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PRELIMINARY RESULTS OF ADDING DYNAMIC SCREWS TO UPPER FUSION SEGMENT IN PATIENTS WITH DEGENERATIVE LUMBAR SPINE

Erdinç ÖZEK[1]
Anas ABDALLAH[1]

[1] *Department of Neurosurgery, Bezmialem Vakif University, Istanbul, Turkey.*

ORCID Numbers:
Anas ABDALLAH: 0000-0003-3600-089X
Erdinç ÖZEK: 0000-0003-1860-4534

Address: Anas Abdallah, Department of Neurosurgery, Bezmialem Vakif University, Vatan Street, 34093 Fatih, Istanbul, Turkey.
E-mail: abdallahanas@hotmail.com; aabdallah@bezmialem.edu.tr
Phone: +90 212 5232288-2175
Cell-Phone: +90 553 223 35 35
Fax: +90 212 4531700
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ABSTRACT

Aim: To assess sufficiency of dynamic screw addition to instrumented fusion segment to prevent development of the adjacent segment disease (ASD).

Material and Methods: Medical records were retrospectively reviewed for degenerative lumbar spine surgery from 2016 to 2018. Patients with degenerative lumbar spinal disease constituted the core sample for this study. To obtain homogeneity of both groups only patients involved with degenerative lumbar spine disease were included. All surgeries were performed by the same spine surgeon (EO).

Results: This series included 87 (66 female, 21 male) patients, with a median age of 56 years. Mean follow-up period was 10.24 months for dynamic screw added patients and 16.06 months for only fusion patients. Eleven patients with adjacent level disease were diagnosed only in alone fusion group (17.7 %) and no adjacent level disease was diagnosed in upper level dynamic screw added group. Adjacent level disease is statistically significant in alone fusion group (p = 0.03).

Conclusions: In our study, there is a statistically significant difference between only fusion instrumentation and dynamic screw added fusion in radiologic and clinical adjacent segment disease. Although long-term followed-up, studies are needed to assess the sufficiency of dynamic screw addition to instrumented fusion segment to prevent the adjacent segment disease.

Key words: Dynamic screws; adjacent segment disease; fusion; degenerative lumbar spine
Level of Evidence: Retrospective clinical study, Level III.

INTRODUCTION

Lumbar spine surgeries involving posterior instrumentation lead to risk of adjacent segment disease (ASD). ASD may occur because of overload on the adjacent segments. ASD can be explained by the adjacent segments have to compensate for the lost range of movement after undergoing fusion, resulting in exposure of those segments to overload and shear forces [3,7]. In one review of literature, the authors found that ASD might develop with the incidence of 30 % [11] after spinal fusion strategies, in another series this ratio was reported as 18.5 % [13].

Various risk factors have been reported such as fusion length, preoperative sagittal balance, intraoperative facet injury, age, increased body mass index, and preoperative radiologically illustrated upper ASD [10,12,14,17-18]. Various dynamic screw and rod systems had been developed to prevent ADS [5,8]. Dynamic posterior lumbar stabilization without fusion versus hybrid instrumentation effect on adjacent level disease is still controversial.

The current study investigated whether the addition of dynamic pedicle screws with hinged screw head to the fusion segment was effective in preventing ASD in patients who underwent lumbar segmental spinal fusion for degenerative lumbar spine diseases.

MATERIAL AND METHODS

This retrospective study was approved

by the medical ethics committee of our hospital. Written informed consent was obtained from the patients for the publication of their cases and accompanying images.

Medical records were retrospectively reviewed for degenerative lumbar spine (DLS) surgery from 2016 to 2018. Isthmic Spondylolisthesis, recurrent disc herniation, degenerative scoliosis patients and long segment posterior instrumented (over 6 segments) patients were excluded from the study. All patients were operated by the same surgeon (EO). Adult patients (age > 18 years) who followed up at least six months constituted the core sample for this study.

Pre- and postoperative clinical status had been evaluated using Oswestry disability index (ODI) scale and visual analog score (VAS) scores. The patients were divided into two groups; patients whom dynamic screws were added to the posterior instrumentation system from the cranial (upper) ends (dynamic group) and others who had underwent posterolateral fusion patients stabilized only with a stable posterior instrumentation system without adding dynamic screws (control group) and the comparison had been performed between both groups. For both groups, the patients' sex, age, symptoms, preoperative course, surgical outcomes, and complications had been compared.

Patients Characteristics

This series included a total of eighty-seven patients. Sixty-six females and twenty-one males were diagnosed as degenerative lumbar spine patients using lumbar MRI, and CT. Dynamic group included 25 patients (17 females and 8 males). Control group included 62 patients (49 femlaes and 13 males). The mean age of both groups were 58.9±19.1 (47-68) and 55.2±17.8 (49-64), respectively. The mean of preoperative course between the first symptom and surgery was 14.6±32.0 (6-72) months for dynmaic group and 16.2±28.0 (6-60) months for alone fusion (control) group.

Surgery

In alone fusion group (control group), polyaxial pedicle screws were placed and laminectomy was performed under surgical microscope, and posterolateral fusion was provided by autogreft or allograft. In dynamic screw added patients (dynamic group), dynamic screws were placed to just cranial end of fusion segment with the care of facet joints. No allo or auto-grefts were used on upper last segment. All standard polyaxial and dynamic pedicle screws were placed to vertebral body under assistance of C-armed fluoroscopy.

Follow-up

As a part of standard care, the patients undergoing surgical intervention for DLS diseases using posterior instrumentation received routine clinical evaluations and serial postoperative early computerized tomography (CT) as well as during their follow-up visits at 6 weeks, 3, 6, 12, and 24 months x-rays were performed. Postoperative lumbar MRIs were planned depending on the patients' complaints. However, if there was no additional new deficit or pain, MRIs were performed at 6, 12 and 24 months. ASD was diagnosed clinically or radiologically. Clinical ASD was evaluated according to whether there was symptomatic spinal stenosis, mechanical low back pain, or sacral or coronal imbalance after the procedures. Radiological ASD diagnosed by standard lumbar MRI. Postoperative CT were obtained at 12, 18 and 24 months to investigate the status of fusion (Fig. 1).

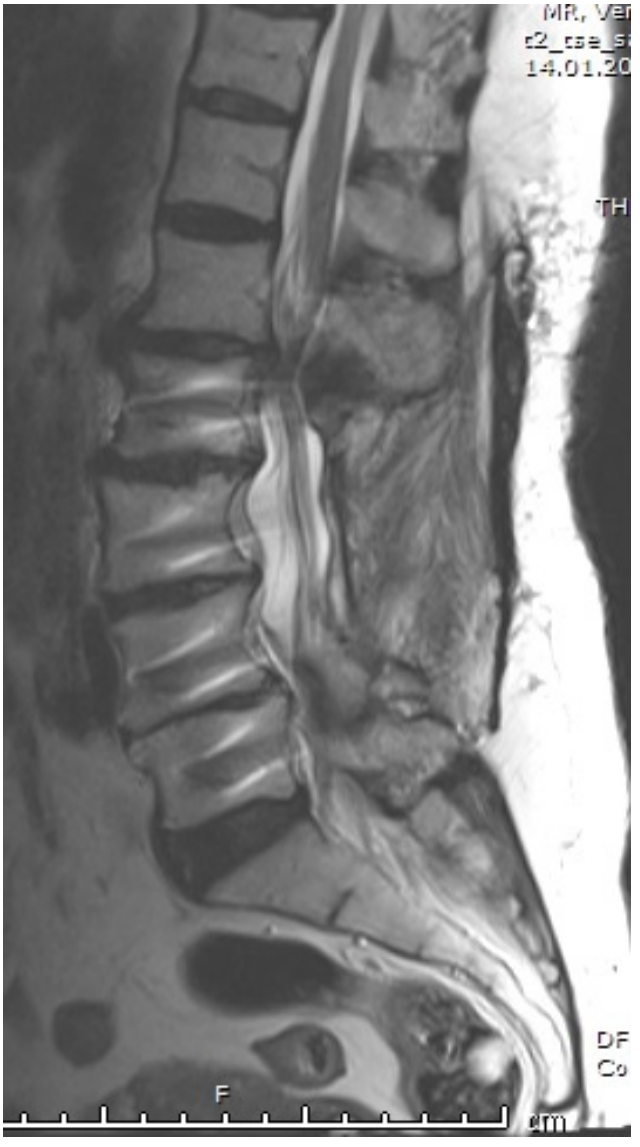

Figure-1. Sagittal T2-weighted MR image shows adjacent segment disease on postoperative 14th month.

Statistical analysis

All data are expressed as the mean ± standard deviation with the range shown in parentheses. Differences between groups were assessed by a one-way analysis of variance (ANOVA) using the SPSS 21.0 statistical package. Significance in the multivariate model was determined using a p value of < 0.05, and a trend-level effect was assigned to a p = 0.05–0.10. All p values were presented with an odds ratio (OR). OR are presented with the 95 % confidential interval (CI). When OR could not be calculated, risk ratio (RR) was calculated. All tests were two tailed.

RESULTS

The most common symptoms were leg pain and low back pain (100 %), followed by weakness of lower extremities was recorded in 16 of 25 dynamic group patients and 41 of 62 fusion alone group patients, loss of sensation was recorded in 14 of 25 and 37 of 62, neurogenic claudication (< 20 meters, or inability of standing up for 10 minutes) in 4 of 25 and 15 of 62, and urine incontinence were recorded in two out of 25 and five in 62 patients, respectively (Table-1).

The median of instrumented levels was 4 (2-5) levels for both groups. All patients were discharged on postoperative third day with recommendation of physical therapy. The mean follow-up periods were 10.2 ± 8.3 (6-27), and 16.1 ± 7.8 (7-29) months, respectively.

Table-1. Comparison between 'Dynamic' and 'Alone Fusion' Groups

	Dynamic Group	Alone Fusion Group	P	OR
No of patients	25	62	-	-
Age (years)*	58.9±19.1 (47-68)	55.2±17.8 (49-64)	0.68	-
Gender (F/M)	17/8	49/13	0.41	1.8 (0.6-5.0)
Preoperative course**	14.6±32.0 (6-72)	16.2±28.0 (6-60)	0.77	-
Symptoms				
- Leg pain	25 (100%)	62 (100%)	1	-
- Low back pain	25 (100%)	62 (100%)	1	-
- Muscular weakness	16 (64%)	41 (66.1%)	1	0.9 (0.3-2.4)
- Loss of sensation	14 (56%)	37 (59.7%)	0.81	0.9 (0.3-2.2)
- Neurogenic claudication	4 (16%)	15 (24.2%)	0.67	0.6 (0.2-2.0)
- Urine incontinence	2 (8%)	5 (8.1%)	1	1 (0.2-5.5)
VAS (Pre/PO)				
- Leg	7.2 (5-8)/ 1.8 (1-3)	6.8 (6-9)/ 2.2 (1-3)	0.6	0.8 (0.4-1.6)
- Back	7.8 (7-9)/ 2.5 (1-3)	8.3 (7-9)/ 2.6 (1-4)	1	1.02 (0.5-1.9)
ODI (Pre/PO)	61.2 (42-68)/ 18.8 (16-36)	58.2 (32-64)/ 17.8 (10-34)	1	1.0 (0.48-2.1)
Surgical Complication				
- ASD	0	11	**0.03****	**RR = 1.5 (1.3-1.7)**
- Reoperation	1	3	1	1.2 (0.12-12.3)
- Dural Tear	1	2	1	0.8 (0.07-9.2)
- CSF Fistula	0	1	1	RR = 1.4 (1.2-1.6)

p < 0.05 is significant. * The mean and range of values were given; ** Preoperative course was given by months; Pre: preoperative; PO: postoperative; ASD: Adjacent segment disease; VAS: Visual analog score; ODI: Oswestry disability index, p: Probability value; OR: Odd ratio; RR: risk ratio.

Surgical Complications and Outcomes

The mean of preoperative leg and back VAS score were 7.2 (5-8), 7.8 (7-9) for dynamic group and 6.8 (6-9), 8.3 (7-9) for control group, respectively. The mean of postoperative leg and back VAS scores were 1.8 (1-3), 2.5 (1-3), 2.2 (1-3), and 2.6 (1-4), respectively. The mean of pre- and postoperative ODI were 61.2 (42-68), 18.8 (16-36) for dynamic group, and 58.2 (32-64), 17.8 (10-34) for control group, respectively. In both groups, there was a significant decrease in postoperative back VAS ($p = 0.01$), and leg VAS ($p = 0.02$) values of the cases. The differences between both groups in improvement are not statistically significant.

Up to last analysis date, ASD was seen in eleven patients (17.7 %) from control (alone fusion) group and no ASD was diagnosed in dynamic group. Of those patients who diagnosed as ASD six patients were diagnosed as clinical and radiological ASD whereas five patients were diagnosed clinically. The patients who diagnosed clinically and diagnosis was supported radiologically (n = 6) were reoperated (Fig. 2).

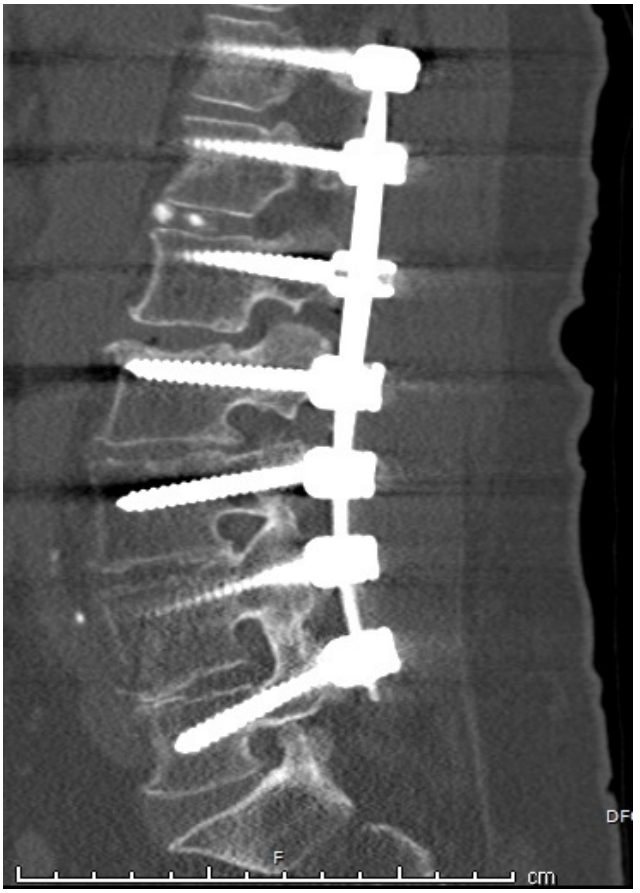

Figure-2. Sagittal CT image shows early postoperative extension using pedicle screws and fusion for the same patient in figure-1.

Clinically diagnosed five patients were treated conservatively. ASD is statistically significant in alone fusion group ($p = 0.03$). Reoperation for malposition was applied in one patient from dynamic group and three patients from alone fusion group. Dural tear was seen in one patient from dynamic group and two patients from control group and all these patients were handled preoperatively using fibrin sealant product after primary sutured using 0.5 absorbable sutures. From these three patients, CSF fistula was seen in one patient from control group and were treated using lumbar drainage for five days and prophylactic antibiotics. Except for ADS complication, the differences between both groups in complications are not statistically significant.

DISCUSSION

ASD is a serious challenging complication of posterior instrumentation and fusion surgery [7,9]. ASD occurs due to transmission of compensatory compression such as flexion-extension strength and forces from fused segment to facet joints and disc space, these conditions are concluded extensive loading on adjacent segment and degenerative process has been started [4,15].

Various non-fusion systems using dynamic screws and non-rigid rod systems have developed to prevent ASD. These systems are successful for pain relief, quality of life and motion preserving. Although non-fusion systems prevention of ASD is still controversial. According to St-Pierre et al. study ADS rate is higher in alone dynamic stabilization when compared to classic fusion (5.2 % versus 16.5 %) systems at a 5-year follow-up period [16].

To prevent the adjacent segment disease hybrid systems are recently developed. Hybrid system is started used for the rigid stabilization of multilevel spinal degeneration while allowing for a limited degree of motion in the adjacent dynamically instrumented segments [6]. Formica et al. found that no significant degenerative changes in adjacent segments at two-year follow-up of 41 patients treated with hybrid stabilization when compare classic fusion surgery [1].

In the current study, we used dynamic polyaxial dynamic screws that allow motion in only one plane with hinged joint. These dynamic screws provide mobility in sagittal plane however causes high degree stability on rotational forces. The dynamic system we used was developed to reduce compressive loading forces on dynamic screws' head and to allow flexion and extension on certain extent, although system does not allow rotational movement. Flexible rods with dynamic screws allow rotational movement that provides to protect from shear forces and rotational stability, which effect the adjacent disc and facet degeneration.

In this study, we aim to prevent ASD by using dynamic rod-screws system that allows moving segment on sagittal plane and concluding to share the extensive loading on adjacent segment. Previous similar study performed by Hayati et al. founded that there was no statistically significant difference between dynamic screws added stabilization and alone fusion when compared radiologic ASD and clinical ASD [(2)]. However they had founded that adding dynamic screw to fused segment has an effect on radiologic ASD that could not supported statistically.

The study has several limitations: first, it is a retrospective study that may suffer from the inherent bias. Second, the sample size of our cohort is small and follow-up period is short to generalize. Third, the results are a single center and a single surgeon results.

Conclusions

Despite the fact that our follow-up period is short and our sample size is small to generalize, this our preliminary study shows that the addition of dynamic screws had beneficial effects to prevent both clinical and radiologic ASD in patients who had LDS disease and treating with the posterior instrumentation systems. Further prospective studies with larger sample size are needed to validate our results.

Disclosure of Potential Conflicts of Interest

The authors declare that they have no conflict of interest.

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