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Original article ■

Transpedicular Screw Fixation of Thoracolumbar Spine Fractures

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SUMMARY

Thoracolumbar spine fractures are most common in the young healthy population. The most common causes of these fractures are high-energy traumas, traffic accidents or falls from heights. Fractures can be followed by neurological damage, which is a direct consequence of the spinal cord damage. Fractures are treated with surgical or non-surgical methods. The best results can be obtained by surgical treatment. Transpedicular screw fixation is one of the methods of surgical treatment.

The aim of the paper was to evaluate the initial results of the application of the posterior transpedicular screw fixation in the treatment of unstable fractures of the thoracolumbar spine segment, without neurologic injury.

Patients were operated on at the Orthopaedic and Traumatology Clinic Niš and in the Traumatology Clinic Skopje. Fractures were classified according to the AO classification. The severity of the injury was determined by means of Thoracolumbar Injury Severity Scale - TLISS. Two types of the internal fixator for the transpedicular srew fixation, Expidium (Johnson&Johnson) and Xya (Stryker) were used for the fracture fixation.

The paper presents the results of the transpedicular screw fixations of the thoracic and lumbar vertebrae in 16 patients, with mean age 45.06 years. There were three patients with Th 12 fractures, five patients with L1 fracture, seven patients with L2 fracture and one patient with L4 vertebral fracture. There were five fractures of A2 type and eight fractures of A3 type. We had one patient with B1 fracture and two patients with B2 fracture. There was one mechanical complication and one superficial infection in an early phase of post-operative recovery. The mean follow-up period was 14.12 months. The final functional results were good in all patients.

By applying the transpedicular screw fixation of the unstable fractures of the thoracolumbar spine segment, a stable fracture fixation can be accomplished, that is, by applying distraction or ligamentotaxis, medular canal decompression is achieved. This kind of fixation prevents the possibility of the occurrence of secondary spine deformities and enables quick recovery of surgically treated patients.

Key words: **transpedicular screw fixation, thoracolumbar fractures**

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INTRODUCTION

Spine fractures, especially fractures accompanied with the spinal cord injury, pose a difficult surgical, social and economic problem. The funds that are allocated for the diagnostics, treatment, rehabilitation and resocialization of these patients are huge. Until about twenty years ago, spine fractures were treated only with non-surgical methods; surgical stabilization was not performed. This kind of treatment implied a long - term immobilization in the cast, and the complications were manifold (1). Surgical treatment is a modern way of treating spine fractures. The success of the treatment depends on the initial treatment, medical treatment, x-ray diagnostics, anatomical reduction, surgical decompression of the spinal canal (if needed) and surgical stabilization as final immobilization. The neurological examination of the patient means a complete examination of sensibility, mobility, surface and deep reflexes. In cases of neurological damage, it is necessary to determine the exact grade of mobility impairment and of sensory functions (2). The classification and gradation of neurological damage in patients with the fractures of thoracolumbar spine are determined according to the Frankel scale and ASIA (American Spinal Injury Association) score (1). This paper presents the initial experiences in the surgical treatment of thoraco-lumbar fractures in patients who did not have any neurological damage after the fracture. The fractures were surgically treated with the method of transpedicular screw fixation.

MATERIAL AND METHODS

The paper presents a series of patients with thoracolumbar fractures that were operated on at the Orthopaedic and Traumatology Clinic Niš and in the Traumatology Clinic Skoplje. The fractures were classified according to the AO classification. The severity of the injury was determined by Thoracolumbar Injury Severity Scale - TLISS. The pre-operative procedure included a detailed radiological diagnostics (Rtg, MRI ili MSCT). Two systems, XIA - Stryker and Expidium - Johnson&Johnson, were used for transpedicular screw fixation.

RESULTS

The paper presents the results of the treatment of 16 patients, 9 men and 7 women, with unstable fractures of thoracolumbar spine. All fractures were sustained in traffic accidents and after falls from height. The mean age of the patient was 45.06 years (range, 19 to 61). There were 3 patients with the Th 12 fracture, 5 patients had the L1 fracture, 7 patients had the L2 fracture and 1 patient had the L4 fracture (Table 1).

Table 1. *Distribution of thoracolumbar fractures according to spine segments*

Th 12	3
L1	5
L2	7
L4	1

According to the AO classification, 5 patients had the A2 fracture, whereas 8 patients were diagnosed with the A3 fracture. One patient was diagnosed with B1 type fracture, and 2 patients were diagnosed with the B2 fracture (Table 2).

Table 2. *Distribution of thoracolumbar fractures according to AO classification*

	1	**2**	**3**
A	-	5	8
B	1	2	-
C	-	-	-

No patient was diagnosed with the C fracture. There were multiple head injuries in one patient, thoracic cavity injuries in two patients, abdominal injuries in one patient, calcaneus fracture in one patient and talus fracture in one patient. All patients were operated on in general-endotracheal anesthesia, using the method of the posterior transpedicular screw fixation (Figures 1-4).

The follow-up of the operated patients was between 6 and 24 months (14.12 on average). During the postoperative recovery, we had one case of a mechanical complication which was overcome successfully by means of reintervention - refixation; we also had one case of superficial infection which was successfully non -surgically overcome by means of antibiotic therapy based on the antibiogram and by changing bandages every day. During early postoperative recovery, all patients were mobilized with thoracolumbosacral orthosis (TLSO). The final anatomical and functional results were good in all patients, considering the severity of the inflicted injuries. There were no cases of secondary deformities of the operated spine segments.

Figure 1. *19-year-old female, neurologically intact, with L4 burst fracture (AP, Lateral X-ray)*

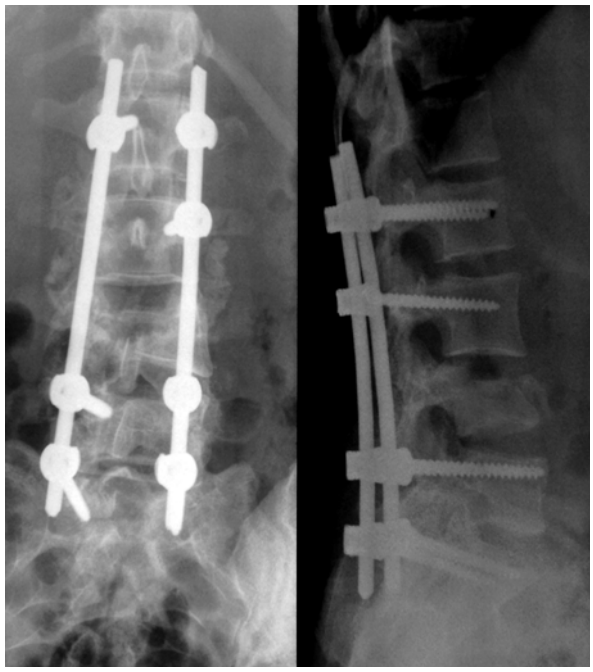

Figure 3. *Postoperative X rays after posterior transpedicular screw instrumentation. Vertebral body height is restored*

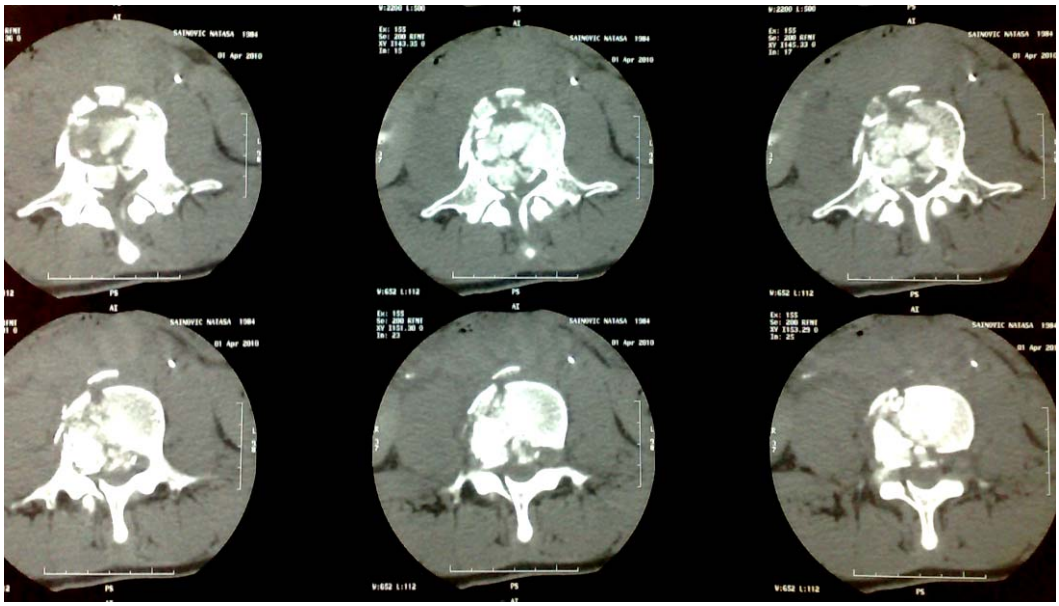

Figure 2. *MSCT image shoving the comminuted burst fracture with the retropulsed fragments causing approximately 80% canal compromise*

Figure 4. *Intraoperative view after posterior transpedicular screw instrumentation*

DISCUSSION

The modern way of life has brought about an increase in the number of patients with spine injuries. Consequently, spinal surgery, which treats patients with the spinal injuries and diseases, has developed. Spinal fractures pose serious surgical and socio - economic problems, especially in cases of permanent neurological damage. The treatment of such patients is long, expensive and followed by permanent disability of patients. The patients with spinal fractures are most frequently young, healthy people who are injured after falls from heights and in traffic accidents. Spinal injuries are not rare as a part of multiple traumatic injuries. It is important to say that spine injuries can be overlooked in patients with multiple traumatic injuries, especially in unconscious patients or in patients who are under the influence of alcohol. According to the studies, in a series of over 1.000 patients with thoracolumbar spine, 16% of fractures were assigned to the segment T1-T10, 52% to T11-L1 and 32% to L1-L5 (3). Almost half of the fractures were the consequence of traffic accidents, 20% of the fractures were the consequence of falls from heights, 13% were sports injuries, 11% of the fractures were the consequence of some form of violence (4). In about 50% of the spinal fractures, there were multiple injuries of other systems and organs. Injury to the spinal cord or cauda equine occur in approximately 10-38% of thoracolumbar injuries (5, 6). The paper does not include fractures which are caused by osteoporosis or pathological fractures of different etiology. All operated patients were injured as a result of high energy traumas, traffic accidents or falls from heights. The internal fixation and surgical treatment of the fracture of the thoracolumbar segment of the spine began after the second world war, when the fracture used to be fixed with a plate and a wire for processus spinosus. This technique was described by Marry Williams, and later, Harrington made a revolutionary step with his original technique for the posterior spinal instrumentation, which is used even today (1,7,8). With his technique, the spine can be reduced and the fracture stabilization can be done until full sanation. The main advantages of the internal fixation of unstable spine fractures are shorter hospitalization stay, early rehabilitation, deformity prevention and prevention of other complications which are caused in non - surgically treated patients. Surgical stabilization and fracture fixation lead to better neurological functioning in patients with the spinal cord injury, especially in early surgical decompressions, stabilizations and fixations. The mechanism of the occurrence of thoracolumbar fractures is most frequently taken as a basis of many classification systems. Fractures are caused by the forces such as flexion, axial compression, extension, flexion rotation, flexion distraction, lateral compression and as a result of non - union. Classification systems are most often based on the mechanism of the fracture occurrence and on the assessment of the fracture stability. The most frequently used classifications are Denis and AO classifications (9). In our paper, we used the AO fracture classification. According to this classification, all fractures are divided into group A (compression), B (distraction) and C (rotation). All groups have subgroups 1, 2, 3. From the group A to the group C and from 1 to 3 the severity of the injury increases, and the possibility of neurologic injury is higher. The indications for the surgical treatment of the patient are determined by the level of fracture stability, neurological status of the patient, spinal cord injury, patients who are neurologically intact, but have a high sagittal or coronal deformity of the injured vertebra, injuries with the spinal cord compression and neurologic injury. A direct surgical decompression in patients with incomplete lesion of the spinal cord is the greatest possible benefit for the patient. The way of fixation can be posterior, anterior or, a combination of the posterior and anterior fixations. The severity of the injury was determined according to the Thoracolumbar Injury Severity Scale (TLISS). This score takes into consideration the mechanism of injury, neurological status and posterior ligamentary complex. TLISS 3 or less than 3 suggests a non-surgical treatment, TLISS 4 implies a surgical or a non-surgical treatment, and TLISS 5 means that a surgical treatment is obligatory. Determining TLISS is important, but not decisive in deciding on the way of the treatment. Local findings, kyphosis or collapse of the vertebral body points to a need for surgical treatment. Patients with the local angulation or kyphotic deformity greater than 20º, with the compression of the medular canal greater than 45%, but without any neurologic

injury, should be treated surgically, in order to prevent progressive deformity (1). None of our operated patients had neurologic injury. Thoracolumbar instrumentation for the posterior spine fixation began with Paul Harrington (8). Studies describe the instrumentation developed by Luque (10). The transpedicular fixation by means of a plate was developed by Roy-Camille, Louter, Walter (11-13). The technique develo-ped by Cotrel Dubousset was also described(14). The modern system for the transpedicular screw segmental instrumentation - fixation widely used is the internal fixator. Dick, in 1982, described the internal fixator which is a modification of Mager, the external fixator for trans-pedicular fixation (15). The modern systems for transpedicular fixation include transpedicular screws which are placed in pedicle**,** and a rod which is fixed with screws after the distraction. In that way, fracture correction and reduction are performed and stabilization is achieved (16). This internal fixator fixes the segments above and below the fracture. Many systems for transpedicular screw fixation have been described. In this paper, the authors use the transpedicular screw instrumentation "Expidium (Johnson& Johnson) and Xya (Stryker)".

CONCLUSION

The transpedicular screw fixation of unstable fractures of the thoracolumbar spine segment achieves a stable fracture fixation. Distraction or ligamentotaxis achieves medular canal decompression. This manner of fixation prevents a possibility of the occurrence of secondary spine deformities and allows a quick recovery of operated patients. The aim of the modern spinal surgery is an early surgical intervention which will enable and give a chance for a neurologic recovery in patients with the damage of the spinal cord and their early activity.

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TRANSPEDIKULARNA FIKSACIJA TORAKOLUMBALNIH PRELOMA KIČME

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Sažetak

Prelomi torakolumbalne kičme najčešće nastaju kod mladih, radno sposobnih ljudi, pod dejstvom sila jakog intenziteta, u saobraćajnim udesima ili padom sa visine. Prelomi mogu biti sa ili bez neuroloških oštećenja, koja su direktna posledica oštećenja kičmene moždine. Leče se operativnim ili neoperativnim metodama. Najbolji rezultati lečenja se postižu hirurškim metodama lečenja. Transpedikularna fiksacija je jedan od načina operativnog lečenja.

Evaluacija početnih rezultata primene zadnje transpedikularne fiksacije u lečenju nestabilnih preloma torakolumbalnog segmenta kičme, bez neuroloških ispada.

Pacijenti su operisani na Ortopedsko-traumatološkoj klinici Kliničkog centra Niš i Traumatološkoj klinici u Skoplju. Prelomi su klasifikovani prema AO klasifikaciji. Za određivanje težine povreda korišćen je Thoracolumbar Injury Severity Scale - TLISS. Za fiksaciju preloma je korišćen unutrašnji fiksator za transpedikularnu fiksaciju tipa Expidium (Johnson&Johnson) i Xya (Stryker).

U radu su prikazani rezultati transpedikularnih fiksacija preloma torakalnih i lumbalnih pršljenova kod 16 pacijenata, prosečne starosti 45,06 godina. Operisano je tri pacijenta sa Th 12 prelomom, pet sa prelomom L1, sa prelomom L2 je operisano sedam pacijenata i jedan pacijent sa prelomom L4 pršljena. Bilo je pet preloma tipa A2 i 8 preloma tipa A3. Sa prelomom tipa B1 smo imali jednog pacijenta i sa prelomom tipa B2, dva pacijenta. Imali smo jednu mehaničku komplikaciju i jednu površnu infekciju u ranom postoperativnom toku. Prosečno vreme praćenja je iznosilo 14,12 meseci. Krajnji funkcionalni rezultati su dobri kod svih pacijenata.

Transpedikularnom fiksacijom nestabilnih preloma torakolumbalnog segmenta kičme postiže se stabilna fiksacija preloma, distrakcijom, odnosno ligamentotaksom se postiže dekompresija medularnog kanala. Ovaj način fiksacije sprečava mogućnost nastanka sekundarnih deformiteta kičme i omogućava brzi oporavak operisanih pacijenata.

Ključne reči: **transpedikularna fiksacija, torakolumbalni prelomi**