

Surgically, mean 1.7±1.2 (range 0-4) corpectomy and mean 6.8±3.8 (range 1-14) level fusion was performed. Interbody cage stabilization was applied for 57.9% of the patients, anterior screw fixation was performed for 21.1% of the patients and posterior screw fixation was performed for 89.5% of the patients. 3 patients received both anterior and posterior screw fixation (Figure-2).

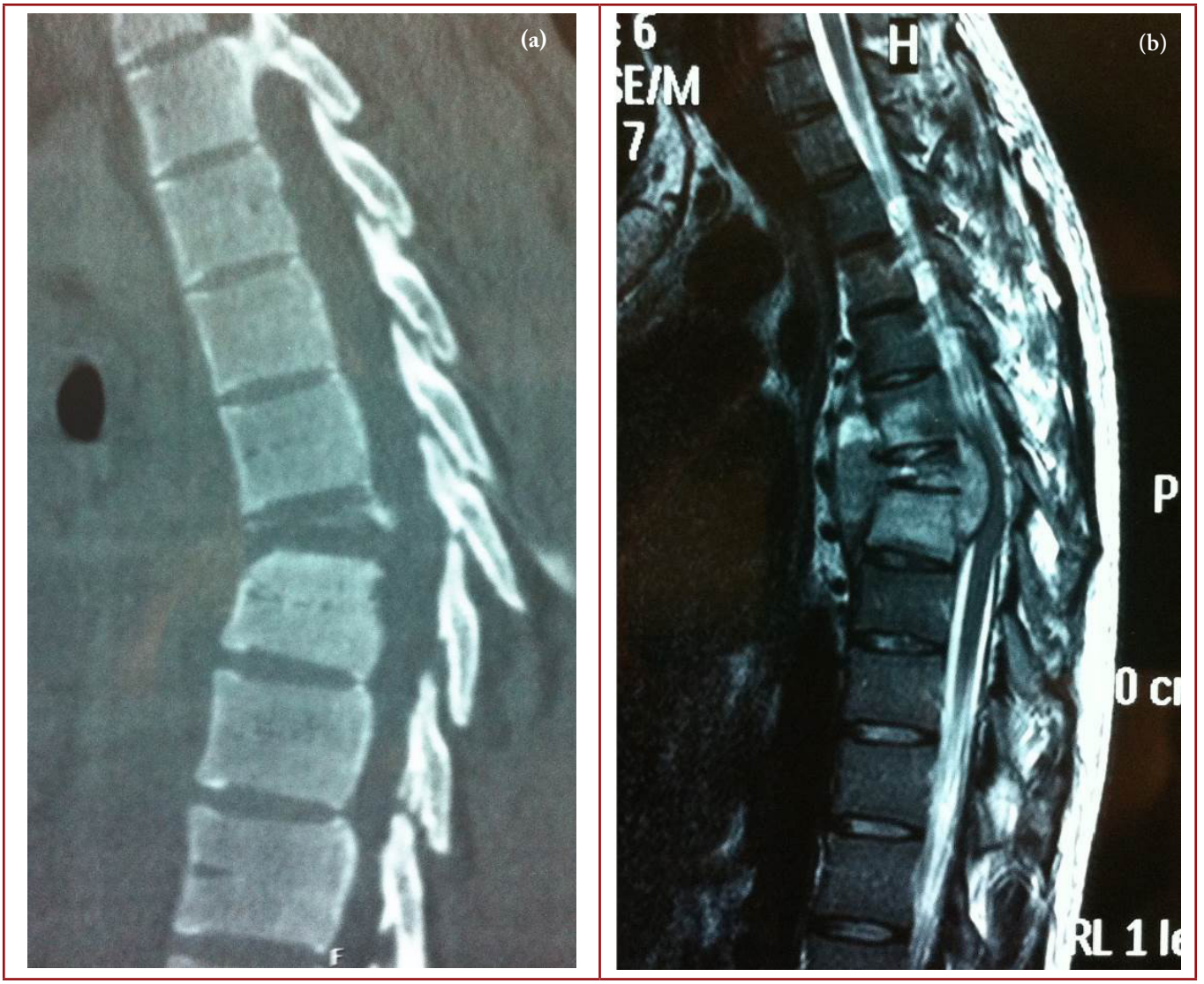

Figure-1. Destruction of the corpus. **a)** Computerised tomography and **b)** T2 weighted magnetic resonance images of the thoracic 7th vertebrae. Note that abcess is extending along the anterior longitudinal ligament.

4 patients (21.2%) had suffered from complications, postoperatively. Two patiens had superficial infection which was treated with debridement. Two patients had instability which was treated with posterior instrumentation and extension of the fusion levels. When complications were examined together with the characteristics of the cases, we found that the complication rate was significantly higher in cases with more intervertebral disc involvement (p=0.005), with more vertebral body involvement (p=0.033), with more number of corpectomies (p=0.003) and with more fusion levels (p=0.023).

DISCUSSION:

If there is a cold abscess, antibiotic-analgesic therapy, bed rest or bracing cannot prevent the extensive destruction of vertebral bone and disc material[13]. In general, debridement is performed anteriorly as the pathology is typically located in the vertebral bodies[1,7,8]. If there is no vertebral collapse, grafting is not necessary. But in the case of vertebral collapse and kyphosis, curettage and grafting of the affected bone is necessary[13].

Debridement may be followed by either anterior or posterior instrumentation[1,7,8]. Many studies in the past have proven superior outcome with radical debridement of diseased tissue and anterior strut grafting, with or without addition of instrumentations[4]. However, in case of multilevel involvement or for deformity correction, the surgeon should may prefer posterior approach with pedicle screw instrumentation[10,14,15].

We observed that in surgical treatment of TBS, complication rate was higher in cases with more disc involvement, with

more vertebral body involvement and in those with more fusion levels. Two of the complications were due to instability and implant failure. After anterior debridement in multilevel TBS, the surgeon creates severe instability which can not be solved with anterior instrumentation alone. All stability-related complications in this study occurred in the anterior alone group only, which was later stabilised with posterior instrumentation.

Figure-2. Postoperative computerised tomography scan of the same case.

Neural deficits in spinal tuberculosis are due to a compressive etiology and a near total recovery may occur if decompressed early[10,12]. Due to anatomical factors of lordotic curvature of the vertebral column and wider canal with the cauda equina and not the cord within, the lumbar region of the spinal column is relatively tolerant to nerve compression[2,12]. But especially in upper segments, the surgeon should be awere of delay in diagnosis and surgery that can cause complete paraplegia[13]. In this study, we observed rapid and complete recovery of the neural deficits.

In conclusion, debridement is essential in cases of neurological impairment, multilevel involvement or severe abscess formation. Debridement may be followed by anterior reconstruction with bone graft and either anterior or posterior instrumentation. However, posterior instrumentation should be added in all cases to prevent anterior implant failure in multilevel TBS.

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Volume: 27, Issue:2, April 2016 pp: 91-96 ORIGINAL ARTICLE / ORJİNAL MAKALE

ANALYSIS OF LUMBAR DISCECTOMY OPERATIONS IN ONE YEAR

BİR YILLIK LOMBER DİSKEKTOMİ AMELİYATLARININ DEĞERLENDİRİLMESİ

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SUMMARY:

Objective: The aim of the study is to analyse the lumbar discectomy operations in one year.

Materials and Method: We inspected 203 patients who were operated for lumbar disc herniation between March-2015 and March-2016 at Dr. Lütfi Kırdar Kartal Training and Research Hospital Neurosurgery Clinic. The parameters that evaluated are the level of discopathy, side of the disc herniation, recurrent or first operation and type of surgery.

Results: Mean age of the study population was 45.2 ± 11.9 years. Eighty-three patients (40.9%) were females, and 120 were males (59.1%). Accordingly the only significant difference was between levels of the lesions, and patients with simultaneous involvement of L4-L5 and L5-S1 were significantly younger than others (p=0.005). The type of operation as first or recurrent (p=262), or operation type (p=0.341) as instrumentation, prosthesis or simple discectomy were similar between sides of the patients. The comparisons revealed that majority of incident cases had simple discectomy, but instrumentation operations were significantly higher in recurrent cases (p<0.001).

Conclusions: Correct surgical indication for lumbar disc herniation remains the key factor for the selection of the technique.

Key Words: Lumbar disc herniation, Lumbar microdiscectomy, Analyse of lumbar disc herniations

Level of evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Çalışmamızın amacı bir yıl içerisinde yapılan lomber diskektomi ameliyatlarının analizini çıkartmaktır.

Materyal ve Metod: Mart-2015 ile Mart-2016 tarihleri arasında Dr.Lütfi Kırdar Kartal Eğitim ve Araştırma Hastanesi Nöroşirurji Kliniğinde lomber diskektomi ameliyatı yapılmış 203 hasta retrospektif olarak incelendi. İncelenen parametreler diskopati seviyesi, disk hernisinin tarafı, nüks veya ilk operasyon mu olup olmadığı ve cerrahinin tipi idi.

Sonuçlar: Çalışmaya katılan popülasyonun ortalama yaşı 45.2 ± 11.9 olarak hesaplandı. 83 hasta kadın (%40.9) ve 120 hasta erkek idi (%59.1). L4-L5 ve L5-S1 seviyelerinden ameliyat olan hastaların istatistiksel anlamlı olarak daha genç hastalar olduğu görüldü (p=0.005). Operasyon sayısı ve operasyon tipi karşılaştırıldığında benzer sonuçlar çıksada enstrumantasyon ameliyatları anlamlı olarak nüks vakalarda daha fazla yapılmıştır (p<0.001).

Çıkarım: Lomber disk hernisi ameliyatı için anahtar nokta doğru konulmuş endikasyon ve doğru tekniğin seçilmesidir.

Anahtar kelimeler: Lomber disk hernisi, Lomber mikrodiskektomi, Lomber disk hernilerinin analizi.

Kanıt düzeyi: Retrospektif klinik çalışmaş Düzey III

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INTRODUCTION:

Lumbar degenerative disc disease is the most common cause of low back pain. The degenerative process is identified as multifactorial, irreversible and associated with a mechanical dysfunction[9]. Progressive disc degeneration will result in a loss of the intervertebral disc space height which depends on the degree of disc degeneration, and it has been shown to have a significant influence on the biomechanics and kinematics of a lumbar motion segment[11,23,24]. Magnetic resonance imaging is the gold standard for radiological diagnosis. Lifetime incidence of sciatica varies from 13 to 40% respectively[3,6]. The annual incidence of an episode of sciatica ranges from 1 to 5%[8]. Conservative treatment modalities for spinal degenerative diseases are various[4,15,16,17,22].

In 1977, Caspar and Williams described a surgical microdiscectomy technique[2,26]. Incomplete resolution of lumbar disc herniation symptoms or inadequate response to conservative measures may result in surgery in 10% of patients[1]. Herniation of nucleus pulposus is the commonest indication for lumbar spine surgery[13]. Lumbar discectomy indications include neurological deficit causing weakness of functionally important muscles, cauda equina syndrome and progressive neurological deficit in spite of conservative treatment[18]. Relative indications for discectomy include persistent pain refractory to conservative care and pain that adversely affects the quality of life[21].

The aim of the study is to analyse the lumbar discectomy operations in one year with the parameters of level of discopathy, side of the disc herniation, recurrent or first operation and type of surgery.

MATERIALS AND METHODS:

We inspected 203 patients who were operated for lumbar disc herniation between March-2015 and March-2016 at Dr.Lütfi Kırdar Kartal Training and Research Hospital Neurosurgery Clinic. The informations were collected from the patients file archieves rethrospectively. Radiological data were inspected from the PACS system. The parameters that evaluated are the level of discopathy, side of the disc herniation, recurrent or first operation and type of surgery.

STATISTICAL ANALYSES:

Categorical data were presented as frequencies and percent, and numerical data were presented as mean and standard deviation. Comparisons between independent groups were performed by Mann-Whitney U test and Kruskall-Wallis test for numerical data, and by Chi-square test for categorical data. Statistical significance was considered as $p<0.05$. SPSS 21 (IBM Corp., NY, USA) was used for the analyses.

RESULTS:

Mean age of the study population was 45.2 ± 11.9 years. Eighty-three patients (40.9%) were females, and 120 were males (59.1%). The distribution of levels of LDH, the side of the involvement, type of operation as first or recurrent, and operation type were summarized in Table-1.

The comparisons of mean age between study groups were presented in Table-2. Accordingly the only significant difference was between levels of the lesions, and patients with simultaneous involvement of L4-L5 and L5-S1 were significantly younger than others (p=0.005).

Table-1. Demographic characteristics of the patients

		Count	Column N %
Gender	Female	*83*	*40,9%*
	Male	*120*	*59,1%*
Level	L1-L2	*1*	*0,5%*
	L2-L3	*4*	*2,0%*
	L3-L4	*18*	*8,9%*
	L4-L5	*108*	*53,2%*
	L4-L5 and L5-S1	*6*	*3,0%*
	L5-S1	*66*	*32,5%*
Side	R	*105*	*51,7%*
	L	*98*	*48,3%*
First or Recurrent Operation	Incident	*162*	*79,8%*
	Recurrent	*41*	*20,2%*
Operation Type	Instrumentation	*16*	*7,9%*
	Prosthesis	*30*	*14,8%*
	Simple discectomy	*157*	*77,3%*

Table-2. Comparisons of ages of patients according to clinical characteristics

		AGE		
		Mean	**Standard Deviation**	**p**
Gender	**Female**	***43,6***	***11***	0.066
	Male	***46,3***	***12,4***	
Level	**L1-L2**	***41***	***-***	0.005
	L2-L3	***52,5***	***9***	
	L3-L4	***53,7***	***12,7***	
	L4-L5	***45,7***	***11,3***	
	L4-L5 and L5-S1	***38,5***	***7,8***	
	L5-S1	***42,2***	***12***	
Side	**R**	***45,1***	***11,3***	0.869
	L	***45,3***	***12,6***	
First or Recurrent Operation	**Incident**	***44,6***	***12,1***	0.176
	Recurrent	***47,4***	***10,8***	
OpType	**Instrumentation**	***52,3***	***11,7***	0.073
	Prosthesis	***44,2***	***10,8***	
	Simple discectomy	***44,7***	***12***	

The comparisons according to side of the lesions and operation types were presented in Table-3. The type of operation as first or recurrent (p=262), or operation type (p=0.341) as instrumentation, prosthesis or simple discectomy were similar between sides of the patients.

The operation type between first and recurrent operations was presented in Table-4. The comparisons revealed that majority of incident cases had simple discectomy, but instrumentation operations were significantly higher in recurrent cases (p<0.001).

DISCUSSION:

The most commonly performed spinal surgery for lumbar discal herniation is discectomy which aims to relieve the nerve root compression induced by the herniation[18]. Lumbar level discopathies are diagnosed more than thoracic and cervical levels[10,14]. Sometimes spontaneous regression of lumbar disc herniations could be seen[7,19,20].

The surgical techniques have been used in our study were simple microdiscectomy, lumbar disc replacement and instrumentation. Our major choice is simple microdiscectomy as seen at the statistical analysis. There are studies have been made for the pain relief techniques to use either at beginning or at the end of the operation[5].

Many technical improvements have decreased operative trauma by reducing incision size, thereby reducing postoperative pain and hospital stay and time off work, while improving clinical outcome. Magnification and illumination systems by microscope and endoscope have been introduced to enable minimally invasive techniques. Several comparative studies have analyzed the clinical results of these various surgical techniques to improve the outcomes[1,13,18].

Despite the improvement of techniques recurrent operations are still challenging. Sometimes fail back syndrome became the dead end for these patients. Instrumentation is usually applied for the recurrent discs to stabilize the level of pathology. In our results instrumentation operations were significantly higher in recurrent cases (p<0.001).

Lumbar disc herniation removal techniques have greatly evolved in terms of instrumentation over the last 30 years. Correct surgical indication for lumbar disc herniation remains the key factor for the selection of the removal technique.

Table-3. Comparisons according to side of lesions

		Side				
		R		L		p
		n	%	n	%	
First or Recurrent Operation	Incident	*87*	*82,9%*	*75*	*76,5%*	*0.262*
	Recurrent	*18*	*17,1%*	*23*	*23,5%*	
OpType	Instrumentation	*7*	*6,7%*	*9*	*9,2%*	*0.341*
	Prosthesis	*19*	*18,1%*	*11*	*11,2%*	
	Simple discectomy	*79*	*75,2%*	*78*	*79,6%*	

Table-4. Comparisons according to a case to be incident or recurrent

		FIRST OR RECURRENT OPERATION				
		Incident		Recurrent		p
		n	%	n	%	
Op.Type	Instrumentation	*2*	*1,2%*	*14*	*34,1%*	*<0.001*
	Prosthesis	*25*	*15,4%*	*5*	*12,2%*	
	Simple discectomy	*135*	*83,3%*	*22*	*53,7%*	

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Volume: 27, Issue:2, April 2016 pp: 97-100 ORIGINAL ARTICLE / ORJİNAL MAKALE

KYPHOPLASTY: EVALUATION OF 108 PATIENTS

KİFOPLASTİ: 108 HASTANIN DEĞERLENDİRİLMESİ

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SUMMARY:

Objective: The aim of this study is to evaluate the experience of 108 patients that operated with kyphoplasty.

Materials and Method: We inspected 108 patients who were operated for vertebral fracture with the procedure kyphoplasty between January-2014 and March-2016 at Dr.Lütfi Kırdar Kartal Training and Research Hospital Neurosurgery Clinic. The parameters that evaluated are the level of fracture, gender and age.

Results: Mean age of the study population was 62.7 ± 12.9 years. Sixty-five patients (60.2%) were females, and 43 were males (39.8%). The comparison of age between genders revealed that mean age of females was 65.6 ± 12.2, and mean age of males was 58.3 ± 13.0. The difference of age between genders was statistically significant.

Conclusions: Kyphoplasty is a relatively safe and effective technique that provides short term pain relief, improved functional outcomes and had a superior capability for kyphotic angle and anterior vertebral body height improvement.

Key Words: Kyphoplasty, Vertebra body fracture , Vertebroplasty

Level of evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Çalışmamızın amacı kifoplasti opeasyonu yapılmış 108 hasta tecrübemizi incelemektir.

Materyal ve Metod: Ocak-2014 ile Mart-2016 tarihleri arasında Dr.Lütfi Kırdar Kartal Eğitim ve Araştırma Hastanesi beyin cerrahisi kliniğinde vertebra kırığı nedeniyle kifoplasti prosedürü uygulanan 108 hastayı inceledik. Değerlendirilmeye alınan parametreler kırığın seviyesi, yaş ve cinsiyettir.

Sonuçlar: Popülasyonun ortalama yaşı 62.7 ± 12.9 olarak hesaplandı. 65 hasta kadın (%60.2) ve 43 hasta erkekti (%39.8). Ortalama kadın hasta yaşı 65.6 ± 12.2, erkek hasta yaş ortalaması ise 58.3 ± 13.0 olarak hesaplandı. Cinsiyet ve yaş ortalamaları arasındaki fark istatistiksel olarak anlamlı bulundu.

Çıkarım: Kifoplasti kısa zamanda ağrı gidermek, fonksyonel geri kazanım, kifotik açıyı düzeltebilme ve vertebra korpus ön yüksekliğini iyileştirme için güvenli ve efektif bir yöntemdir.

Anahtar Kelimeler: Kifoplasti, Vertebra cismi kırıkları, Vertebroplasti

Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

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INTRODUCTION:

Vertebral fractures are devastating if they impose neurological deficits especially if unstable. Vertebral fracture patients who were inflicted by osteoporosis, trauma or neoplasm would present by pain and progressive functional limitation interfering with their daily activity[12,15,18]. Conservative treatment modalities of these fractures are bed rest, analgesia, bracing, rehabilitation and a combination of these treatments[10]. But it may be difficult for patients, especially the elderlies, to tolerate long term bed rest. Also conservative management cannot reverse kyphotic deformity that causes the biomechanical changes in the spinal segment. Surgery fails because of poor quality of osteoporotic vertebral bone[17].

Percutaneous vertebroplasty was introduced in France by Galibert et al. in 1987, first described for the treatment of a hemangioma at the C2 vertebra[8]. It involves percutaneous injection of viscous polymethylmethacrylate (PMMA) into the vertebral body. With kyphoplasty, prior to injecting the cement, balloon is percutaneously inserted into the fractured vertebral body and inflated to create a cavity. The balloon is then deflated and removed and PMMA is injected.

The aim of this study is to evaluate the experience of 108 patients that operated with kyphoplasty.

MATERIALS AND METHODS:

We evaluated 108 patients who were operated for vertebral fracture with the procedure kyphoplasty between January-2014 and March-2016 at Dr.Lütfi Kırdar Kartal Training and Research Hospital Neurosurgery Clinic. The informations were collected from the patients file archieves rethrospectively. Radiological data were inspected from the PACS system. The parameters that evaluated are the level of fracture, gender and age.

STATISTICAL ANALYSES:

Categorical data were presented as frequencies and percent, and numerical data were presented as mean and standard deviation. Comparisons between independent groups were performed by Mann-Whitney U test. Statistical significance was considered as $p<0.05$. SPSS 21 (IBM Corp., NY, USA) was used for the analyses.

RESULTS:

Mean age of the study population was 62.7 ± 12.9 years. Sixty-five patients (60.2%) were females, and 43 were males (39.8%). The levels of vertebral fractures that the patients had presented in Table-1. The comparison of age between genders revealed that mean age of females was 65.6 ± 12.2, and mean age of males was 58.3 ± 13.0. The difference of age between genders was statistically significant.

The thoracolomber junction levels T12 (%16.7) and L1 (%29.6) are consisting most of the operations.

Table-1. Levels of the vertebral fractures operated with kyphoplasty

	N	%
L1	*32*	*29,6*
L1 and L2	*1*	*0,9*
L1 and L3	*2*	*1,9*
L1 and L4	*1*	*0,9*
L2	*16*	*14,8*
L2 and L3	*2*	*1,9*
L2 and L5	*1*	*0,9*
L3	*4*	*3,7*
L3 and L4	*1*	*0,9*
L3 and L4 and L5	*2*	*1,9*
L4	*6*	*5,6*
T10 and T12	*1*	*0,9*
T11	*8*	*7,4*
T11 and L1	*1*	*0,9*
T12	*18*	*16,7*
T12 and L1	*2*	*1,9*
T12 and L1 and L2	*1*	*0,9*
T6	*1*	*0,9*
T7	*1*	*0,9*
T7 and T8	*2*	*1,9*
T8	*4*	*3,7*
T9	*1*	*0,9*
Total	*108*	*100,0*

DISCUSSION:

Osteoporotic vertebral fractures are multiple in up to 20% of patients and affect more than 20% of those older than 50 years with slight female prevalence that markedly increases when they age above 80 years[7]. Height loss of the osteoporotic fractured vertebra may be mild (20-25%), moderate (25-40%) or severe (> 40%). The thoracolumbar region is mostly affected. Osteoporotic vertebral fractures are commonly wedged with anterior or midbody shortening, and minimal posterior vertebral body curbing.

Pain management is the key feature of treating osteoporotic fractures through vertebral body stabilization in patients with no neurological deficits. Prolonged bed rest together with analgesics and drug management may bring about pain relief at the expense of increased consequent dreadful recumbence complications[17]. Increased osteoporosis, pneumonia, pulmonary dysfunction, eating disorders, loss of independence, mental status change due to pain and the use of medications and deep vein thrombosis or strokes are commonly confronted[18]. It was reported that conservative outpatient treatment would not yield adequate control of pain in less than 20-25% of patients[11]. Early ambulation after surgical interference is a safeguard against multitude of complications especially in old patients following vertebral osteoporotic fractures. Minimally invasive fixation and vertebral cementing procedures deliver several advantages in this setting of pain control.

Vertebroplasty and kyphoplasty are statistically both effective and safe if applied when properly indicated. This was proved in both retrospective and prospective studies as well as in meta-analysis[9,14,19]. The procedure benefits supersede its risks and it proved to be cost effective[11]. Also there are studies that denies the benefits of vertebroplasty[1,2].

Kyphoplasty was developed as adjunctive procedure to vertebroplasty when a balloon inflates the compressed vertebra and enables more thick bone cement to maintain the restored height with less incidence of cement leakage. It permits kyphosis correction if performed within 3 months post-fracture.

Complications like cement leakage, vascular invasion of cement, pedicle fractures and neurological deficits could be seen at the same time[4,16]. To avoid complications vertebral pedicle anatomy and curvature angles must be evaluated[3,5,6,13]. Both vertebroplasty and balloon kyphoplasty are contraindicated in the presence of infection, blood coagulopathy, sensitivity to contrast or cementing substance or breach of the posterior vertebral cortical bone and retro pulsed fragments[7].

Kyphoplasty is a relatively safe and effective technique that provides short term pain relief, improved functional outcomes and had a superior capability for kyphotic angle and anterior vertebral body height improvement.

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Volume: 27, Issue:2, April 2016 pp: 101-106 CASE REPORT / OLGU SUNUMU

AN UNUSUAL COMPLICATION OF VERTEBROPLASTY: URINARY INCONTINENCE

VERTEBROPLASTİNİN NADİR BİR KOMPLİKASYONU: ÜRİNER İNKONTİNANS

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SUMMARY:

We present an unusual complication following a vertebroplasty performed under local anaesthesia and sedation in an osteoporotic patient with a lumbar burst fracture: urinary incontinence. Computed tomography showed retropulsion of the posterior wall of the fracture due to the effect of the cement in a patient who developed postoperative urinary incontinence immediately after a percutaneous vertebroplasty under local anaesthesia. An emergency laminectomy, with reduction of the retropulsed fragment, and instrumentation with a pedicle screw were performed. The urinary incontinence resolved within 24 hours after the second procedure. Surgeons should be aware of the risk of retropulsion in burst fractures, which might result in a neurogenic bladder. In such cases, urgent decompression is a good treatment option.

Keywords: Percutaneous vertebroplasty, neurologic deficit, cement leakage, local anesthesia

Level of Evidence: Case report, Level IV

ÖZET:

Osteoporotik bir hastada lumbar burst kırığı hastasında lokal anestezi ile yapılan vertebroplasti sonrasında gelişen üriner inkontinans vakasını sunduk. Lokal anestezi ile Perkütan vertebroplasti sonrasında postoperatif hemen uriner inkontinans gelişimine neden olan semente bağlı gelişen posterior duvar kırığının retropulsiyonu bilgisayarlı tomografide gösterildi. Acil olarak pedikül vidaları ile enstrümentasyon, laminektomi ve posterior duvar parçasının redüksiyonu yapıldı. İkinci cerrahiden sonra 24 saat içinde üriner inkontinans düzeldi. Cerrahlar burst kırıklarında nörolojik mesaneyle sonuçlanabilen retropulsiyon riski açısından dikkatli olmalıdır. Böyle vakalarda acil dekompresyon iyi bir tedavi seçeneğidir.

Anahtar kelimeler: Perkütan vertebroplasti, nöroljik deficit, sement kaçağı, lokal anestezi

Kanıt düzeyi: Olgu sunumu, Düzey 4

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INTRODUCTION:

Vertebroplasty is a common treatment method for burst fractures with low morbidity and mortality[12]. During vertebroplasty, cement may leak around the vertebral body[3]. Despite the leakage of cement into spinal canal or foramen, neurological deficits are rare[10]. Consequently, local anaesthesia and sedation, which enable communication with the patient and evaluation of the lower extremity motor muscle strength during the procedure, are preferred to general anaesthesia. However, it may be impossible to detect urinary incontinence during the procedure, especially in the presence of a urinary catheter. This case report discusses the treatment of an unusual complication, urinary incontinence, which developed suddenly due to posterior wall compression following percutaneous vertebroplasty (PVP).

CASE PRESENTATION:

An 84-year-old female was hospitalised with a burst fracture of an osteoporotic L3 vertebra (Figure-1).

Under local anaesthesia and sedation, PVP was performed using polymethylmethacrylate cement. During the surgery, neurological examination of leg movements revealed no abnormalities. Urinary incontinence developed immediately after the operation. The postoperative neurological examination revealed normal muscle strength. Bilateral stretch tests were negative. Emergency computed tomography (CT) showed retropulsion of the L3 vertebra posterior wall (Figure-2).

Two hours after the PVP, the patient was reoperated on for decompression. Through a posterior approach, L2-L4 stabilisation and L3 total laminectomy were performed (Figure-3).

Twenty-four hours later, the patient stated that she could feel urinary fullness and was continent. The patient was mobilised on the first day postoperative. Follow-up visits at 1, 3, and 12 months showed that her pain had resolved completely and there was no further incontinence.

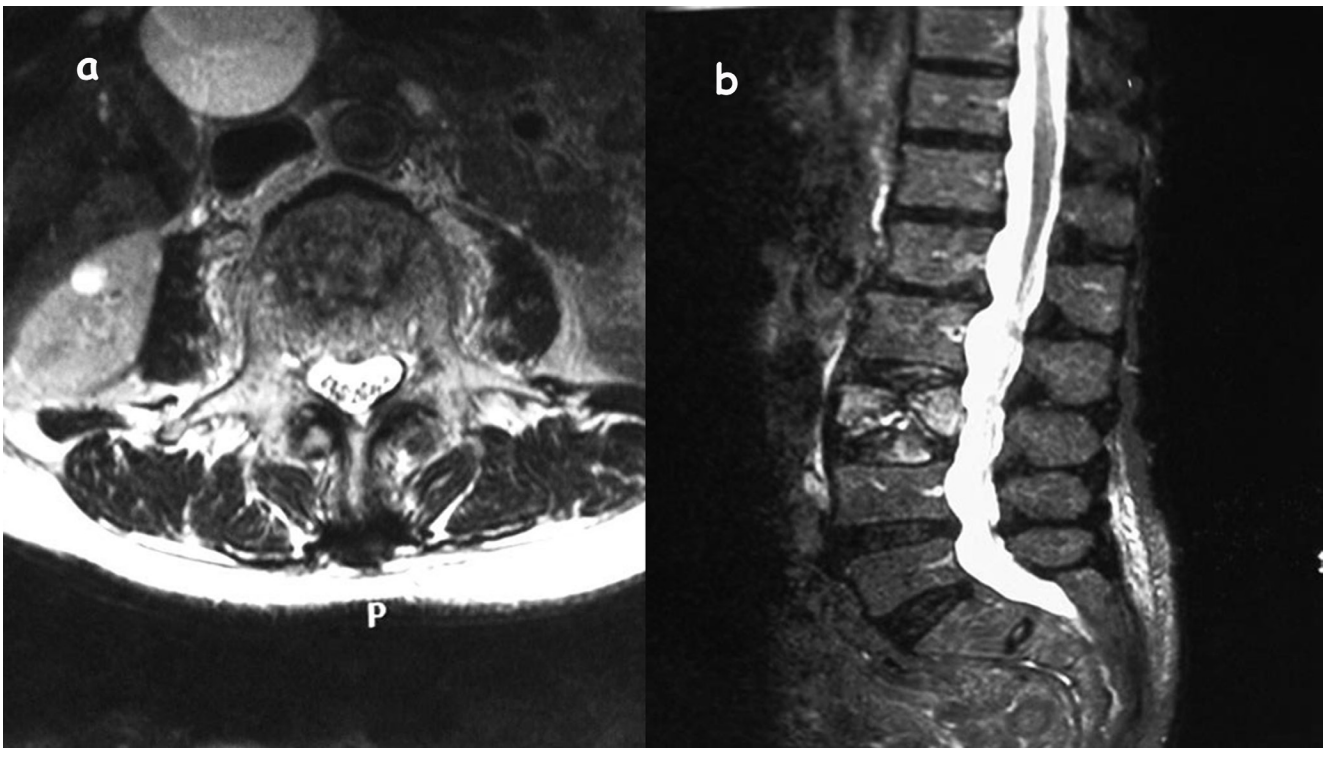

Figure-1. Magnetic resonance images on **a)** sagittal and **b)** axial planes of the third lumbar vertebra burst fracture before PVP.

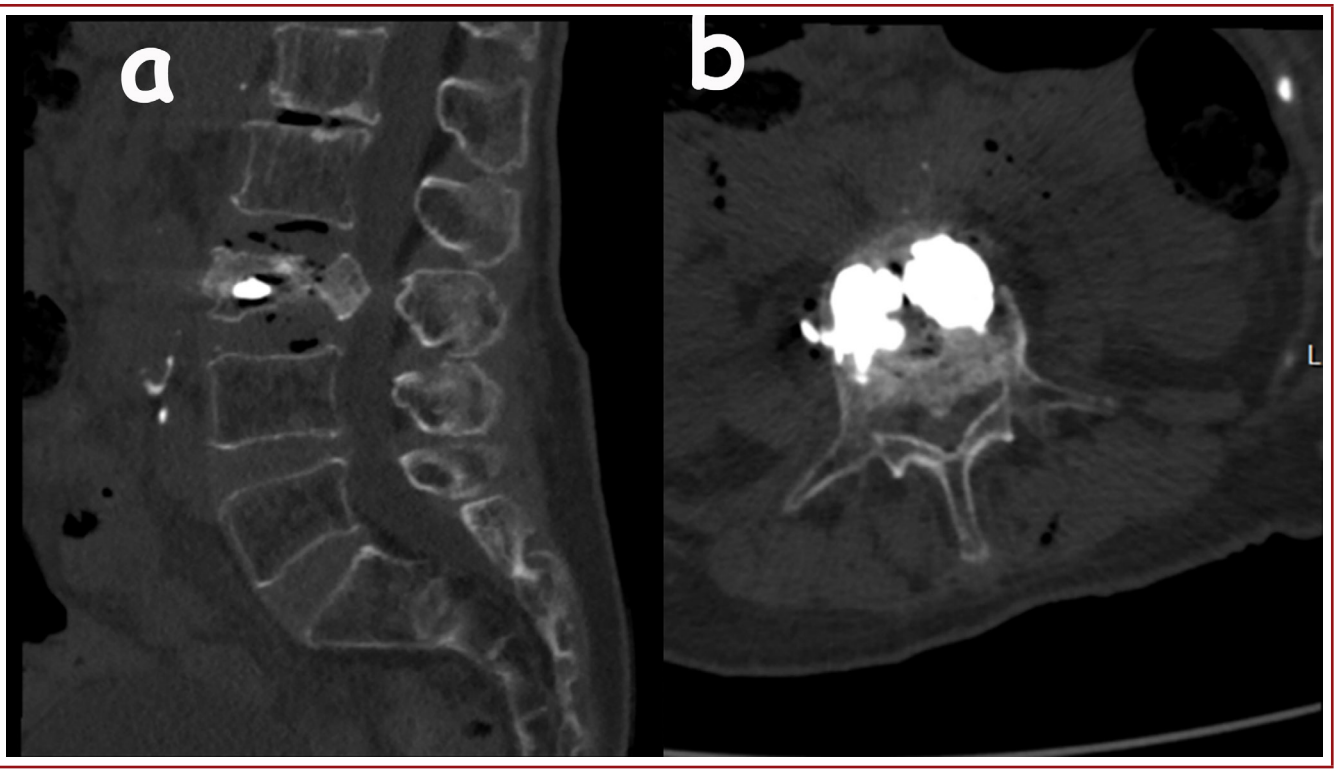

Figure-2. a) Computed tomography images on on sagittal and **b)** axial planes showing posterior wall retropulsion of the third lumbar vertebra after PVP.

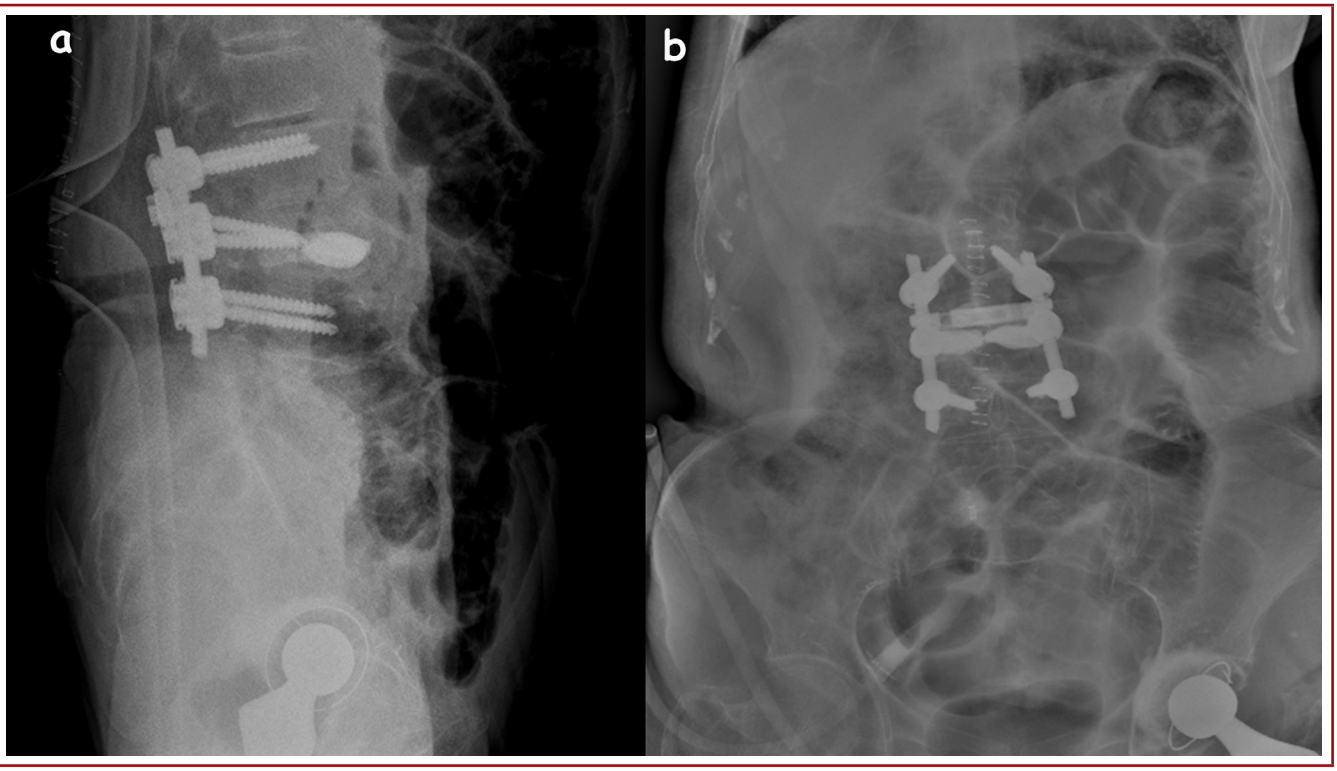

Figure-3. a) Anteroposterior and **b)** lateral radiological examination after posterior instrumentation of vertebra L2–L4.

DISCUSSION:

There are many systems for classifying thoracolumbar burst fractures. Some of them are descriptive, while others use the fracture pattern and treatment strategy[1,4-9,11,12]. Nevertheless, there is no consensus on which fractures need surgical treatment or the surgical technique that should be used[1,4-9,11,12].

Chen and Lee presented the results of vertebroplasty alone in six patients in whom conservative treatment was unsuccessful. The patients' pain decreased to basal levels within 72 hours despite cement leakage into the disc space or paravertebral field in four patients[1]. Huwart treated 62 neurologically intact patients with AO Type A-2 fractures using CT-guided PVP. Despite the CT-assisted intervention, 11% of the patients had cement leakage into the disc space[7].

For AO Type A3.1–A3.3 fractures involving posterior wall protrusions, Hartmann performed kyphoplasty without instrumentation. At the final follow-up visits at an average of 14.6 months, most of the patients showed a 6° loss of kyphosis, but no patient had canal encroachment[6].

Posterior wall fractures pose a risk of a neurological deficit in osteoporotic burst fractures. Yang et al. reported different techniques to prevent cement leakage in thoracolumbar burst fractures based on anterior, posterior, or lateral locations of the fracture line[11].

In a patient who developed paraplegia at the T-6 level due to cement leakage after PVP, Lopes performed a T-5 to T-7 laminectomy 7 hours after the initial operation and obtained complete neurological improvement 1 month postoperatively[9]. In our patient, the neurological deficit likely developed while she was under local anaesthesia, but it was impossible to identify this deficit using neuro-monitoring or perioperative muscle testing. This is the first report of isolated urinary incontinence due to posterior fragment compression after vertebroplasty. All of the reported neurological complications have resulted from cement leakage.

In a neurological deficit due to cement leakage, the symptoms often occur immediately[9], although Cosar et al.[2] and Ross and Fineman[8] reported patients with late-onset neurological deficits.

Surgical decompression should be performed as soon as the deficit is verified[9]. Two of three reported cases that did not undergo surgical decompression failed to resolve[3,5]. Wu[10] reported neurological improvement in a patient who underwent surgical intervention 4 months after the onset of symptoms. We observed improvement in our patient within 24 hours after the emergency decompression.

Computed tomography is the gold standard for evaluating cement leakage[4]. In our case, emergency CT imaging revealed bone fragment retropulsion.

In conclusion, Surgeons should consider the risk of bone fragment retropulsion according to the type of fracture. If the patient requires a urinary catheter during the procedure, the surgeon should check for a neurogenic bladder postoperatively. If suspected, a detailed neurological examination together with imaging should be performed, with emergency decompression as required.

Conflict of Interests:

The authors declare no conflict of interests.

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Volume: 27, Issue:2, April 2016 pp: 107-110 CASE REPORT / OLGU SUNUMU

THORACOLUMBAR SPINAL FRACTURE MISDIAGNOSED IN CHILDHOOD: A CASE REPORT

ÇOCUKLARDA GÖZDEN KAÇIRILAN TORAKOLOMBER OMURGA KIRIĞI: OLGU SUNUMU

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SUMMARY:

Spinal fractures in childhood therefore differ from such fractures seen adults with respect to their location, and the consequences that they can cause on spinal growth[9]. Ogden et al[10], published that the most seen scenario is the multi-leveled vertebral compression resulting "Plastic fracture of the spine"[4] leading to a delay in the diagnosis of thoracolumbar spine fractures. In this study, 4 years old child patient with progresive severe back pain continuied two weeks after trauma determined a L-4 spine fracture neglected due to the traffic accident in MRI was presented. As a result, if thes back pain is contiuned after trauma like our patient, the spinal fracture must be thought and made the MRI.

Key words: Spinal fracture of children, pediatric spinal trauma, treatment.

Level of evidence: Case report, Level IV.

ÖZET:

Torakolomber omurga kırıkları çocuklarda ender görülür. Klinik muayene yanıltıcı olabilir. Ayrıca çocukların vertebra kıkırdak yapısı tam olarak olgunlaşmadığından zayıf alanlar içerir ve kırıklar sıklıkla direk grafilerde görülmez. Çoğu çocuk omurga kırıkları gözden kaçabilir veya tanı gecikebilir. Klinik ve nörolojik muayeneden sonra kırık şüphesi var ise MRG veya BT mutlaka istenmelidir. Bu çalışmada, maalesef 15 gün sonra geçmeyen ağrıları nedeniyle yeniden tetkik edilerek MR ile tanı konulan ve araç içi kaza sonrası L-4 vertabra kırığı saptanan 4 yaşındaki çocuk hastayı sunacağız. Genel beden travması sonrası sırt ve bel ağrısı olan hastalarda, radyoloji negatif olsa bile burada sunulan olguda olduğu gibi çocuğun ağrıları devam ediyor ise mutlaka MR inceleme ile omurga kırığı olup olmadığı teyid edilmelidir.

Anahtar Kelimeler: Çocuk omurga kırıkları, pediatrik omurga travmaları, tedavi.

Kanıt Düzeyi: Olgu sunumu, Düzey IV

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INTRODUCTION:

Thoracolumbar spinal fractures are usually rare in children as its prevalence in related published data shows a variety of figures. Hubbard et al[5] reported that it is observed in less than 1% of all skeletal injuries where itincreases up to 3% according to Behrooz et al[1]. Regarding these differencial data one can say that no common criteria exists for defining thoracolumbar fractures in children. The clinical examination could be misleading due to the fact that the cartilaginous structures of the vertebrae are relatively week and their fractures are often omitted on routine X-rays[7]. The specific physiological and anatomical features of the spine in children should be taken into consideration as the posterior joint surfaces are more horizontal than adults, which increases the risk of antero-posterior displacements in[10] .The nucleus pulposus is more hydrated in children than adults[8] and absorbs shocks more in early ages.

Spinal fractures in childhood therefore differ from such fractures seen adults with respect to their location, and the consequences that they can cause on spinal growth[9]. Ogden et al[10], published that the most seen scenario is the multi-leveled vertebral compression resulting "Plastic fracture of the spine"[4] leading to a delay in the diagnosis of thoracolumbar spinefractures. Our patient (4 years old) had L-4 spine fracture due to the traffic accident and has admitted to the hospital with thoracolumbar pain.

CASE REPORT:

After having a car accident the 4 year old boy has been hospitalized due to lomber pain. The history from the family has been elaborated as he had fallen from the seat with the impact of the crush. The X-rays taken in emergency service revealed no sign of vertebral fracture. In the following 15 days the patient experienced progressive severe back pain and has applied to our clinic. During palpation there was a pain in thoracolumbal vertabra but no sign of neurological defect in clinical examination. After the evaluation of the x-ray graphics of the patient MRI showed accute L-4 fracture. The patient was treated with a TLSO (A thoracolumbosacral orthosis) brace for 1 month following that radiologic examinations appeared to be quite normal. The patient had no pain and no limitation of lumbar movement.

After 3 years the incident the patient has been examined for routine control where dynamic and standart X-ray showed full recovery and no signs of old fracture (Figure-1).

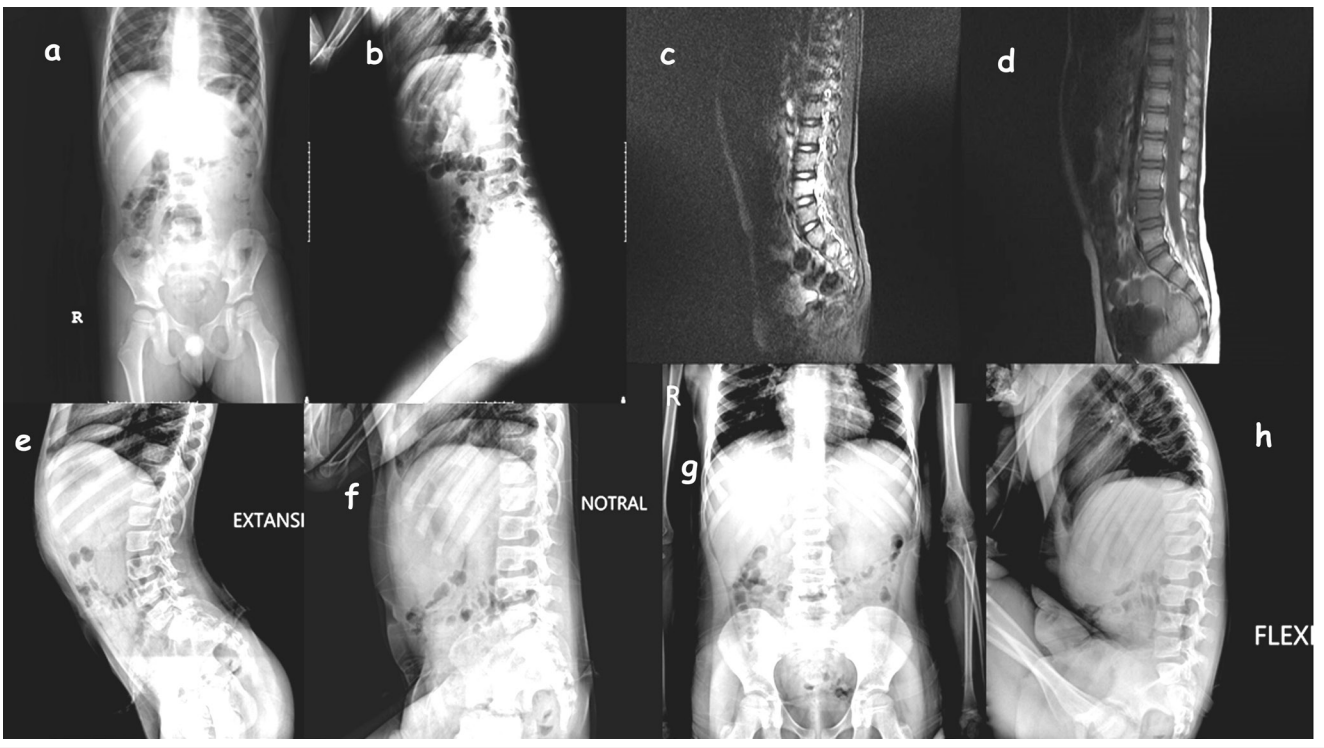

Figure-1. a) First AP and **b)** lateral x-rays taken in ER. Signs of fracture were not determined. **c-d)** In the MRI (STIR) of the patients L-4 fracture was shown. **e)** Post-treatment AP and **f)** lateral, **g)** extension and **h)** flexion x-rays in 3rd years control visit after trauma.

DISCUSSION:

Thoracolumbal spinal fractures without any neurological defect are rare in children. According to a study by over 5 years period, of the 323 patients treaded for spinal fracures only 10 of them has been accounted for fracture near or at Thoracolumbar junction[6].

Even though there were no signs of fracture in routine X-rays if patient had lomber or thoracal pain after a trauma historry, as presented in our report, MRI or CT is main necessity. Generally patients with no signs of neuorological defect had CT instead of a MRI because the result of clinical examination suggest there is no damage neither in spinalcord nor in vertebral ligamants and soft tissues. In our case we have peformed MRI, not CT because of the patients age and radiation risk of CT. Sledge et al[12] demonstrated MRI to be a effective tool in the diagnosis and classification of pediatric thoracolumbar injuries.

Acccording to previous research; thoracolumbar injuries in the pediatric population occur primarily between the ages of 10 and 16 [3]. The majority of the patients are male (63%)[2]. The most common mechanism of injuries to the thoracolumbar spine is sports-related injuries and vehicle accidents. Other mechanisms include falls, child abuse, pathological fractures, insufficiency fractures and gun-shot injuries[11]. Patient's story should be accounted for the diagnosis for thoracolumbal fracture.

After the scans, depending on fracture's stability neccessary treatment could be initiated. Instable fractures require surgical approach but stable fracture can generaly be treated with more conservative treatments such as TLSO (A thoracolumbosacral orthosis) brace. On the basis of good healing potential of younger patients, non-surgical management of unstable fractures in patients youger than 9 years of age is recommended by some authors, except neurological compromise, irreducible subluxation, polytrauma and brace/cast intolerance[2,13]. Non-operative treatment should include bed rests, and additional treatments for muscle spasm. For all non-operative treatments, close follow-up is necessary to confirm fracture stability and aligment.

CONCLUSION:

As a result thoracolumbal fractures without neural defects are rare cases . We need further trials and publications in order to have a wider approach. In this study, 4 years old child patient with progresive severe back pain continuied two weeks after trauma determined a L-4 spine fracture neglected due to the traffic accident in MRI was presented. As a result, if the back pain is contiuned after trauma like our patient, the spinal fracture must be thought and made the MRI.

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Volume: 27, Issue:2, April 2016 pp: 111-116 REVIEW ARTICLE / DERLEME

PEDIATRIC THORACOLUMBAR SPINE FRACTURES

ÇOCUK TORAKOLOMBER OMURGA KIRIKLARI

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SUMMARY:

Pediatric spinal trauma is unique. Moreover, the trauma patterns differ in each age group. Cranio-cervical spine injuries seen in before the age of 8, however, thoracolumbar fractures seen in the adolescence period. Most common injury pattern is sport related injuries and traffic accidents. Initial evaluation should include Advanced Trauma Life Support protocols. Plain radiography and computer tomography is the first line of imaging. Magnetic resonance imaging is sensitive for disco-ligamentous and spinal cord injuries. The treatment depends on the fracture pattern and neurologic problems. Overall, most pediatric injuries of thoracolumbar spine have good to excellent long-term outcomes. In this review, a summary of pediatric thoracolumbar spine fractures is discussed.

Key words: Spine fracture, pediatric, diagnosis, treatement, surgery

Level of evidence: Review article, Level V

ÖZET:

Pediatrik spinal travmalar kendine özgüdür. Ek olarak travma şekli yaş grupları arasında bile değişkendir. Kranioservikal omurga yaralanmaları daha çok 8 yaş öncesinde görülürken, torakolomber kırıklar daha çok adolesan dönemde görülür. En sık yaralanma şekli sporla ilişliki yaralanmalar ve trafik kazalarıdır. İlk değerlendirme İleri Travma Yaşam Desteği protokollerini içermelidir. Düz grafiler ve bilgisayarlı tomografi görüntülemede ilk basamaktır. Manyetik rezonans diskoligamantöz ve spinal kord yaralanmalarına spesifiktir. Tedavi şekli yaralanmaya ve nörolojik duruma gore değişir. Genel olarak peditarik torakolomber omurga kırıklarının sonuçları iyidir. Bu derlemede, pediatrik torakolomber omurga kırıkları özet bir şekilde tartışılmıştır.

Anahtar Kelimeler: Omurga kırıkları, çocuk, tanı, tedavi, cerrahi

Kanıt Düzeyi: Derleme, Düzey V

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INTRODUCTION:

Thoracolumbar spinal trauma in pediatric population is a rare but separate entity and have differences from adults due to anatomical, anthropometric, injury pattern, clinical presentation, imaging and management. Some of these injuries may be life-threatening and may cause big disabilities, thus, early diagnosis and appropriate management of these injuries is essential.

EPIDEMIOLOGY:

Spine fractures in the pediatric population occur 2% to 5% of all spine injuries[9]. The majority of the pediatric spine fractures occur at the upper cervical spine younger than 8 years of age due to ligamentous laxity, horizontal orientation of vertebral facets, wedge shaped vertebral body, underdeveloped paraspinal muscles and large head-to-torso ratio[24]. In contract, the adolescent patients present similar injury patterns with the adults. Thoracolumbar injuries in the pediatric population occur primarily between the ages of 10 and 16[12]. The majority of the patients are male (63%)[8]. The most common mechanism of injuries to the thoracolumbar spine is sports-related injuries and motor vehicle accident (MVA). Other mechanisms include falls, child abuse, pathological fractures, insufficiency fractures and gun-shot injuries[28].

ANATOMY AND PATHOPHYSIOLOGY:

The anatomic and biomechanical differences between pediatric and adult spine result in different injury patterns. Each pediatric thoracolumbar vertebra has 3 ossification center; one central and two neural arches. Fusion occurs between 2-6 years of age. The growing vertebrae has two physis; superior and inferior end plates. They begin to ossify between the ages of 4-7 and fusion begins at the age of 12-14 and compete fusion occurs at the age of 21-25[32].

Before that age, physeal lines may be interpreted as fractures lines (Figure-1). Before the complete fusion, the apophyeal ring and physis are relatively weaker and more susceptible to injury than the surrounding tissues.

Similar to subaxial cervical spine, thoracolumbar spine has horizontal oriented facet joints. The ligaments, discs and soft tissues are laxer than the adult spine. These elastic properties explain the increase incidence of spinal cord injury without radiographic abnormalities in children[15].

MECHANISM OF INJURY:

Flexion, distraction and shear forces are the main mechanism of thoracolumbar injuries. Flexion injuries result in compression fracture, which involves the anterior column of the vertebrae. Greater forces result in burst fracture, involves both anterior and middle column and may result retropulsion of the fractured fragments into the spinal canal. A distraction injury may occur with greater degrees of flexion and usually occur during rapid deceleration of an automobile in a patient uses a seat belt (seat belt injury). This kind of distraction results in posterior bony and ligamanteous injuries.

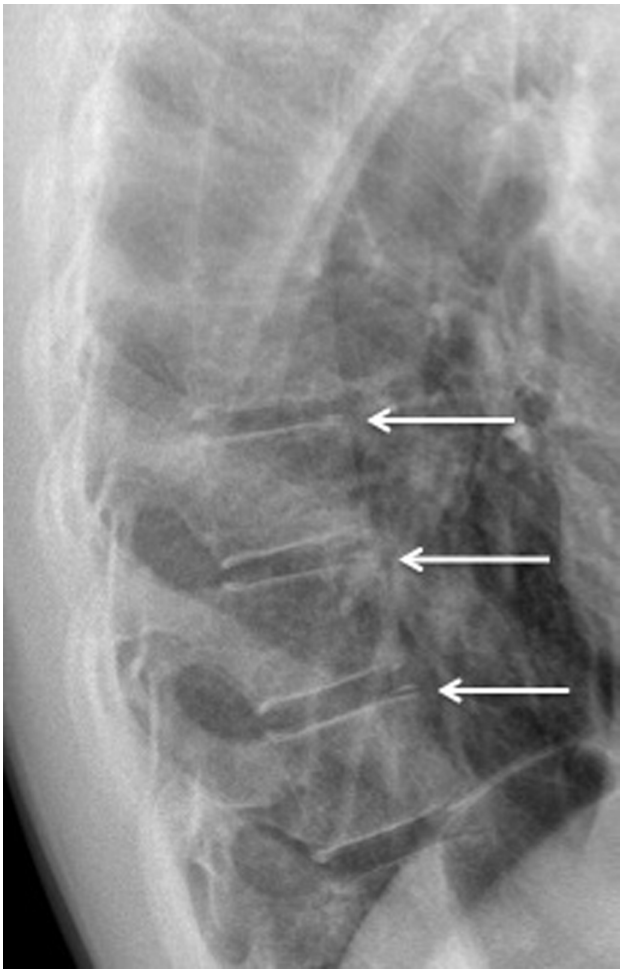

Figure-1. 14 year-old girl. White arrows show vertebral physeal lines.

HISTORY AND CLINICAL EVALUATION:

The initial evaluation of the pediatric spine injuries should include Advanced Trauma Life Support (ATLS) protocols and the patient should be kept in a immobilized position until spinal injuries can be ruled out[28]. Thoracolumbar injuries are often a result of high-energy trauma and associated skeletal, cranial and visceral injuries are frequent[27]. For this reason, multidisciplinary approach with other clinical trauma services is essential.

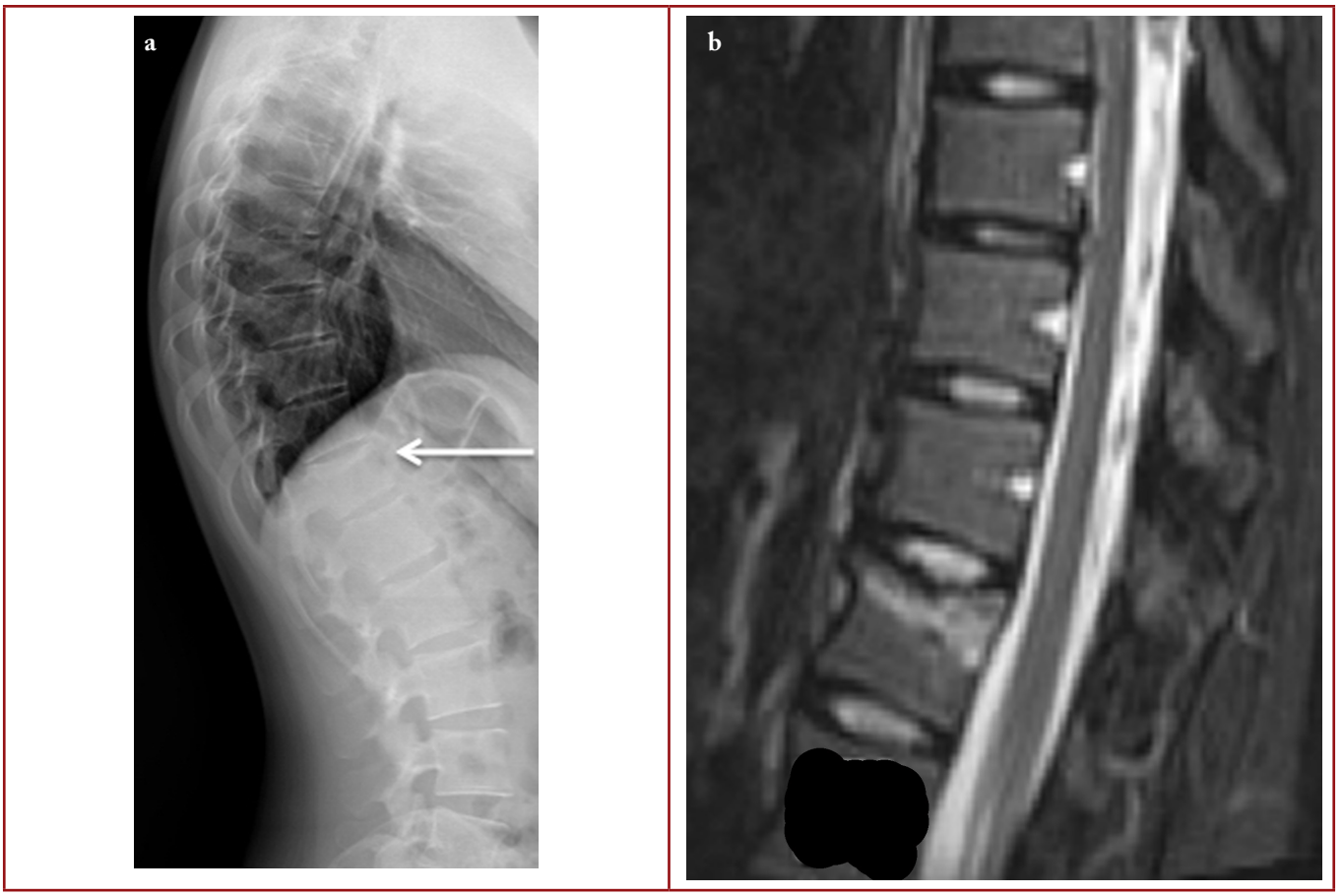

Figure-2. 17 year-old girl. **a)** White arrow shows T12 compression fracture. **b)** T2-weighted sagittal MRI shows T12 bone edema and compression fracture.

If possible, a detailed history should be obtained after ATLS approach. Mechanism of injury, neurological complaints, any other extraspinal symptoms should be obtained.

Most common physical findings with thoracolumbar injuries among children are tenderness, bruising, skin injuries, crepitus and step-offs or gaps between spinous processes[28]. 'Lap belt' sign, bruising or abrasions on the abdomen along the site of the lap portion of safety belt, is associated with a high rate of injury to the abdominal organs in 50% to 84% and spinal fracture in 15% to 50% of pediatric patients[1,23] (Figure-2, 3).

A through motor and sensorial neurological examination should be performed and documented in all patients with suspected injury to the spine. Rectal sensation, tone, bulbocavernosus reflex and bleeding also should be examined. The absence of the reflex with complete absence of motor function indicates spinal shock and no definitive statement can be made about the neurological deficit[11]. In case of the recovery of the bulbocavernosus reflex with the persistence of complete absence of the motor deficit, it is unlikely that significant neurological function will ever return.

IMAGING:

For adult trauma patients, there is evidence-based recommendations exist. In case of high velocity injury, decreased level of consciousness, associated head injury, pelvis-lower extremity trauma, back and midline tenderness, local signs of thoracolumbar spine injury, abnormal neurological signs, cervical spine fracture, Glaskow Coma Scale (GCS) <15, major distracting injury or alcohol/drug intoxication, the thoracolumbar spinal imaging is recommended[16,31].

There is no consensus on which pediatric trauma patients need thoracolumbar spinal radiographic evaluation. Recommendations for imaging of the thoracolumbar spine include GCS<15, multisystem injuries, positive findings on clinical examination, suspected nonaccidental trauma and a preverbal child with a high-risk mechanism of injury[12,18,28]. Most of the pediatric spinal injuries are multilevel, thus, whole spine imaging is recommended when an abnormal radiographic finding is identified within any level[28].

Figure-3. Seat belt sign

Analyzing the stability of the fracture is very important, because it can guide the management. Suggestive imaging signs of instability (Table-1)[2] are generally for adult thoracolumbar spine fractures, however, some authors suggest that they may be applies to the children older than 9 years[4,8,13,30].

Table-1. Radiographic Instability Signs of Thoracolumbar Spine Fracture in Pediatric Patients

• 40-50 % loss of vertebral body height
• 15 °-30° of kyphotic angulation
• 35-50 % spinal canal compromise by fracture fragments
• >2.5 mm translation of the vertebral body in any plane
• Widening of the pedicles
• Bilateral facet dislocations
• Abnormal widening of spinous processes, facets, or laminae

Most of thoracolumbar fractures can be visualized by plain radiographs. Loss of vertebral body height, kyphotic angulation, translation of the vertebral body, interpedicular widening, abnormal widening of spinous prosesses, facets and laminas are some of the radiographic findings of thoracolumbar pediatric spinal injuries (Figure-2).

CT scan is especially needed for osseous component of the spine for example can evaluate spinal canal after burst fracture. MRI preferred for evaluating spinal injuries to assess the cord injury[5,8]. Interpedicular widening on the AP projection and small cortical defects at posterosuperior corner of the vertebral body on the lateral projection can be seen on conventional radiography in burst fractures. But leading cause of missed injury and subsequent neurologic deterioration in trauma patients, supporting the argument for increased use of CT and MRI[21]. Although plain film radiographic and CT images may elucidate the integrity of the posterior ligamentous complexes of the spine, MRI is more reliable and recommended when compression fractures of the vertebral body present with a loss of more than 50% in anterior height[22].

Spinal cord injury without radiographic abnormality (SCIWORA), is a condition of objective signs of acute spinal cord injury in the absence of spinal column findings on plain radiographs and/or computed tomography (CT)[25]. The incidence is from 4% to 67% of all pediatric spinal traumas[6,26]. The most common region for SCIWORA is cervical spine, however, 13% of lesions are within the lowest thoracic spine[30]. The pathogenesis is related with the higher laxity of the bony and ligamentous structures compared with the spinal cord. In the setting of spinal injury, bony and ligamentous structures can undergo significant stretching, however, the spinal cord may be injured.

CLASSIFICATION:

Thoracolumbar fractures in children are uncommon but cause significant morbidity and mortality. Two classification systems for thoracolumbar spine injuries are discussed.

Denis described a three-column classification system. It divides column of vertebrae to three parts; anterior, middle and posterior. This system used to classify thoracolumbar fractures as compression fractures, burst fractures, flexion-distraction injuries or fracture-dislocations. He also classified the stability of these fractures based on number of columns affected[10].

TLICS scale help analyze and manage fracture patterns into three axes: **1)** injury morphology, **2)** integrity of the posterior ligamentous complex, and **3)** neurologic status (Table-2)[33].

The TLICS system based on score about value of injury. Patients with a score of 3 or less are generally treated nonoperatively but score of 5 or greater generally require surgical fixation. Although TLICS system is a reliable for classifying and managing adult thoracolumbar fractures, yet to be validated for pediatric patients[29].

Table-2. Thoracolumbar Injury Classification and Severity Scoring System

Characteristic	Points
Morphology	
Compression	1
Burst	2
Rotation/translation	3
Distraction	4
Disruption of the Posterior Ligamentous Complex	
Intact	0
Suspected	2
Disrupted	3
Neurologic Status	
Intact	0
Nerve root	2
Cord, conus medullaris: Complete	2
Cord, conus medullaris:Incomplete	3
Cauda equina	3

MANAGEMENT:

Stable injuries of the thoracolumbar spine in pediatric population can be treated non-operatively, often without an orthosis[19,30]. Additionally, on the basis of good healing potential of younger patients, nonsurgical management of unstable fractures in patients youger than 9 years of age is recommended by some authors, except neurological compromise, irreducible subluxation, polytrauma and brace/cast intolerance[8,30]. Non-operative management in this setting includes bed rest, bracind and casting with analgesia and myorelaxants for muscle spasm. For all non-operative management options, close follow-up is necessary to confirm fracture stability and aligment.

After adequate analgesia minor spinous process fractures, transverse process fractures, wedge compression fractures can be treated by thoracolumbosacral orthosis (TLSO) for 6 weeks[21]. Chance fractures require hyperextension casting/bracing for 8-12 weeks[22].

Children who sustain an unstable injury, such as a vertebral subluxation or a fracture dislocation, should undergo reduction in the same manner as an adult with a similar injury. Early surgical treatment, instrumentation, and fusion are mandatory for unstable fractures and injuries associated with spinal cord lesions[17,20]. In children, atraumatic spinal cord lesion may develop a deformity that mainly scoliotic, kyphotic, or lordotic in 90% of cases[3,14,20].

Children with burst fractures that result in spinal canal narrowing (greater than 25%) and kyphosis are increased risk of further canal compromise and should be considered for early correction and decompression[7,28]. Also found that non-operative treatment of burst fracture is a viable option in neurologically intact children, but progressive angular deformity occurred during the first year after the fracture[20]. As in the adult, spinal instrumentation is helpful in reducing deformity and stabilizing the fracture site. Open reduction must be accompanied by a posterior spinal fusion at least one level above and below the fracture site. Laminectomy is rarely needed because can cause kyphotic deformity during short time follow-up[34]. Spontaneous interbody fusion seldom occurs and should not bed depended on to provide long-term stability[3].

CONCLUSION:

Injury of the thoracolumbar spine are uncommon during the childhood and most arise from high-energy motor vehicle accidents. Because of related with significant injury, carefully clinical examination and treatment is very important. Overall, most pediatric injuries of thoracolumbar spine have good to excellent long-term outcomes.

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Volume: 27, Issue:2, April 2016 pp: 117-120 TECHNICAL NOTE / TEKNİK NOT

EXTENDED LUMBAR LAMINECTOMY: A SAFE AND SWIFT TECHNIQUE

UZATILMIŞ LOMBER LAMİNEKTOMİ: GÜVENLİ VE HIZLI BİR TEKNİK

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SUMMARY:

Even though spinal surgeons are very familiar lumbar laminectomy, prolongation of surgical time increases the risk of complications. The shift towards minimally invasive and shorter operation time pushes surgeons in search of new methods. Thus arises the need for safer maneuvers and techniques. The goal of method employed within this paper is to expand the lumbar canal dorsally by removing the spinous processes, laminae, ligamentum flavum, and bony hypertrophy that are contributing to the canal stenosis. This technique is hasty in technical manners and also flexible. With proper diagnosis and selection of patients, careful appliance of this technique will allow for safe, swift and effective approach to the management of lumbar canal stenosis.

Key words: spinal canal stenosis, lumbar, decompression, surgical drill, laminectomy

Level of Evidence: Technical note, Level V

ÖZET:

Lomber laminektomi sırasında sürenin uzaması, spinal cerrah ne kadar tecrübeli olursa olsun komplikasyon riskini arttırmaktadır. Minimal invaziv ve daha kısa süren cerrahi tekniklere eğilimin artmasıyla beraber cerrahlar yeni yöntemler aramaktadır. Bu şekilde daha güvenli manevra ve tekniklere ihtiyaç doğmaktadır. Bu yazıda ele alınan tekniğin amacı lomber kanalı daraltan posterior elemanları daha geniş ve hızlı bir şekilde çıkartarak güvenli dekompresyon sağlamaktır. Teknik olarak hızlı ve kolaylıkla uygulanabilir bir yöntemdir. Lomber dar kanalın cerrahi tedavisi ele alınırken dikkatli tanı süreci ve hasta seçimiyle beraber bu teknik ile güvenli, hızlı ve etkin bir dekompresyon sağlanabilir.

Anahtar Kelimeler: Spinal dar kanal, lomber, dekompresyon, cerrahi, laminektomi

Kanıt Düzeyi: Teknik not, Düzey V

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INTRODUCTION:

Lumbar laminectomy alone or combined with other procedures continues to be one of the most common technique employed during lumbar surgery. Laminectomy with or without foraminotomy is the common accepted treatment for decompression of the lumbar spondylosis. It is also frequently used for spinal malignancies, infection or traumatic lesions. Although performed frequently, incidental durotomy is not rare averaging around 10% [2]. At least one complication has been reported in 7% of laminectomy cases based on 6376 lumbal operations[3].

TECHNIQUE:

A shortened version of the technique has been attached to better visualize the steps. Within this technique after anesthetic preparations the patient is rolled over to prone position supported by silicone pillows bilaterally. A C-arm may be used to localize correct level. After an appropriate midline incision, subperiostal dissection of paravertebral muscles is followed by splitting of interspinous ligaments using a surgical blade. A high speed drill with a ball end thin pars interarticularis bilaterally from lateral to the medial side. A Kerrison rongeur may be employed before the drill is used to assist the drill entrance point (Figure-1.a-b).

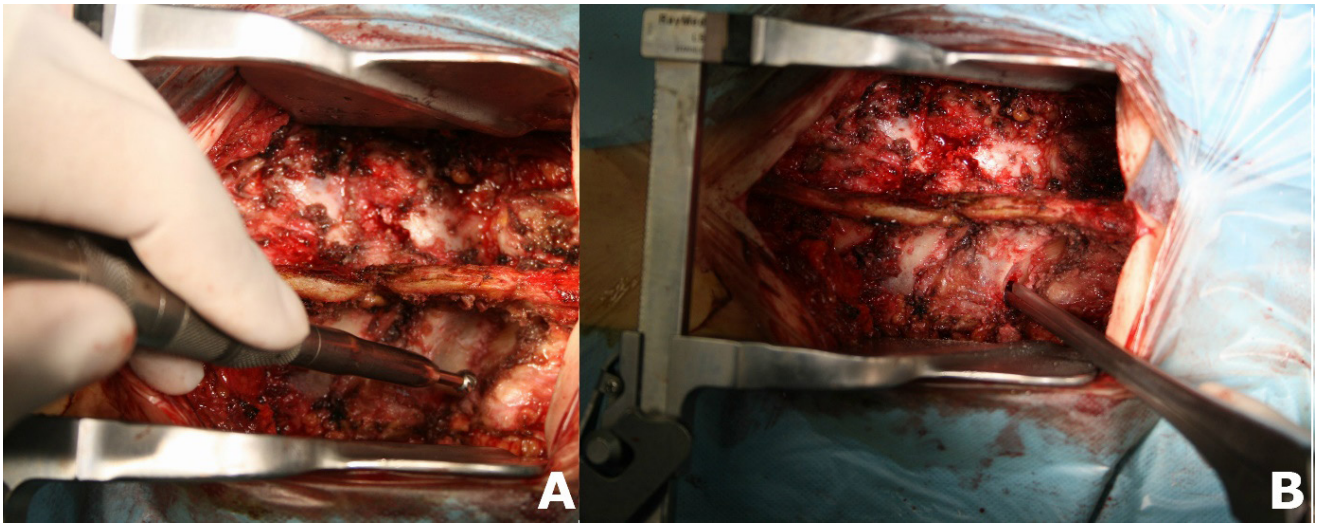

Figure-1. a) A ball ended drill thinning pars articularis. **b)** Kerrison rongeur used to create an entrance point for the footed drill.

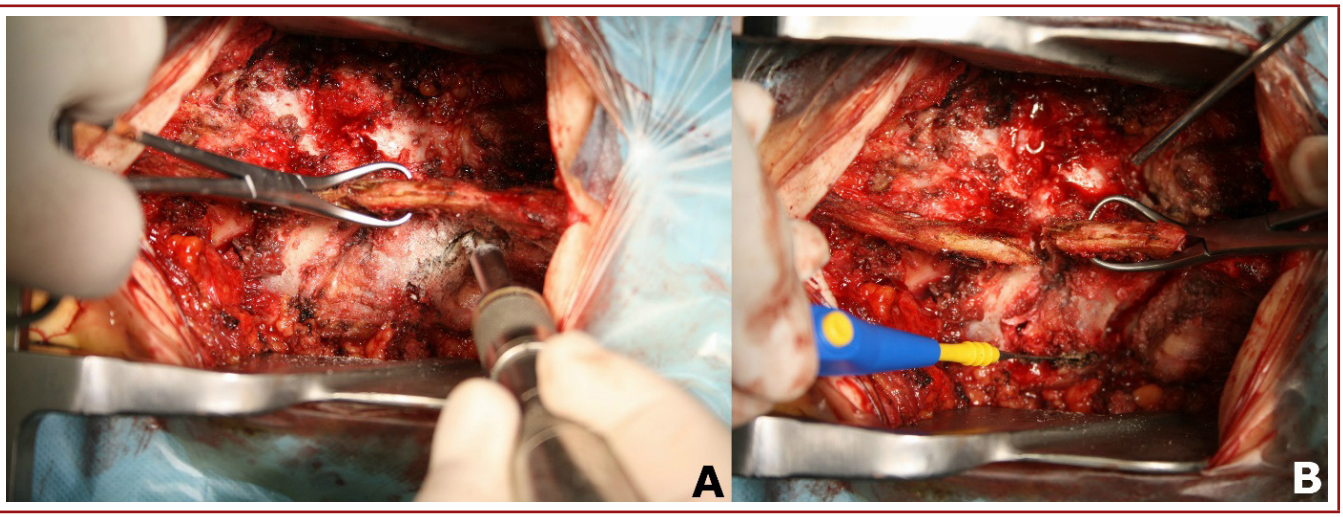

Figure-2. a) Footed end drill used to excise pars interarticularis. **b)** Monopolar cautery used to split facet joint.

After thinning pars interarticularis, a drill with a footed end is used at an approximate 45^0 angle to excise pars interarticularis allowing the connection between laminae, spinous process and inferior facet joints (posterior elements) to be separated from the vertebral corpus and pedicles.

The inferior facet the joint is then split using a monopolar cautery, then a backhaus clamp is used to elevate the posterior elements and a periosteal dissector is inserted in between ligamentum flavum and facet joints allowing an en bloc excision of the posterior elements (Figure-2,3).

A backhaus clamp should be employed throughout the procedure to allow better visualization of spaces by maneuvering the lamina. After excising lig. flavum, Kerrison rongeur is again used to remove the medial aspects of the superior articular facet joint of the inferior level until pedicle junction along with extended foraminotomy. This wide decompression of the lumbar vertebrae will create the need for posterior instrumentation due to instability. Posterior pedicle screws were used to allow bony fusion.

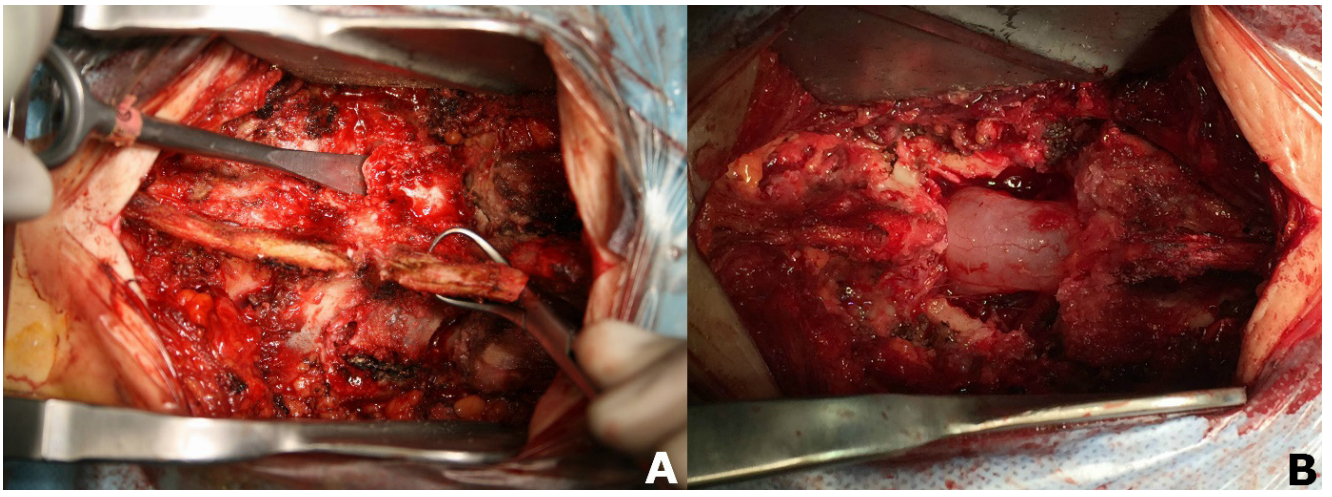

Figure-3. a) Periosteal dissector used to elevate posterior elements along with dissection from the cord. **b)** After the removal of the posterior elements of the spine.

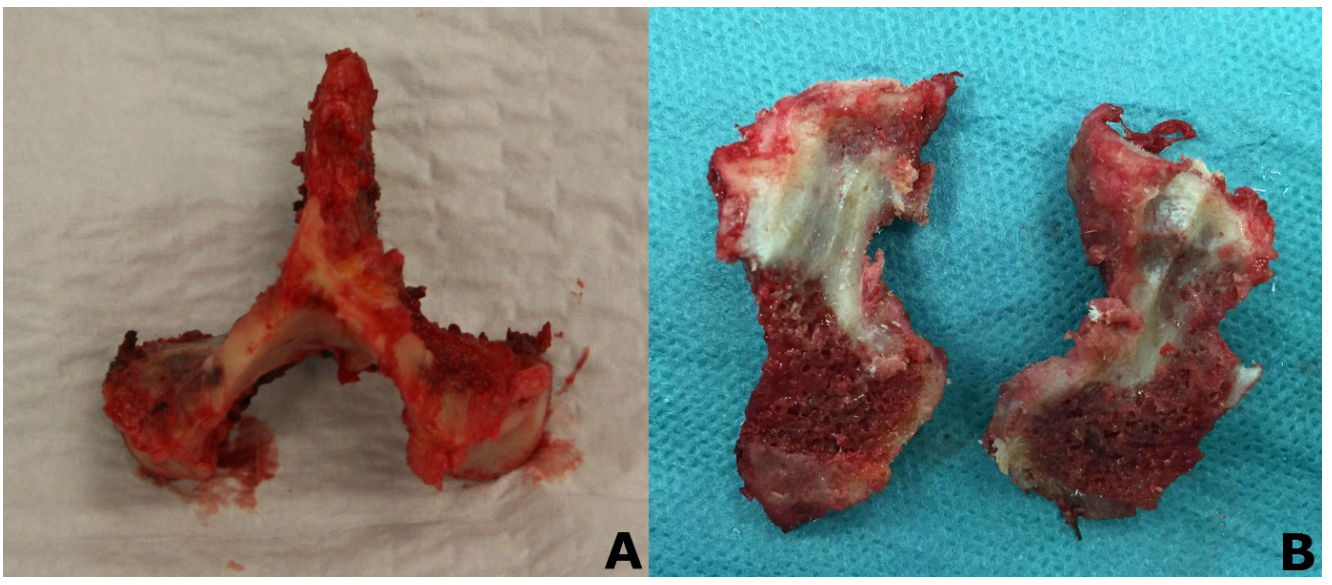

Figure-4. a) Excised bony elements, **b)** Split in half for better placement in bony fusion.

DISCUSSION:

A retrospective analysis of 17, 232 who underwent short-segment lumbar fusion revealed an incidental durotomy rate of 4.6 %[1]. This correlated with increased neurological complications and longer hospital stay. A classical decompression using kerrison and leksell rongeur would require multiple entrances to the epidural space and with every debulking manuever the dura mater is at risk for laceration. Within this technique kerrison rongeur is used to create an entrance point for the drill where dura is clearly visualized. Once the drill is inserted safely into the epidural space, the risk for damaging dura is minimized. Additionally, the classical method is debilitating and prolongs surgical period.

This extened lumbal laminectomy permits for a maximum neural decompression along with a safer and greater visualization allowing the surgeon for a safer transforaminal lumbar interbody fusion (TLIF) or posterior lumbar interbody fusion (PLIF) placement and pedicle subtraction osteotomy. En bloc excision of the posterior elements also creates a valuable cortical spongious auto graft to be used for posterolateral fusion (Figure-4).

CONCLUSION:

Although experimental research comparing classical methods and these techniques are required to state the technique mentioned here to be safer, clinical experience with this method so far has yielded no complications.

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HUMAN ENGINEER: PROF. MAHİR GÜLŞEN, M.D.

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SUMMARY:

Prof. Mahir Gülşen was born in Muğla in 1956. He was graduated from Ege University Medical Faculty. Then, he continued his academic life in Çukurova University in Adana. He was mainly interested in Spinal Surgery and External Fixation after the residency program. Prof. Gulsen was president of the Turkish Spine Society during 2009-2011. He has reported many papers in the international journals. His studies about the anterior surgery of the scoliosis and osteotomies of the complex deformity of the spine are very important landmarks for the development Spine Surgery in Turkey.

Key words: Mahir Gülşen, Scoliosis, spine, external fixation

Level of Evidence: Biography, Level V

ÖZET:

Prof. Dr. Mahir Gülşen 1956 yılında Muğla'da doğdu. Ege Üniversitesi Tıp Fakültesini bitirdi. Daha sonra, akademik hayatına Çukurova Üniversitesinde Adana'da devam etti. Uzman olduktan sonra temel olarak omurga cerrahi ve eksternal fiksasyonla ilgilendi. Prof. Gülşen 2009-2011 arası Türk Omurga Derneği başkanlığını yürüttü. Uluslararası dergilerde çok sayıda makale yayınladı. Özellikle onun skolyoz cerrahi tedavisindeki anterior cerrahi uygulamaları ve kompleks omurga deformitelerindeki osteotomi uygulamaları, Türk Omurga Cerrahisine büyük katkılar sağladı.

Anahtar Kelimeler: Mahir Gülşen, skolyoz, omurga, eksternal fiksatör

Kanıt Düzeyi: Biografi, Düzey V

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INTRODUCTION:

Although I have known Prof. Mahir Gülşen for a long time, I have got acquainted with him during our stay in Madrid, Spain because of European Board educator and tester course and I began to admire him also in that time. During that trip, I discovered that we had a lot in common and more important than that he was a man of goodness and friendship and a very good scientist and surgeon in contrast to his humbleness. I have learned that he was regularly attending to Renewal courses in USA and is a good reader (Figure 1).

Figure-1. Prof. Mahir Gülşen and me in EBOT Course in Spain.

Before writing his biography I have realize that we were somewhat late on that. I was jealous of a book published about Mahir Hoca (master) under the title of "Human Engineer" before this biography was written; but, on the other hand this book was used by me as an important source in writing of his biography[1].

Mahir Gülşen, is a surgeon that has dedicated himself to spine surgery and is a self- made man who improved himself by his own. In addition to his numerous international publications, he has contributed to training of many spinal surgeons in Çukurova Medical Faculty and then in the one and only private Orthopedics and Traumatology Hospital of Turkey which is established by himself.

LIFE STORY:

Twins were born on 20th of July in 1956 in Karabortlen village of Mugla. Their names were Mahir and Sait. Their mother Hatice was a housewife and their father Mehmet Sabri was a farmer. They were the fourth and the fifth children of the family as fraternal twins. Mrs. Saziye, the aunt of the twins still didn't have a child (even they were in the fourth year of their marriage). With the desire to have a child and her love for them, Mrs. Saziye insisted on taking care of Mahir of the twins and raise him herself, the family accepted helplessly. Mahir Gulsen called his auntie as mother and his uncle-in-law as father; his own mother as auntie-mom and his own father as big-dad. Mahir introduced to Izmir when his new family was assigned to this beautiful city. But since they kept in touch with the village, Mahir spent his summers with his real family (Figure-2)[12].

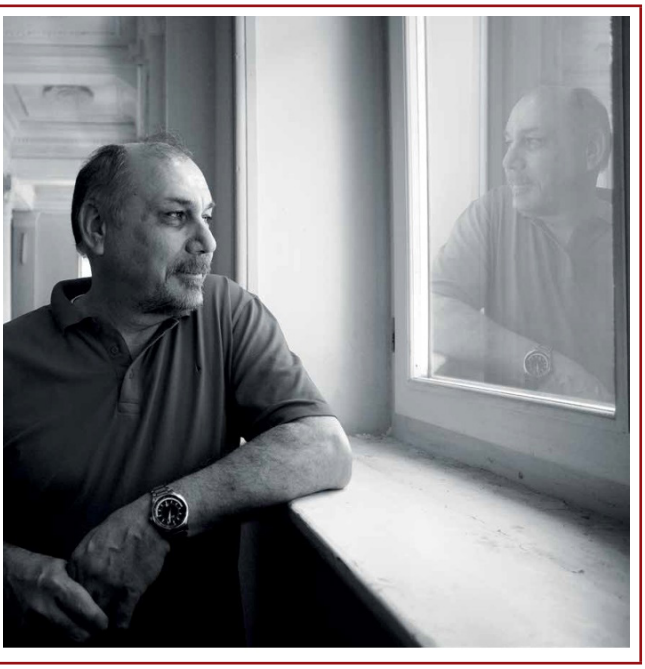

Figure-2. Prof. Mahir Gülşen.

He started elementary school in Izmir but because of reassignment of his family to Mugla he continued his education in Mugla. After he attended 4th year of the school in Mugla, they were reassigned to Izmir and he completed 5th year of elementary school In Izmir Esrefpasa Elementary school. Prof. Mahir was left handed… One of those days, his teacher in Mugla tied his left hand and asked him to write with his right hand (Figure-3)[12].

Esrefpasa where they lived in Izmir was one of the oldest neighborhoods of the city. He started middle school there in Bestepeler Middle School. He had a very good math teacher. Maybe he was one of the most important teachers who made him successful and love science department. His name was Kemal Hortacli.

Figure-3. Old İzmir, during 60s.

Teacher Kemal used to make students put away textbooks in the last fifteen minutes of the class and was saying "We will read a novel." For three years, they read books of Yasar Kemal in the last minutes of the math classes. This had -affected Prof. Mahir a lot during his life and it also made him love the math lesson[12].

During middle school years, Prof. Gülşen continued to go to the village every summer. He was working in Forest Administration time to time when he was there. So he was both on holiday and working. He had proved himself during the work in Forest Administration, even he was still a child, he worked in jobs that requires responsibility. For some reason, Mahir was interested in circus. He read some books that have parts describing circus. After he read these books, his entire dream was to work in a circus. He was a very good gymnast. He used to do somersault and do a handstand and walk on his hands. When he returns home for the summer, he used to tie a stretched rope between two trees and he tried to walk on it with a pole in his hands[1].

Mahir had taken the exam for scholarship and had entered to Izmir Ataturk High School. It was one of the best schools and it was great to study in a boarding school. In the later years his math teacher had chosen him for the Math Team even his grade was three out of five. And in the end he was able to write his name in the entrance of Izmir Ataturk high school (Figure-4)[12].

Figure-4. TUBITAK Math award.

He always wanted to be a mechanical engineer actually. That's where his relation with math was taking him towards. He wanted to take the exams of universities out of Izmir; however since his father didn't let him to leave for another city because of his financial constraints, his longing to him and the violent political skirmishes of the period, he started to consider a university in Izmir[12].

In the end, he decided to enter the medical school of Ege University. Before he became an orthopedist, his dream was to be a psychiatrist. Actually he had this thought until third grade. In the following days Ege University Orthopedics Department President Prof. Merih Eroglu started to come to his classes. Mahir Gulsen was very impressed while he was giving lecture on treatment methods in orthopedics and he made his mind on being an orthopedist.

He started to volunteer in hospitals starting from the first grade. He learned practical things like medical dressing and giving an injection. Of course you can't deny the practical benefits of being in hospitals as a medical student. In the summer of third grade, he worked in Mugla Public Hospital. While he was there, he asked permission from surgeon Mr. Gultekin to attend the operations. He started to attend operations with the purpose of observation[1,12].

Prof. Gülşen finished the medical faculty in 1979. He started to residency program of Orthopedics and Traumatology in Çukurova Medical Faculty 1980, and finished in 1985. He was married with Arzu Gülşen in 1983 (Figure-5).

Figure-5. Arzu Gülşen.

He studied in Kayseri voluntarily for a few years after becoming a surgeon of Orthopedics and Traumatology. In Kayseri, during his studies about the external fixation, he figured out and understood the technique of the Ilizarov external fixator and the idea behind it. Then he designed a new external fixator and took a patent of the that new fixator (Figure-6).

Figure-6. In Kayseri, during his studies about the external fixation, he figured out and understood the technique of the Ilizarov external fixator and the idea behing it. Then Prof. Gülşen designed a new external fixatour and took a patent of that new fixator.

Prof. Gülşen worked in the İzmir Soldier Hospital for military service. Then he was accepted as Assistant Professor of Orthopedics and Traumatology in the Çukurova University. He became an associate professor in 1989. Because of his interest in external fixator, he kept his studies on this field and he also focused on his studies about his other area of interest namely spinal diseases.

As he got more experienced he started to think that he needs go abroad for further improvement. Paul Harrington had made a breakthrough with the spinal instrumentation device he developed in Houston, USA which was coined by his name. Mahir Gulsen decided to go there and in the summer of 1991, he went to USA as an associate professor[12].

Mahir Gulsen had them bring these tools to Adana. This way he started to apply Ilizarov surgery. Mahir Gulsen became a professor in 1995 and he held Ilizarov Course for the first time in 1996 in Adana Cukurova University. Mahir Gulsen held the 17th of this course in 2013 and until now more than 2500 orthopedists have taken these courses. The starting point of Ilizarov surgery in Turkey is Adana. Because of Mahir Gulsen, Adana became the worldwide known center of a very important medical application. Because of him, nationally or internationally many patients visited our city. In 2004, World Ilizarov Conference was held in Turkey and Mahir Gulsen was the chairman of the conference (Figure-7)[12].

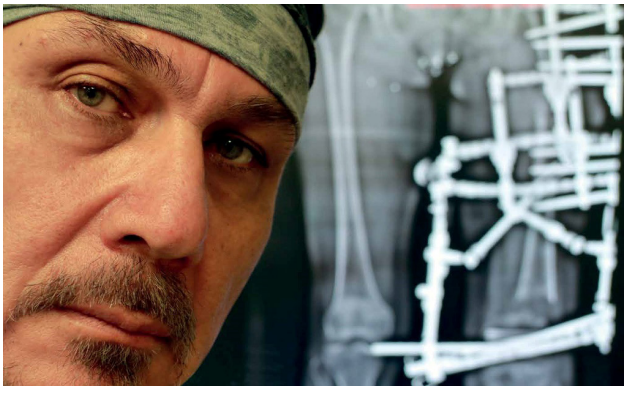

Figure-7. In 2004, World Ilizarov Conference was held in Turkey and Mahir Gulsen was the chairman of the conference.

In 2008, he left from the University and founded the Orthopedia Hospital and Spine Center with his friends. Now he is working in the same hospital as a chairman of the spine center.

Mahir Gulsen; his wife Arzu, his two daughters Zeynep and Ege form a precious modern family portrait. Mahir Gulsen is a man who empowers Adana with everything he did and everything he will do. With the light of the science, he is a man who never stays in the dark (Figure-8)[12].

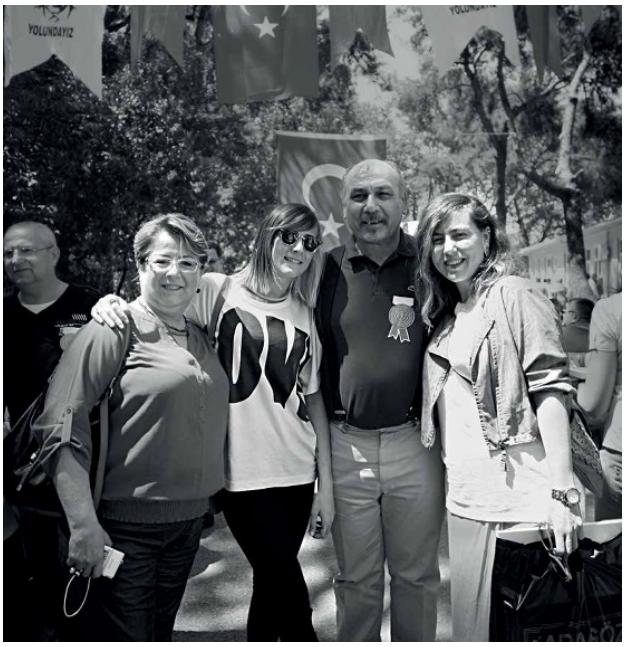

Figure-8. Prof. Gülşen and his wife, Arzu Gülşen is seen with their daughters.

CONTRUBUTIONS TO THE TURKISH SPINAL SURGERY:

He returned to Adana after working in spinal surgery department for four months in USA and he decided to focus on rheumatic spine disorders such as ankylosing spondylitis. The self-confidence of being an associate professor was pushing him to make brave decisions[12].

Mahir Gulsen decided to use a technique which was never used in Turkey before. The name of this technique used in ankylosing spondylitis treatment was "Egg Shell" and it was a method that was started to be employed in the world only recently. In this technique, neurocentrum was being carved by entering from backside like carving the interior of an egg, it is emptied and bone is weakened. The bone is cracked easily like an egg shell and the desired shape is given. The two sides of the spine are left at different heights to correct the arch in the spine (Figure-9)[1,4-5].

He became the executive board member of Turkish Spine Society during 2000-2005 period. He organized the 7th International Congress of Turkish Spine Society in 2005 as a chairman. He was elected for executive board member of Turkish Society of Orthopedics and Traumatology in 2004. He became the president of Turkish Spine Society during 2009-2011 period (Figure-9)[1,12].

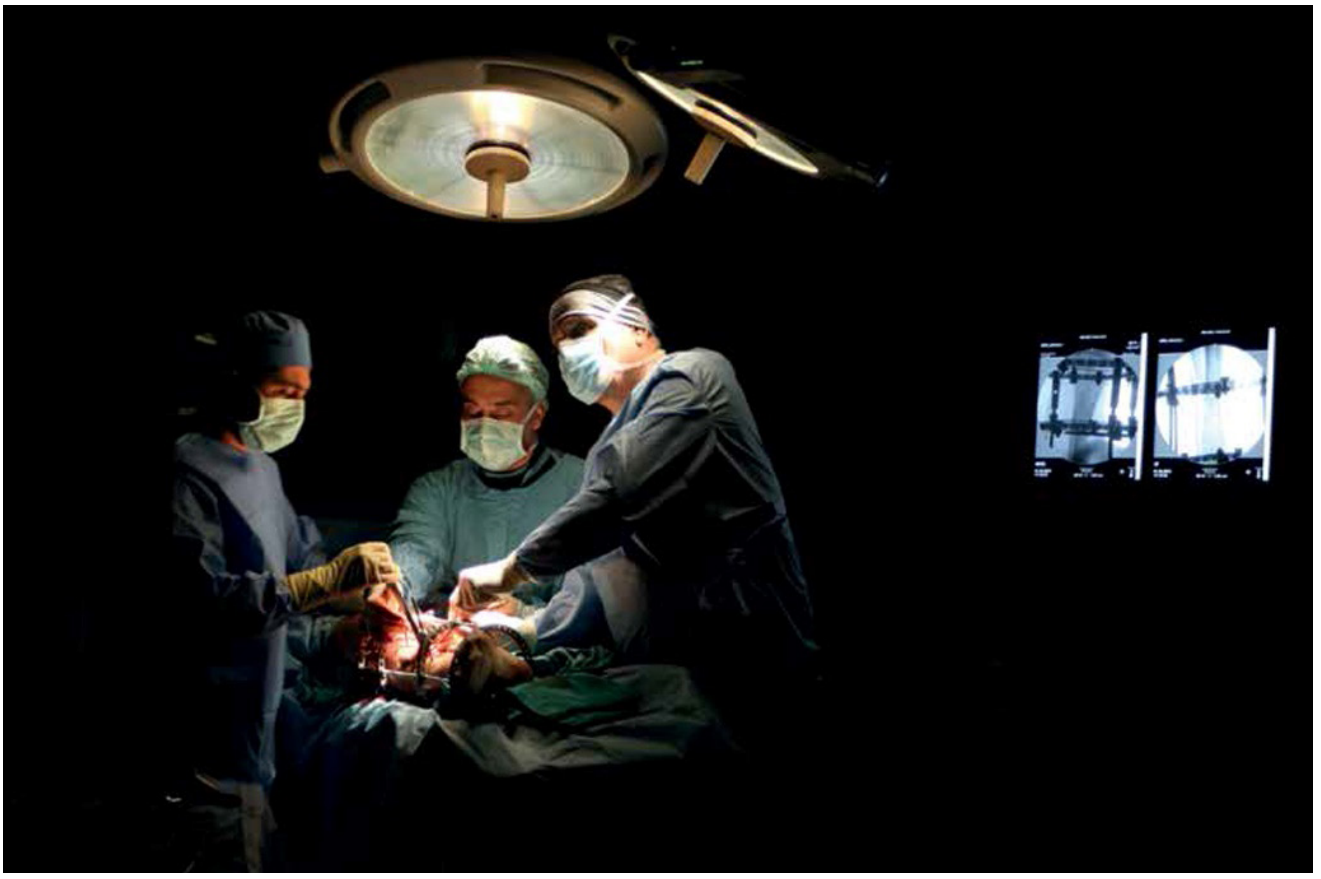

Figure-9. Prof. Gülşen is seen in the operating theatre.

Figure-10. He is one of the first surgeons in Turkey performing anterior instrumentation for the scoliosis and other spinal deformities and osteotomies in the rigid spinal deformities.

He reported many articles in international journals and made presentations in international congresses[2-11]. His main topic was "eggshell procedure for the ankylosing spondylitis" [4,5].

He is one of the first surgeons in Turkey performing anterior instrumentation for the scoliosis and other spinal deformities and osteotomies in the rigid spinal deformities. He also performed growing rods and similar techniques in the childhood spinal deformities (Figure-10).

In conclusion, Prof. Dr. Mahir Gülşen's flawless character, caring personality, knowledge and experience, and countless publications have made him an indispensible pioneer of modern spinal surgery, not just in Turkey, but worldwide. He is really a pioneer of the Turkish Spinal Surgery.

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turkishspine

1- Which level is most affected in the study of Gürçay and Gürsoy.

a) C1-2
b) C2-3
c) C3-4
d) C4-5
e) C5-6

2- How many patient had been exitus due to respiratory distress syndrome in the study of Gürçay and Gürcan?

a) 1
b) 2
c) 3
d) 4
e) 5

3- Which one is wrong according to the study of Kazancı and Gürcan?

a) Impaction of retropulsed fragments of burst fracture can have better spinal canal restoration
b) There was no significant difference between groups in terms of VAS
c) The ligamentotaxis with impaction of retropulsed fragments group had slightly more peroperative blood loss and longer operation duration.
d) After total laminectomy of posterior bony structures with facetectomy the risk of iatrogenic spinal cord injury was increased.
e) All patients were operated within 36 hours after injury.

4- How many patient was operated with posterior decompresion and impaction of the bone feagments?

a) 9
b) 19
c) 29
d) 39
e) 49

5- How many patient with different vertebral tuberculosis were treated with surgical intervention in the study of Kaya *et al*?

a) 9
b) 19
c) 29
d) 39
e) 49

6- Which sentence of the below <u>is not</u> correct according to the study of Kaya *et al*?

a) Mean age was 48±18.1 years
b) Mean follow-up time was 59.9±27.7 months
c) There was avarage 1.2±0.5 disc and 2.2±0.5 vertebral body involvement
d) 15 cases were surgically debrided through anterior approach,
e) 24 were surgically debrided through posterior approach with posterior pedicle screw fixations.

7- How many AIS cases were presented in the study of Yılmaz *et al*?

a) 22
b) 32
c) 42
d) 52
e) 62

8- Which value was not detected according to the study of Yılmaz *et al.* ?

a) Lumbar lordosis
b) Pelvic incidence
c) Pelvic tilt angle
d) Mehta's angle
e) Sacral slope

9- Which complication of the below was seen in the case of Oltulu *et al*?

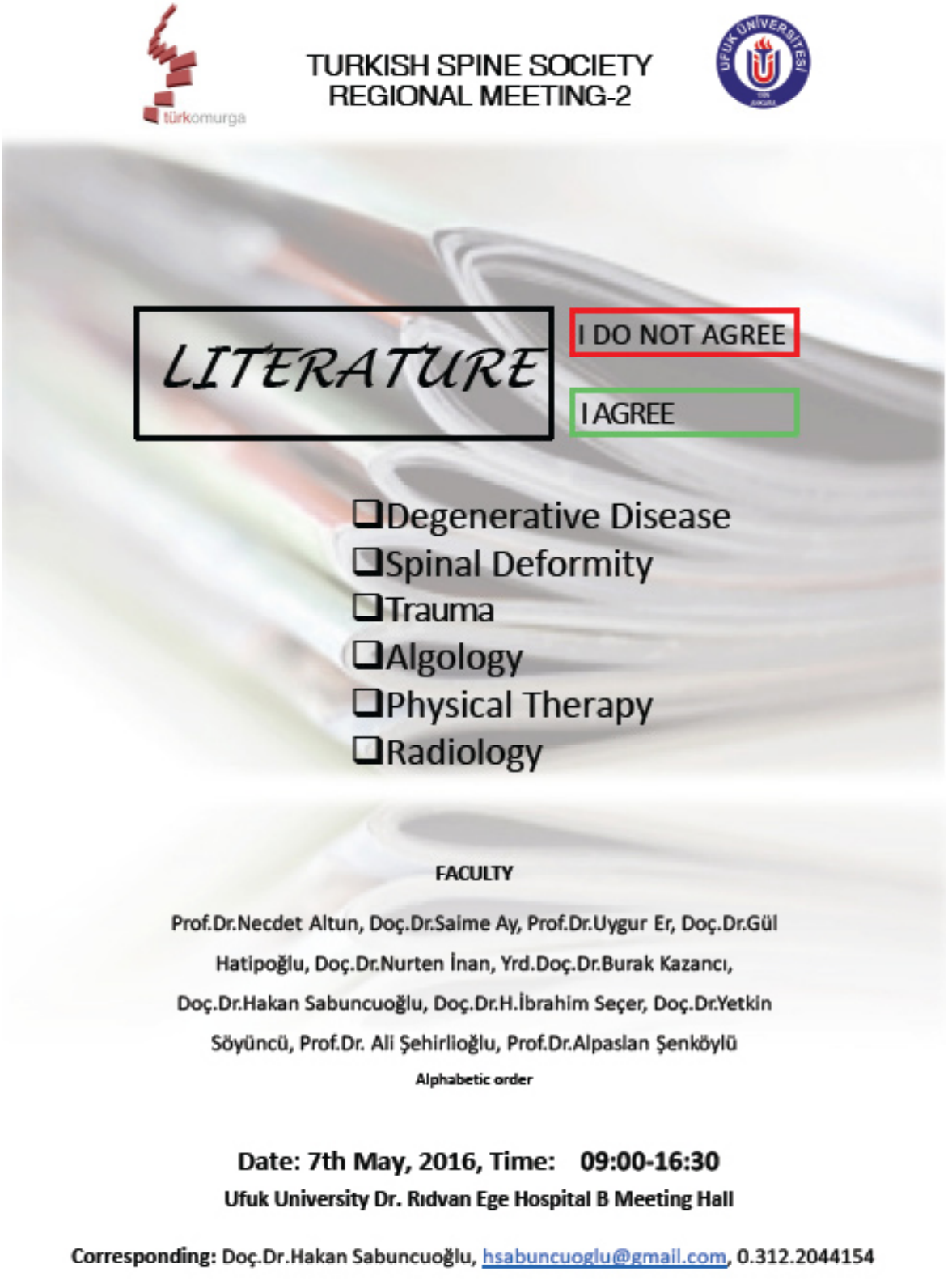
a) Neural deficit
b) Respiratory distress syndrome
c) Lung infarct
d) Urinary incontinence
e) Cerebral embolism

10- Which level of the child patient with spinal fracture was presented in the study of Taşkoparan and Çakır ?

a) L-1
b) L-2
c) L-3
d) L-4
e) L-5

JTSS 27 (2) ISSUE CORRECT ANSWERS OF CME QUESTIONS:

1. d
2. b
3. a
4. b
5. b
6. e
7. d
8. e
9. d
10. b


türkomurga
TURKISH SPINE SOCIETY
REGIONAL MEETING-2
UFUK ÜNİVERSİTESİ
LITERATURE
I DO NOT AGREE
I AGREE
❑Degenerative Disease
❑Spinal Deformity
❑Trauma
❑Algology
❑Physical Therapy
❑Radiology
FACULTY
Prof.Dr.Necdet Altun, Doç.Dr.Saime Ay, Prof.Dr.Uygur Er, Doç.Dr.Gül Hatipoğlu, Doç.Dr.Nurten İnan, Yrd.Doç.Dr.Burak Kazancı, Doç.Dr.Hakan Sabuncuoğlu, Doç.Dr.H.İbrahim Seçer, Doç.Dr.Yetkin Söyüncü, Prof.Dr. Ali Şehirlioğlu, Prof.Dr.Alpaslan Şenköylü
Alphabetic order
Date: 7th May, 2016, Time: 09:00-16:30
Ufuk University Dr. Rıdvan Ege Hospital B Meeting Hall
Corresponding: Doç.Dr.Hakan Sabuncuoğlu, hsabuncuoglu@gmail.com, 0.312.2044154

TURKISH SPINE SOCIETY

REGIONAL MEETING-3

4th June, 2016, Antalya

« THORACOLUMBAR SPINAL FRACTURES»

CHAIRMAN: PROF. YETKİN SOYUNCU, M.D.

09:00-09-10 – Opening speech
Prof .Dr. Teoman BENLİ

09:10-09:30 **TL fractures: classification - biomechanics -algoritm of management**

09:30-09:50 **TL fractures: clinical presentation and radiologic evaluation**
Doç. Dr. Mehmet AYDOĞAN

09:50-10:10 **Burst fracture without neural deficit- Conservative treatment?**
Prof . Dr . Yetkin SÖYÜNCÜ

10:10-10:30 **Coffee break**

10:30-10:50 **Burst fracture with neural deficit- Surgical treatment?**
Prof . Dr. Metin ÖZALAY

10:50-11:10 **The role of MISS**
Prof . Dr . Esat KITER

11:10 -11:30 **Pearls and traps (video)-** *All faculty*

11:30 -12:30 **Case discussion**
Chairman: *Prof. Dr. Teoman BENLİ – All faculty*