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SURGICAL PRINCIPLES IN POSTERIOR TRANSPEDICULAR SCREW FIXATION AND FUSION FOR TREATMENT OF SPONDYLOLISTHESIS: RETROSPECTIVE EVALUATION OF 77 CASES

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ABSTRACT

Aim: This study aimed to report our surgical principles and outcomes in patients who had posterior transpedicular screw fixation and fusion operation with a diagnosis of spondylolisthesis at our department between 2014 and 2017.

Method: Seventy-seven patients who had internal fixation and posterolateral fusion operation using lumbar posterior transpedicular screw systems were retrospectively evaluated. All patients were assessed by dynamic lumbar graphics, computerized tomography and magnetic resonance imaging prior to surgery. Posterior decompression, internal fixation with posterior interpeduncular screw, and posterolateral fusion were applied to all patients. Stabilization systems were evaluated by lumbar graphics and computerized tomography at the postoperative first day.

Results: All patients who had clinical and radiological evidences of lumbar spinal instability also had lumbar and/or leg pain and varying levels of neurological deficits. Mean age of the patients was 52.6 (19-74) years, of whom 10 were male and 67 were females. Sixty-nine patients had grade I, and 8 patients had grade II spondylolisthesis according to the Meyerding classification. Nine patients were operated for L3-4, 36 were operated for L4-5, 30 were operated for L5-S1 spondylolisthesis, and 2 patients had 2 levels of spondylolisthesis. Complaints were decreased postoperatively in all patients. One patient was reoperated due to a screw on L5, which was out of the pedicle and caused symptoms. Another 3 patients were reoperated due to breaking of a unilateral S1 screw.

Conclusion: Internal fixation with posterior transpedicular screw and posterolateral fusion applications should be preferred for surgical treatment of patients who have symptomatic and neurologic-deficit causing lumbar spondylolisthesis.

Keywords: Spondylolisthesis, spinal instrumentation, posterolateral fusion.

Level of Evidence: Retrospective Clinical Study, Level III.

INTRODUCTION

Spondylolisthesis is a significant etiological factor for lumbar pain that commonly seen in daily living of the patients. Pain that not responds to conservative treatment, radicular compression, and increased deformity are the indications for surgical treatment [8,25-26]. Non-instrumental posterior or posterolateral fusion applications for surgical treatment of spondylolisthesis are now disfavored due to need for long-term immobilization and high rates of pseudoarthrosis [10,13]. Fixation applications using transpedicular screws are the most appropriate internal fixation methods for lumbar spinal fusion in the treatment of lumbar spondylolisthesis [4,11,14,18,20]. This technique provides higher bone fusion rates and strong vertebral segmental fixation [5,9,17,21].

Transpedicular screw systems were found to provide much better segmental fixation compared to other posterior instrumentation systems like laminar hook-rod or segmental wire-rod [1,16]. Three-column stabilization provides prevention of adjacent mobile normal segments, and also prevents from mechanical pain syndromes [11-12].

Successful application of transpedicular screw systems necessitates a complete

knowledge of pedicular anatomy as well as biomechanical features of instrumentation, and also a meticulous surgical preliminary preparation [5].

MATERIALS AND METHODS

In this study, a total of 77 patients with spondylolisthesis whom were operated for stabilization and posterolateral fusion using posterior transpedicular screw-rod system between 2014 and 2017 at our department were retrospectively evaluated.

All patients had clinical and radiological evidences of lumbar spinal instability, lumbar and/or leg pain, and neurological deficits of varying levels. Surgery was not applied solely for pain treatment in any of the cases.

Four-way lumbosacral vertebrae graphics, hyperflexion-hyperextension graphic, lumbar vertebrae computerized tomography (CT) imaging, and lumbar vertebrae magnetic resonance imaging (MRI) studies were performed prior to surgery in all cases. Additionally, cases with suspected osteoporosis in direct graphies were evaluated with bone densitometry, and cases with multiple lesions in vertebras were evaluated with bone scintigraphy (Figure-1).

Pedicle diameters and corpus depths were controlled on lumbar CT axial images, and screw projections in planned levels were marked on images in all cases prior to surgery (Figure-2).

Fluoroscopy was used for visualizing the lumbar lordosis and vertebrae in supine position in all cases, and visualizations were compared with preoperative graphics. Medial, superior and inferior surfaces of the pedicle was controlled from the hole probes after determining the pedicle projections and decorticating the facet. Images were taken using c-arm fluoroscopy following administration of the screws (Figure-3).

Each screw on L1, L2, L3, L4 and L5 were placed according to 2/3 of the total corpus height, and each screw on the sacrum were placed by targeting promontory. Decompression laminectomy was applied to all cases, and every upper radicle were essentially decompressed.

Autogenous grafts were used after facet decortication. Hemostatic sponge was placed on laminectomy area in all cases, and grafts were not used in laminectomy fields. Extra effort was not applied in any case for the sake of reduction.

All cases were mobilized in same day postoperatively using steel underwire lumbosacral corset. Control assessments were done by direct graphies on the postoperative 1st day (Figure-4).

Figure-1. Preoperative roentgenogram

Figure-2. Corpus length and pedicle diameters were calculated in preoperative Lomber CTs

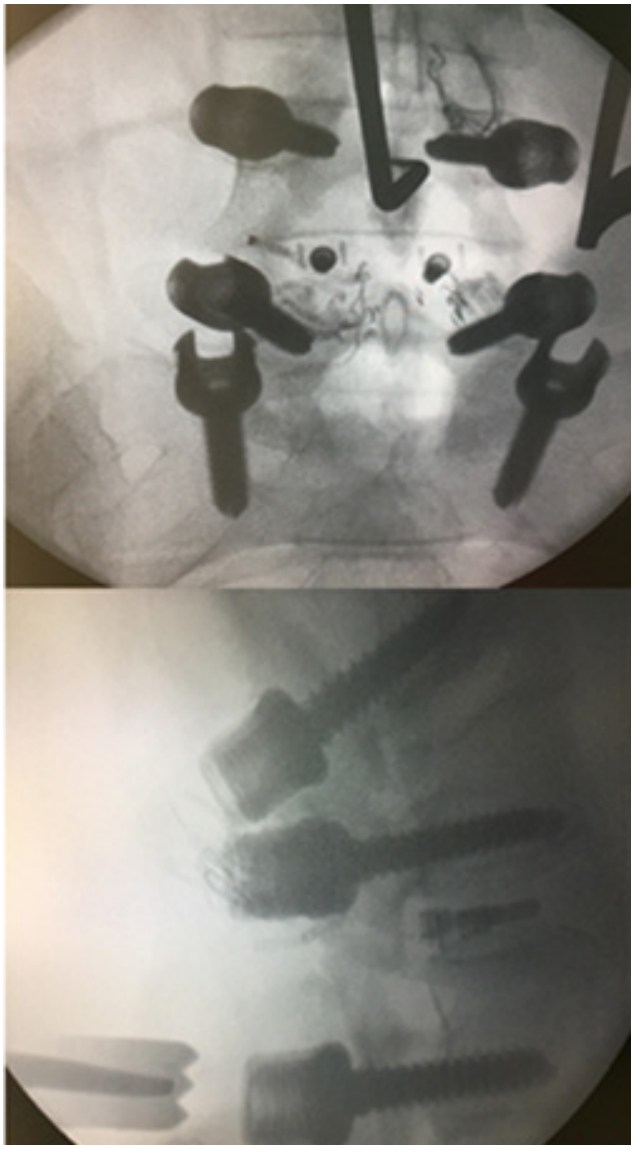

Figure-3. Lateral and AP images at C-arm fluoroscopy during operation

RESULTS

Sixty-seven of the patients were females, and 10 were males (Table-1).

Mean age of the patients was 52.3 (19-74) years, and distribution according to age groups was presented in Table-2.

Mean duration between first symptoms and admission was 67 months (1-240 months). Five patients had a trauma history due to fall, but none of the cases had a history of major trauma. Six patients had previously operated for lumbar disc hernia in other healthcare centers, and the spondylolisthesis was in close proximity to the operation site in 5 cases. Sixty-nine cases had grade I, 8 had grade II spondylolisthesis according to the Meyerding classification (Table-3).

Figure-4. Control radiological images in two patients at postoperative 1st day.

Table-1. Sex distribution of the patients

	Number of patients	%
Male	10	12,99
Female	67	87,01

Table-2. Distribution of patients in age groups

	Number of patients	%
10-29 ages	2	2,60
30-49 ages	22	28,57
50 ages and over	53	68,83

Nine patients were operated due to spondylolisthesis on L3-4 level, 36 patients on L4-5 level, 30 patients on L5-S1 level, and 2 patients on 2 levels (Table-4).

All cases had varying levels of lumbar and/or leg pain symptoms at admission. Moreover, all patients had varying levels of neurological deficits, and operation was not administered for pain treatment solely in any case (Table-5).

Table-3. Distribution of patients in Meyerding categories

Meyerding	Frequency	%
Grade I	69	89,6
Grade II	8	10,4
Grade III	-	-
Grade IV	-	-

Table-4. Distribution of patients in shift levels

Level	Frequency	%
L3-4	9	11,69
L4-L5	36	46,75
L5-S1	30	38,96
Two levels	2	2,6

Table-5. Physical examination results of the patients before surgery

	Number of patients	%
Motor deficit	25	32,47
Reflex alterations	52	67,53
Sensorial alterations	47	61,04
Laseque test positivity	72	93,51
Femoral strain test positivity	10	12,99
Neurogenic claudication	15	19,48

Prophylactic antibiotics were given to each patient, one dose in the morning of operation, and 2 doses postoperatively. Skin was irrigated with antiseptic solution for 5 minutes. Distance measurements were performed essentially using perioperative fluoroscopy. Radixes and dural sac decompressed in all cases by operation microscope. One unit of erythrocyte suspension of own blood-type was given to patients. Diameters and lengths of the screws were calculated by preoperative CT and MRI. Screws of a mean diameter of 6 mm were used in L1, L2, and L3 pedicles, 6.2 mm were used in L4 and L5 pedicles, and 7 mm were used in S1 pedicle, and these screw diameters were suitable for both sexes.

Dura was repaired primarily in 2 cases that had dura injury during operation. No cases had postoperative cerebrospinal fluid (CSF) fistula. Nevertheless, 3 cases without dura repair and without macroscopic dura damage intraoperatively had subcutaneous CSF collection. These 3 patients were managed by serial cutaneous aspirations and compression dressings without a need for reoperation. One patient had a superficial skin infection, and treated with appropriate antibiotic therapy. Control CT assessment was performed for one patient due to postoperative radicular pain. This patient was reoperated one day after due to symptomatic misplacement of the screw out pf the pedicle on L5, and the placement of the screw was adjusted. Three cases had unilateral S1 screw breakage due to fall in their daily life in the postoperative first year, and they were reoperated due to their symptoms and the screws were replaced with steady ones (Table-6).

Patients were followed-up according to the postoperative Prolo follow-up scale. Our surgical outcomes were perfect in 19 cases (24.68 %), good in 54 cases (70.12 %), moderate in 2 cases (2.6 %), and poor in 2 cases (2.6 %) (Table-7).

Table-6. Complications

	Number of patients	%
Dura injury	2	2,6
Subcutaneous CSF collection	3	3,9
Superficial cutaneous infection	1	1,3
Screw breakage	3	3,9
Reoperation	1	1,3

Table-7. Clinical outcomes according to Prolo follow-up criteria

	Number of patients	%
Perfect	19	24,68
Good	54	70,12
Moderate	2	2,60
Poor	2	2,60

Perfect outcome stands for complete recovery of complaints and gaining the daily life activities back. Good outcome means that patients can get back to their work and daily activities, but may sometimes have mild complaints. Moderate outcome defines patients who cannot get back to their work, but to lighter works. And, poor outcomes include patients who do not benefit from surgery and still have the same complaints. Among our cases, 94 % stated that they had benefit from the surgery. Patients were followed-up for a mean of 7.73 (3-30) months. Any of our cases had pseudoarthrosis during the follow-ups.

DISCUSSION

Aim of the spondylolisthesis surgery should be applying fusion to the least number of segments to decrease shifts, applying adequate decompression, fixing the sagittal axis, and obtaining a fusion [27]. Posterior transpedicular screw applications have several pros and cons compared to other stabilization systems (hook and wire) in the lumbar region. Pedicular screws are much more efficient and advantageous than other instrumentation systems due to efficiently and rigidly fixing the spine, being able to be used in vertebrae with laminectomy, keeping the instrumentation level short, being an appropriate method for instrumentation of the sacrum, and keeping the normal curvature of the spine [1-2,6,11-12,24].

Necessity of reduction in stabilization applications using transpedicular screw and rod systems is a controversial topic. A generally accepted approach is that reduction is not needed in symptomatic grade I and grade II cases [5,15]. But, reduction can be applied in grade III and grade IV cases [3,19]. Discectomy should be applied in cases that reduction is considered [7]. Since all of our cases are Grade I and II, reduction was not applied and discectomy was not administered unless necessary.

Some complications of pedicular screw applications include inadequate instrumentation, wound infection, elongated operation times, and massive bleeding, but most important complication is the misplacement of the screw. Radix, dura, cauda equine or the spine can be injured in these occasions. For minimizing or eliminating this risk, a very-well preoperative plan and meticulous surgery is needed [22-23]. Surgical technic, experience, utilization of fluoroscopy, and anatomical correlation minimizes the complications in posterior transpedicular screw applications. Lumbar CT and direct graphics with screw localizations in early postoperative periods helps surgeons for prediction [7-8]. In one of our cases, a misplaced screw on L5 through out of the pedicle caused symptoms, and the patient was reoperated. Other complications are lower than reported in the literature and in accordance with currently available data. We think that utilization of microscope during spinal decompression and obeying the surgical principles decreased our complication rates.

Conclusion

We think that internal fixation and posterolateral fusion applications using transpedicular screws should be preferred for the treatment of symptomatic lumbar spondylolisthesis due to several reasons including early postoperative mobilization of all patients who underwent posterior transpedicular fixation and posterolateral fusion for the treatment of spondylolisthesis, almost no significant complications by applying meticulous and careful surgery, low risk for development of pseudoarthrosis, obtaining favorable outcomes in majority of the cases, and literature data that favor the applications using these methods.

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