SURGICAL TREATMENT OF LUMBAR SEGMENTAL INSTABILITY

S. YALÇIN * O. GÜVEN * M. KARAHAN *

ABSTRACT :

One of the main functions of the human spine is to provide mechanical support to the body while allowing various degrees of motion. There are numerous lumbar pathologies that may cause instability. Although clinical experience on large patient groups with fractures, infections, neoplasiae, scoliosis and spondylolisthesis has produced a vast amount of knowledge on the diagnosis and treatment of these disorders, clinical information is scarce on primary and secondary degenerative instabilities. Between the years 1989-1993, fourteen patients (5 M, 9F) with primary or secondary degenerative lumbar segmental instabilities were treated at the Marmara University School of Medicine, Department of Orthopaedics and Traumatology. The patients were followed up for clinical signs of healing and radiological signs of stability for 23,8 months (mean 6-55 months). Eight cases healed completely, in three cases there was considerable improvement, in three cases there were various complaints in which one had established pseudoarthrosis requiring revision.

Key Word: *Functional Spine Unit, Segmental Instability, Spinal Pseudoarthrosis.*

INTRODUCTION :

One of the main functions of the human spine is to provide mechanical support to the body. Various degrees of motion are also performed by the cervical, dorsal and lumbar spinal segments. These two conflicting functions: stability and mobility are expected to be performed by the inherently unstable human spine. The 24 individual vertebrae and the sacrum have more than 200 articulations and they tend to collapse under the load of two kg when the muscle support is removed. Stability is provided by a very complex network of stabilizers (1).

1. **Passive stabilizers of the vertebrae:** shape, size etc of the vertebral body and the size and orientation of the facet joints.

2. **Dynamic stabilizers of the vertebrae:** ligaments, capsules, annulus fibrosis and articular cartilage.

3. **Active stabilizers of the vertebrae:** muscles (paravertebral, psoas, quadratus lumborum, abdominal wall musculature)

4. **Hydrodynamic stabilizer of the vertebrae:** nucleus pulposus.

The basic constituents of the spine consist of one vertebra, its ligaments (anterior longitudinal, posterior longitudinal, interlaminar, interspinous etc) and the neighbouring disc and is named as the Functional Spine Unit (FSU) for biomechanical purposes (2). The integrities of individual FSU's are crucial for stability and physiological mobility of the human spine. Degenerative processes, surgical procedures or primary diseases like tumors, infection, scoliosis may lead to a dysfunction in one or more of the above listed stabilizing structures. The thoracic spine is relatively less mobile - more stable and is reinforced by the thoracic cage (5). On the other hand the lumbar spine is under heavy stresses, prone to develop primary or secondary instability. Segmental spinal instability is defined as a loss of motion stiffness such that force application to the FSU produces greater displacement(s) than would be anticipated in a normal structure, resulting in a painful condition, the potential for progressive deformity and a risk to the neurological structures (2). The more commonly encounterd lumbar pathologies that arise secondary to instability are listed in Table I (3).

Clinical experience on large patient groups with fractures, infections, neoplasiae, scoliosis and spondylolisthesis has produced a vast amount of knowledge on the diagnosis and treatment of these disorders. On the other hand, primary and secondary degenerative instabilities are recently described pathological entities where clinical information is scarce.

The aim of this study is to investigate the role of surgery in the treatment of pure degenerative lumbar

* Department of Orthopedics and Traumatology, School of Medicine, Marmara University, Istanbul - TÜRKİYE

segmental instabilities (primary and secondary) in a diverse patient group treated in our institution.

Table I. Classification of lumbar segmental instabilities according to Frymoyer.

Lumbar Segmental Instabilities
Fractures and fracture-dislocations
Infections (involving anterior and middle columns)
Primary and metastatic neoplasms
Scoliosis
Spondylolisthesis
Degenerative instabilities
Primary instabilities
Secondary instabilities
Post-disc excision
Post-decompression laminectomy
Accentuation
New deformity
Post-spinal fusion
Post-chemonucleolysis

MATERIALS AND METHOD :

Between the years 1989-1992, fourteen patients with primary or secondary degenerative lumbar segmental instabilities were treated at the Marmara University School of Medicine, Department of Orthopaedics and Traumatology, There were five male, nine female patients with a mean age of 50,7 (28-70). Eight patients had primary degenerative instability (Table 2), six patients had instability secondary to decompression-laminectomy performed elsewhere before, with the aim of decompression for spondylolisthesis (Table 3). All patients had unrelenting back pain for long periods. The diagnoses were achieved on the specific histories and on the existence of pathological motion on flexion-extension roentgenograms (Figure I). The patients were followed up for clinical signs of healing and radiological signs of stability 23,8 months mean (6-55 months).

A standart posterior approach was performed. Posterior fixation mainly with transpedicular screws and supplementary hooks in some cases were performed on as many levels as considered necessary for each patient (Figure 2). Posterior or posterolateral fusion with

Table II. Clinical details of the patients with primary degenerative lumbar segmental instability.

case	age	sex	level	deficit	fusion type	fusion level	implant	screw no	follow up (months)
1	38	M	L5-S1	+	PL	L5-S1	AO	4	55
2	47	F	L5-S1	+	PL	L5-S1	CD	5	44
3	70	F	L4-L5	+	PLIF	L4-L5	AO	4	43
4	58	F	L5-S1	+	PL	L4-S1	CD	6	19
5	66	M	L1-L5	---	PL	L1-L5	CD	10	8
6	28	F	L4-S1	+	A+PL	L4-S1	IQL	6	7

Table III. Clinical details of the patients with primary degenerative lumbar segmental instability (post - decompression laminectomy).

case	age	sex	level	deficit	fusion type	fusion level	implant	screw no	follow up (months)
9	45	F	L5-S1	---	P	L4-S1	CD	6	42
10	54	M	L4-L5	+	PL	L3-S2	CD	6	28
11	61	F	L5-L5	+	PL	L4-L5	CD	4	26
12	38	M	L5-S1	+	PL	L5-S2	CD	4	25
13	52	F	L4-L5	---	P	L4-S1	IQL	6	10
14	45	M	L4-L5	---	P	L4-S1	CD	6	14
15	43	F	L4-L5	+	P	L4-S1	CD	6	7
16	66	F	L3-4-5	+	P + A	L2-L5	CD	8	6

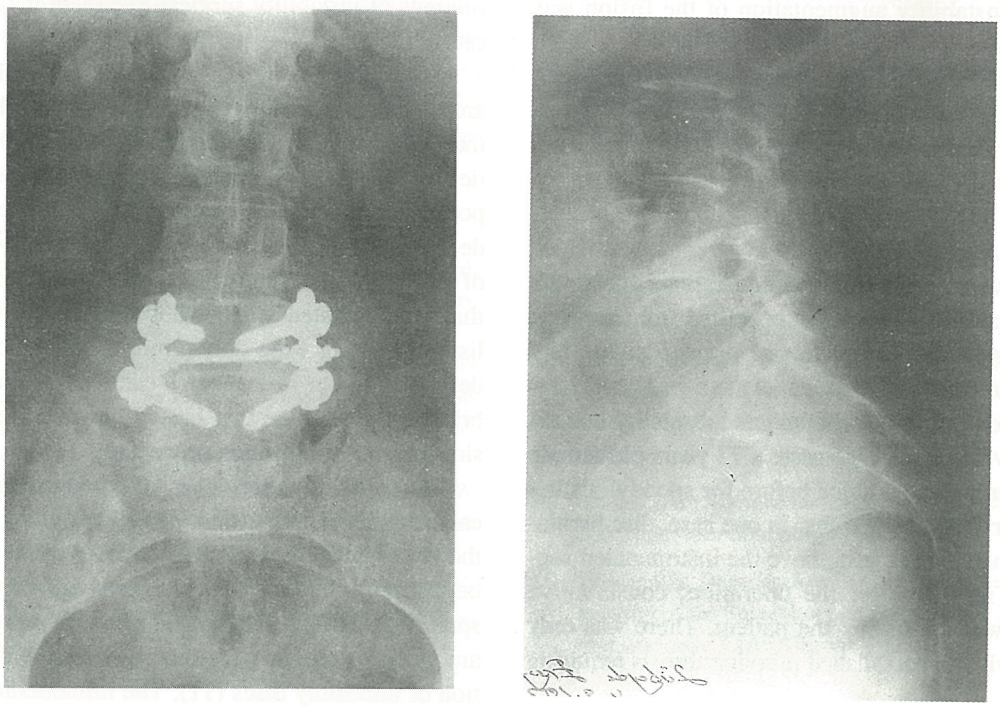

Figure I. Flexion - extension radiographies of a patient demostrating pathological motion at L4 and L5.

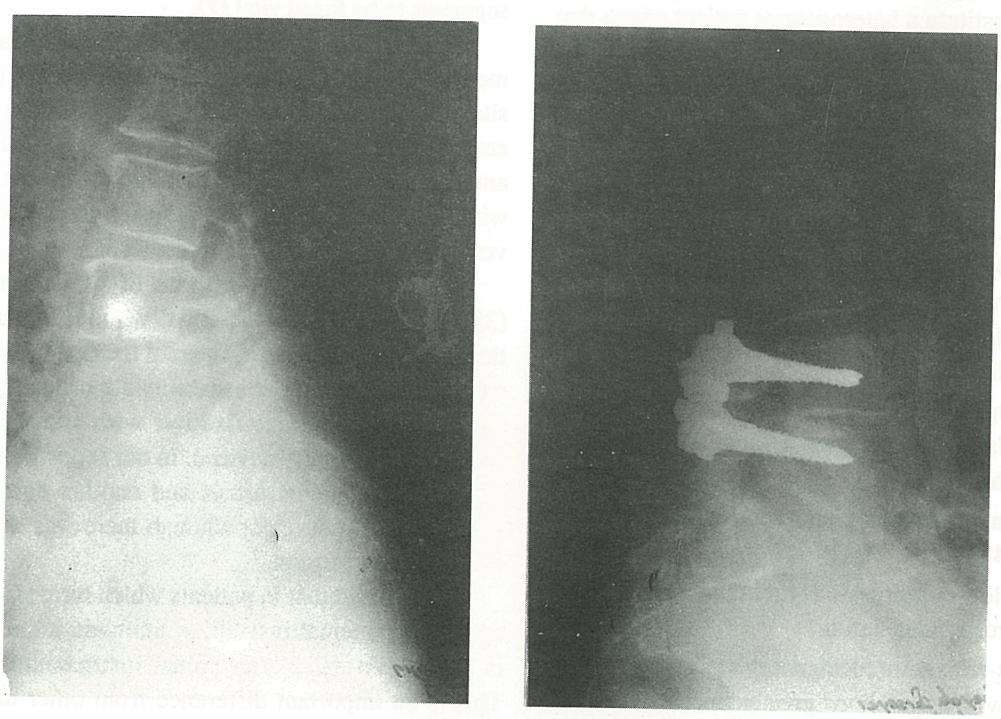

Figure II. Postoperative anteroposterior and lateral radiographies of the same patient.

autogenous bone grafts was added. In two patients with excessive instability augmentation of the fusion was done with anterior intervertebral bone chips.

All patients were mobilized within the first week after surgery with a light TLSO, they were weaned from the brace between the third and sixth months according to individual features.

RESULTS :

There were no important complications during the follow up period. All patients benefited from surgery. Eight cases healed completely no longer having any low back problems, in three cases there was considerable improvement, but slight pain and disability was reported now and then. One case, a 72 years old female having been operated twice before for spondylolisthesis, had persisting symptoms. In one case, disc herniation was encountered just above the instrumented segments six months after the operation; conservative treatment was chosen by the patient. There was only one case with an established pseudoarthrosis requiring revision.

DISCUSSION :

Patients with primary or secondary degenerative instabilities constitute a heterogenous patient group that is difficult to treat either conservatively or surgically. Ten to 20% of the patients that have residual low back problems after "disc surgery" are assumed to have secondary instabilities (4). Presumably there also is a subgroup of patients that are operated for "disc" although their primary problem is instability.

Diagnostic criteriae are not well established yet. According to Nachemson (8) the verification of the suspicion of instability must come from at least two of the methods listed below:

1. Roentgenograms in flexion-extension demonstating translation greater than 4 mm and /or angulation greater than 15°.

2. Biplanar roentgenograms demonstrating motion in excess of 4 mm.

3. Traction-compression roentgenograms with translation greater than 5 mm.

4. Stress-relaxation roentgenograms using the Selvik method with angulations greater than 11° degrees and translation greater than 3 mm.

In patients with radiological evidence and clinical findings of instability surgical treatment may be indicated.

According the literature, among the patients that are "decompressed" for degenerative spondylolisthesis there are many that have accentuation of their deformities on long term (4). Winter (11) also stresses the importance of fusion in cases requiring laminectomy and decompression. If fusion is not performed, worsening of the symptoms is the rule, as seen in our six patients that were operated earlier without fusion for spondylolisthesis. There were only minor accentuations of the deformity in our series which can be explained by the brief period of time that lapsed between decompression and our stabilization procedure.

The case with a secondary disc herniation is a typical example of post-fusion instability, letting us notice the importance of careful selection of the segments to be instrumented on elderly subjects with degenerative spine. Discograms or magnetic resonans imaging scans are usually necessary for the preoperative determination of unhealthy discs (11). The immoderate stresses concentrated on the first disc adjacent to the lower or upper end vertebra is a side effect of rigid instrumentation which makes preoperative determination of the segments to be fused vital (7).

Another controversial topic in the surgical treatment of lumbar segmental instabilities is the optimal site of fusion. Some authors have suggested the routine employment of posterior lumbar interbody fusion or anterior interbody fusion (11). Pseudoarthrosis rates with posterior or posterolateral fusion make further investigation on this subject necessary.

The unacceptably high rate of pseudoarthrosis (35%) in patients that are fused without instrumentation have made the use of internal fixation in the surgical treatment of lumbar instability almost compulsory (5, 6). Rigid internal fixation with transpedicular screws is particularly adviced. In our series we had one established pseudoarthrosis and another case whose symptoms did not relent alhough there was radiological evidence of fusion.

It is realized that in patients which have pure degenerative segmental instability, dramatic improvement is to be seen early after spinal instrumentation (9). This is an important difference from other disorders causing low back pain.

Patients with lumbar segmental instabilities are typical challenging "problem back" cases. Currently rigid posterior instrumentation and fusion with transpedicular screws is the treatment of choice. Augmentation of the fusion with an anterior approach is also advisable. However the diagnostic techniques and the indications for surgical intervention are not settled yet.

REFERENCES:

1. Dupuis PR, Yong-Hing K, Cassidy JD, et al: Radiologic diagnosis of degenerative lumbar spinal instability. Spine 10: 262-276, 1985.
2. Frymoyer JW: Segmental Instability, in Weinstein JN, Wiesel SW, (eds): The Lumbar Spine. International Society for the study of the Lumbar spine. Philedelphia, PA, Saunders, 1990, pp 612-636.
3. Frymoyer JW: Segmental instability in Frymoyer JW (ed): The adult spine: Principles and practice. New York, NY, Raven Press, 1991, pp 1873-1892.
4. Grobler LJ, Frymoyer JW, Roberson PA, Novotny JE: Biomechanics oi Lumbar Spinal Surgery. Sem Spin Surg 5: 59-72, 1993.
5. Güven O., Esemenli T., Yalçın S., Karahan M.: Transpedicular Fixation in the Treatment of Various Spinal Disorders. Acta Chir Belg 93: 188-192, 1993.
6. Herkowitz HN, Kurz LT: Degenerative lumbar spondilolisthesis with spinal stenosis. J Bone Joint Surg (Am) 73: 802-808 1991.
7. Krag MH: Biomechanics of Thoracolumbar Spinal Fixation. A review. Spine 16: 84-99, 1991.
8. Nachemson AL: Instability of the Lumbar Spine. Neurosurg Clin N Amer. 2 (4): 61-64, 1991.
9. Olerud S, Sjorstom L, Karlstrom G et al: Spontanous effect of increased stability of the lumbar spine in cases of severe chronic back pain. The answer of an external transpedicular fixation test. Clin Orthop 203: 67-74, 1986.
10. Stokes IAF: Biomechanics of the Thoracic Spin and Rib Cage. Sem Spin Surg 5: 42-50, 1993.
11. Winter RB: Degenerative Disorders and Segmental Instability of the Spine. Lecture given at The Spine - Current Concepts. Maui, Hawaii, 1992.