Journal of Neurosurgery Imaging and Techniques
JNSIT, 1(2): 45-51
www.scitcentral.com
ISSN: 2473-1943
Original Research: Open Access

Lumbar Translaminar Facet Screws Fixation: Is It An Effective Minimal Invasive Old Technique?

Alaa Azzazi[1] and Omar Youssef[1]*

[1]*Department of Neurosurgery, School of Medicine, Cairo University, Egypt*

Received January 25, 2016; Accepted April 21, 2016; Published July 5, 2016

ABSTRACT

Lumbar translaminar facet srews (TLFS) fixation was first described by Magerl in 1984. Multiple biomechanical and clinical studies have justified lumbar facet screw fixation as a technique that provides stable fixation comparable to pedicle screw fixation with less reported complications. In this study we reported the early clinical results of this old TLFS fixation technique as a minimal invasive posterior fixation to the lumbar spine. Sixteen patients with segmental lumbar instability were operated upon by decompression and TLFS fixation. All patients were followed for 6 months postoperatively and clinical outcome was assessed according to Modified MacNab's Criteria as regards pain relief and functional outcome and visual analogue scale (VAS). Based on pre-operative and post-operative pain VAS, a calculated mean difference between the post-operative VAS and the pre-operative VAS could be determined with significant difference between both results. The overall results were rated as excellent in 3 patients (18.8%) good in 10 patients% (62.5%) and fair in 3 patients (18.8%) with no poor outcome patients at 6 month follow up. The early results in this study demonstrated TLFS as a safe and effective minimal invasive technique in short segment lumbar fusion in selected cases with good clinical outcome.

Keywords: Translaminar facet screws, Minimal invasive fixation, Segmental lumbar instability, Functional outcome

Abbreviations: TLFS: Translaminar Facet Screws; VAS: Visual Analogue Scale; MRI: Magnetic Resonance Imaging

INTRODUCTION

Pedicle screw fixation has been the gold standard for providing stabilization to the lumbar motion segment while fusion matures. However, several studies have reported high complication rates, increased pain, and juxtalevel degeneration due to the bulky size of the pedicle screw instrumentation, the necessary wide soft tissue dissection, and exposure of the cephalad facet joint [1,2]. These criticisms of pedicle screw fixation have necessitated more minimally invasive techniques and less bulky instrumentation. Translaminar facet screw (TLFS) fixation of the lumbar spine was first described by Magerl [3] and has been widely used and represents a simple minimal invasive technique for short segment fusion.

TLFS has been shown to limit the surgical exposure, soft tissue disruption, incision size, length of surgery, estimated blood loss, perioperative pain and avoid injury to the adjacent facet above the fused segment, which may decrease the incidence of adjacent segment disease [4, 5].

Multiple biomechanical [6-9] and clinical studies [10-15] have justified facet screw fixation as a technique that provides stable fixation comparable to pedicle screw fixation both short and long term. Pseudoarthrosis rates vary from 2% to 9% with greater than 90% good to excellent clinical outcomes.

The purpose of this study was to report the early clinical results of this TLFS fixation as a minimal invasive posterior fixation to the lumbar spine.

MATERIALS AND METHODS

Patient population

Our study included patients with segmental lumbar

Corresponding author: Omar Youssef, M.D., Lecturer of Neurosurgery, Cairo University, Egypt, Tel: +201223123322; Email: omaryoussef@gmx.com

Citation: Azzazi A & Youssef O (2016) Lumbar Translaminar Facet Screws Fixation: Is It An Effective Minimal Invasive Old Technique? Neurosurg Imaging Techniques, 1(2): 45-51. J

instability who were scheduled for posterior decompression and fusion. All patients were treated conservatively for at least 3 months without any benefit before being operated upon. Patients' symptoms were mechanical low back pain, neurogenic claudication, and radiculopathy.

We excluded the patients who had more than two levels instability, isthmic spondylolisthesis, more than grade 1 severity degenerative spondylolisthesis, osteoporosis, previous lumbar decompressive procedures involving removal of the lamina and spinous process of the affected level.

Sixteen patients were included in this study. All patients underwent diagnostic procedures with conventional radiographs and magnetic resonance imaging (MRI). Dynamic radiographs with flexion-extension views was done for the evaluation of lumbar spinal stability. A cutoff value of 3mm for translational motion or 10 degrees for angular motion [16] was used to assess radiological instability of the lumbar spine.

Preoperative pain score on a 10-point visual analogue scale (VAS), level of surgery, operative time, blood loss, and any complications including any subsequent operations were reported.

Surgical technique

The patient is placed prone on a spinal frame under general anesthesia. Using a vertical midline incision a subperiosteal exposure of the spinous process, laminae, facet joints is performed bilaterally. The levels are confirmed using fluoroscopy. The facet capsule is incised and opening up the facet joints by gentle traction on the spinous process facilitates the curetting of the articular cartilage using small sharp curettes. Trimming of osteophytes is done to regain the normal joint margins and surfaces to allow accurate screw alignment.

A 3.2 mm long drill is introduced through a separate percutaneous stab incision, about 5 mm away from the midline. After confirming the direction of intended screw placement, a drill hole is made at the base of the spinous process on the contralateral side, across the center of the facet joint and ending at the base of the transverse process of the lower vertebra. The first screw is inserted at the superior part of the base of the spinous process so that the two screws don't impinge on each other. For a lumbosacral fixation, the screws are inserted into the spinous process and exit at the ala of the sacrum. A 4.5 mm titanium cortical screw is inserted into the drill hole at the base of the spinous process.

The screw placement should be confirmed in both antero-posterior and lateral planes using fluoroscopy. At the time of screw insertion, any listhesis should be reduced by applying a gentle traction between the spinous processes using a spreader or by direct reduction of the forward slip by manually lifting up the vertebra with a hold on the spinous process. The TLFS does not function as a lag screw and hence does not need to be over tightened. The facet joint is then filled with small chips of cancellous bone.

Postoperative evaluation

Lumbar spine computed tomography (CT) scans and X-rays were done postoperatively in all cases to check the position of the screws and in the follow up period to check if any screws failure occurs. All patients were followed for 6 months postoperatively and clinical outcome was assessed according to VAS and Modified MacNab's Criteria as regards pain relief and functional outcome. Follow-ups were recorded in the office by an unbiased observer.

Table 1. Modified Macnab's criteria

Degree of recovery	Clinical status
Excellent	Free of pain, no restriction of mobility, able to return to normal work and activities
Good	Occasional non-radicular pain, relief of presenting symptoms, able to return to modified work
Fair	Some improved functional capacity, still handicapped &/or unemployed
Poor	Continued objective symptoms of root involvement, additional operative intervention needed at operative level irrespective of repeat or length of postop period.

RESULTS

There were 16 patients included in this study, 9 males and 6 females with a mean age of 52.7+/-7.4 years (43-67 years range). All patients in this study were complaining of both radicular and mechanical low back pain. There were 10 patients with Meyerding grade 1 spondylolisthesis and segmental canal stenosis and 6 patients with segmental stenosis and instability as diagnosed by preoperative MRI and dynamic views X-rays. Eight patients met both the translation and angular motion criteria for radiological instability, 5 patients met the translation motion only and 3 patients met the angular motion only.

Figure 1. Preoperative and postoperative imaging of a patient with grade 1 degenerative L4-5 spondylolisthesis operated upon by decompression and TLFS fixation.

All patients were operated upon by lumbar canal decompression and TLFS fixation with 2 patients needed additional discectomy at the affected level. Fourteen patients were operated upon for single level involvement, including 2 patients with previous L5-S1 fusion and subsequent L4-5 adjacent segment failure. Eight patients were operated upon L4–5 level, 4 patients for L5-S1 level and 2 patients for L3-4 level. Two levels involvement (both involving L4-5 and L5-S1 levels) was present in 2 patients.

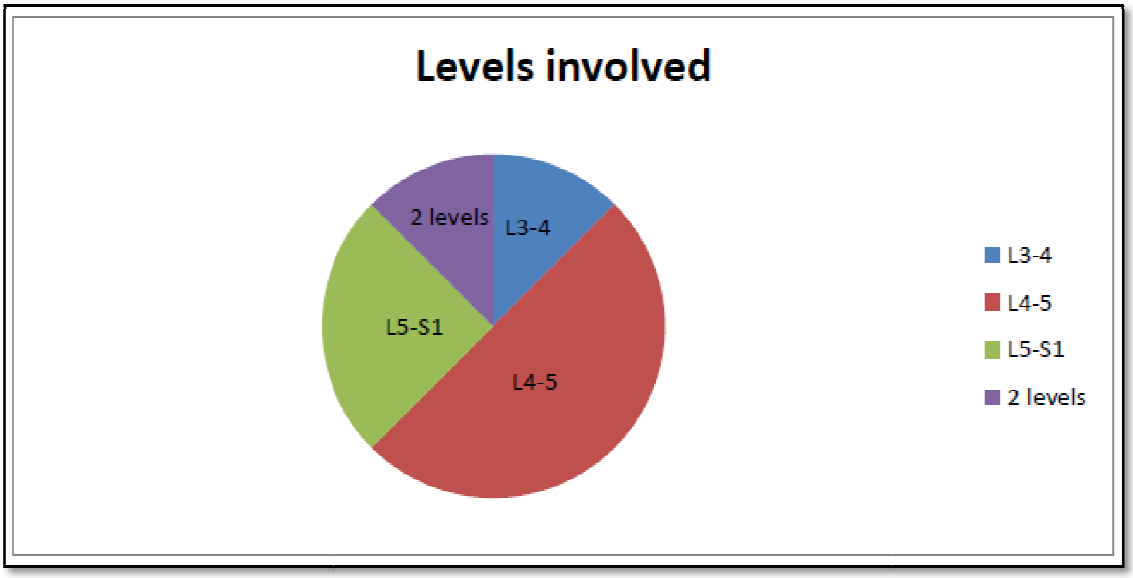

Figure 2. Levels involvement in population studied.

Figure 3. Preoperative and postoperative x-rays of a patient with L4-5 adjacent segment failure operated upon by decompression and TLFS.

The mean operative time was 95 min (65-150 min) and the mean estimated blood loss ranged was 218 ml (100-400ml). No misplacement of the screws were reported in any of the cases in the follow up images. The postoperative hospital stay ranged from 2-4 days. All patients were mobilized the first day after surgery. There were no neurological problems and no wound infections reported.

Based on pre-operative and post-operative pain VAS, a calculated mean difference between the post-operative VAS and the pre-operative VAS could be determined with significant difference between both results. The mean preoperative VAS was 7.13 and the postoperative mean VAS was 3.5 with a mean difference of 3.63. The overall results according to Modified Macnab's Criteria were rated as excellent in 3 patients (18.8%) good in 10 patients% (62.5%) and fair in 3 patients (18.8%) with no poor outcome patients at 6 month follow up.

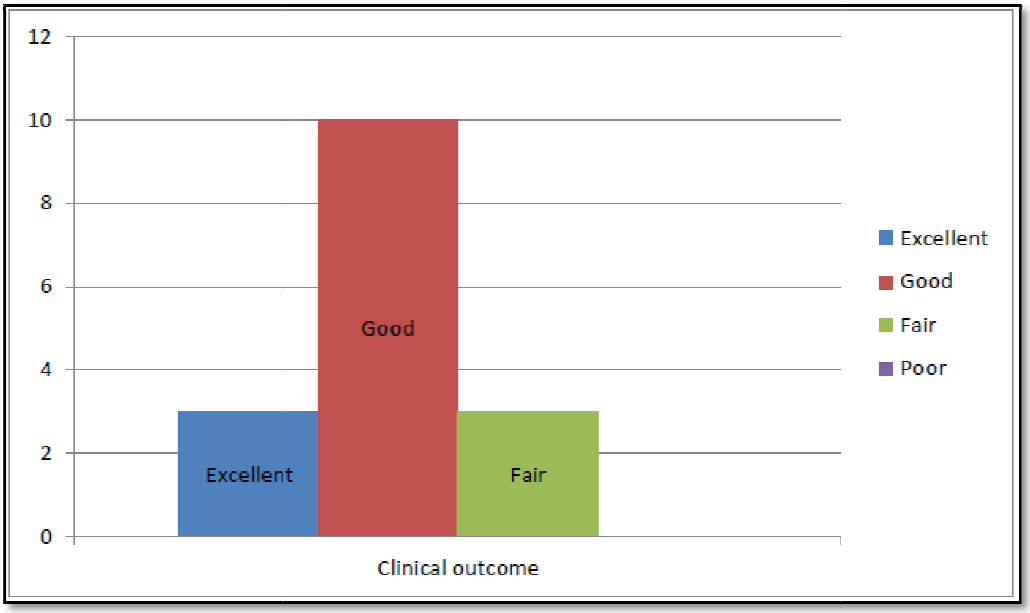

Figure 4. Clinical outcome according to Modified MacNab's Criteria.

DISCUSSION

Minimal invasive approaches to spinal fusion tends to reduce the exposure area and its associated morbidities such as blood loss, perioperative pain, and potential for infection. TLFS can be inserted in a minimally invasive fashion without significant dissection while maintaining a technically simple procedure. Several studies have substantiated the clinical and biomechanical performance of TLFS.

A histologic and enzymatic analysis of back muscle injury following posterior lumbar surgery led Kawaguchi et al. [17] to conclude that postsurgical morbidity is directly proportional to the extent of surgical dissection and trauma. The benefits of minimally invasive lumbar surgery [18] and the use of facet screw fixation as a minimally invasive fusion option are evident but it remains unclear why facet fixation has not gained more popularity.

TLFS have shown to provide considerable biomechanical stability to the instrumented segment in several studies. The first study assessing the biomechanics of TLFS was in 1986 by Kornblatt et al. [19]. Increased stiffness in static loading tests was determined. In 1991, Heggeness et al. [20] adduced these findings with further biomechanical testing utilizing repetitive cyclic compressive loads. They found that TLFS were able to maintain an increased stiffness under cyclic loading (4 sec/cycle) following 5,000 cycles.

Additional biomechanical comparisons between pedicle screws and TLFS have been done. Deguchi et al. [21] and Ferara et al. [22] found a statistically comparative stiffness and rigidity in the flexion-extension biomechanics of pedicle screws and TLFS although being less bulky and invasive.

Despite TLFS gives adequate stability in a stand-alone situation, they show to be especially beneficial when combined with interbody grafts. Ferrara et al. compared pedicle screws and facet screws in a human cadaveric model with interbody spacers under short and long-term cyclic loading [22]. No differences were found between both techniques but under flexion loads, the transfacet screws were statistically significantly stiffer over the pedicle screws. The authors concluded that in a circumferential fusion with an interbody graft it is more reasonable to use a minimally invasive and less bulky posterior instrumentation technique with TLFS.

Pre-requisites for considering the utilization of TLFS include intact spinous process, laminae and an intact anterior column that is able to resist compressive forces. Therefore, degenerative states with segmental instability and no major anterior deficiency constitute the perfect indication for this procedure [10, 12].

If additional posterior decompression is being planned, a technique preserving significant parts of the laminae and spinous processes has to be used. Isthmic spondylolithesis with a loose lamina and spinous process are clear contraindications for TLFS. To contrast, degenerative spondylolisthesis with intact posterior bony elements, and not more than Meyerding Grade I severity, can be stabilized with TLFS [23].

The TLFS is ideal for short segment stabilization and fusion, as it does not interfere with the adjacent facet joints. The pedicle screw and rod construct may produceearly juxtalevel degeneration by impinging upon the cephalad facet complex [23]. The minimal use of hardware and technical simplicity results in less surgical exposure and shorter operation time. These advantages in comparison with pedicle screws construct may reduce the rate of infection. The bulk of the pedicle screw and rod construct may also disrupts the normal function of the multifidus muscle. Multifidus muscle dissection lateral to the superior articular process avulses the medial branch of the posterior primary ramus with subsequent denervation of the muscle [23]. The position of the screws away from the spinal canal cause less distortion and artifacts in P the post-operative MRI and CT scans [24]. The low cost of the implants is an added advantage regarding the rising costs of health care [12].

According to the literature, the technical difficulties of pedicle screws are considerable and the complication rate significant. Incidence of clinically relevant nerve root injury from misplaced pedicle screws varies from 0 to 12% [25] in earlier reports, but remains around 3% [26] in more recent studies. In terms of complications involving injury of neural structures, the TLFS compares favorably with these reports of pedicular fixation. The neurological complications rate of TLFS are very low, the reported complications in a series of 173 patients (with five year follow-up) include a temporary quadriceps weakness in one case; transient nerve root irritation in three and one dural tear [12].

Grob et al. [11] reported five broken screws in 120 operated segments. Other technical complications like failure to cross the facet joint were reported in five cases by Grob et al. [11] One case of wrong level fixation was reported by Humke et al. [12]. John et al. [27] reported no intraoperative or postoperative complications, except one superficial wound infection, in a study evaluating 710 patients in 1988 followed for at least 6 months.

In our study, no neurological deficits were reported postoperatively with no hardware misplacement or failure in the follow up period. Penetration of the spinal canal was safely avoided by using a dissector underneath the lamina during the drilling procedure. We can attribute the low incidence of neurological injuries to the fact that insertion of the screws is technically easy with a short learning curve.

In our study, all patients were mobilized the first day after surgery and the postoperative hospital stay was relatively short and ranged from 2-4 days with no cases of wound infection reported. This can be attributed to the relatively

short operative time (mean 95 minutes) and the small amount of operative blood loss (mean 218 ml). Sasso et al. [28] compared the operative time and blood loss between 2 groups of patients operated by TLFS fixation and pedicle screw fixation respectively. They reported that the operative time was significantly lower in the TLFS population (p=.0062) as was the blood loss (p=.0019).

Our follow up clinical outcome evaluation at 6 months revealed excellent outcome in 18.8% (3 patients) good outcome in 62.5% (10 patients) and fair outcome in 18.8% (3 patients), with a significant improvement in VAS scores when comparing preoperative VAS (mean 7.13) and postoperative VAS (mean 3.5). No patients in our study required reoperation at the end of the follow up period. Similar results were reported in 2 studies evaluating the procedure in a large group of population in 1998 and 2009 [27, 29].

John et al. [27] evaluated TLFS fixation in 710 patients with lumbar instability who were followed for at least 6 months postoperatively. They demonstrated 90% of patients with satisfactory and successful outcomes. They concluded that TLFS is safe and efficacious, less traumatic, and less demanding in terms of time, equipment, instrumentation, and cost compared with the use of pedicle screw construct.

Martin et al. [29] evaluated the long-term results after TLFS of the lumbar spine in 643 patients. After an average follow-up period of 10 years, 74% of the patients reported that the operation had either "helped a lot" or "helped" (good outcome); and 26% declared that it "helped only little," "didn't help," or "made things worse" (poor outcome). The authors concluded that TLFS fixation represents a successful fixation technique in the lumbar spine with good long-term results for patients with intact posterior elements and a low preoperative disc height.

Sasso et al. [28] in 2006 retrospectively studied 67 patients (43 TLFS patients and 24 pedicle screw patients) who underwent circumferential lumbar fusions comparing the reoperation rates of TLFS versus pedicle screws. The average follow-up time for all patients was 46.3 ± 25.5 months. They reported better functional outcomes in the TLFS group compared to the pedicle screw one. Also, a significantly lower reoperation rate with lower operative time, blood loss, and complication rate was found in the TLFS group. At a minimum 2 year follow-up, subjective evaluation showed a significant decrease in the post-operative pain VAS as compared to the pre-operative values (p<.0001). There are however some potential disadvantages with the use of TLFS. Anterior column stabilization is not possible with TLFS unlike the pedicle screw fixation systems, which anchor all the three spinal columns [23]. Compression and distraction maneuvers cannot be performed to widen the neural foramen and disc space as with the pedicle screw fixation systems. Distraction can be achieved to a limit with TLFS by distracting the spinous processes with a spreader before inserting the screw [10,11]. Also, the decompression procedure has to be modified by undercutting the lamina and facet joints instead of completely excising them [30] as these structures are needed for the passage of the TLFS.

Study limitations

The follow-up period of only six months is likely not enough to make conclusions regarding the fusion status. The study didn't evaluate the use of different interbody fusion techniques as adjuvants to the TLFS to demonstrate their impact on the functional outcome and the ultimate fusion achievement for this technique. Further studies should compare the outcome of this technique with different minimal invasive techniques for lumbar spinal instability.

CONCLUSION

The early results in this report demonstrated that TLFS, in a stand-alone situation, is a safe and effective minimal invasive technique for short segment lumbar fusion in selected cases with good clinical outcome. There were no technique-related complications, hardware failures, or reoperations. Longer term follow up period and increased use of this technique will provide further information for its evaluation. This may open the door in the near future for the revival of this minimal invasive old technique with new trends in decision making.

REFERENCES

1. Lonstein JE, Denis F, Perra JH (1999) Complications associated with pedicle screws. J Bone Joint Surg Am 81: 1519-1528.

2. Esses SI, Sachs BL, Dreyzin V (1993) Complications associated with the technique of pedicle screw fixation. Spine 18: 2231-2239.

3. Magerl FP (1984) Stabilization of the lower thoracic and lumbar spine with external skeletal fixation. Clin Orthop 189:125-141.

4. Best NM, Sasso RC (2006) Efficacy of Translaminar Facet Screw Fixation in Circumferential interbody Fusions as Compared to Pedicle Screw Fixation. J Spinal Disord Tech 19: 98-103.

5. Sasso RC, Best NM (2006) Translaminar facet screw fixation. WSJ 1: 34-39

6. Heggeness MH, Esses SI (1991) Translaminar facet joint screw fixation for lumbar and lumbosacral fusion: A clinical and biomechanical study. Spine 16: S266-S269

7. Deguchi M, Cheng BC, Sato K, Matsuyama Y, Zdeblick TA (1998) Biomechanical evaluation of translaminar facet joint fixation: a comparative study of poly-1 lactide pins, screws, and pedicle fixation. Spine 23: 1307-1312.

8. Ferrara LA, Secor JL, Jin BH, Wakefield A, Inceoglu S, Benzel EC (2003) A biomechanical comparison of facet screw fixation and pedicle screw fixation: effects of short-term and long-term repetitive cycling. Spine 28: 1226-1234.

9. Kandziora F, Schleicher P, Scholz M, Pflugmacher R, Eindorf T, et al. (2005) Biomechanical testing of the lumbar facet interference screw. Spine 30: E34-E39.

10. Grob D, Humke T (1998) Translaminar screw fixation in the lumbar spine: Technique, indications, results. Eur Spine J 3:178-86.

11. Grob D, Rubeli M, Scheier HJ, Dvorak J (1992) Translaminar screw fixation of the lumbar spine. Int Orthop 16: 223-226.

12. Humke T, Grob D, Dvorak J, Messikommer A (1998) Translaminar screw fixation of the lumbar and lumbrosacral spine: a 5-year follow-up. Spine 23: 1180-1184.

13. Jacobs RR, Montesano PX, Jackson RP (1989) Enhancement of lumbar spine fusion of use of translaminar facet joint screws. Spine 14: 12-15.

14. Reich SM, Kuflik P, Neuwirth M (1993) Translaminar facet screw fixation in lumbar spine fusion. Spine 18:444-449.

15. Stonecipher T, Wright S (1989) Posterior lumbar interbody fusion with facet-screw fixation. Spine 14: 468-471.

16. Dupuis PR, Yong-Hing K, Cassidy JD, Kirkaldy-Willis WH (1985) Radiologic diagnosis of degenerative lumbar spinal instability. Spine 10: 262-276

17. Kawaguchi Y, Matsui H, Tsuji H (1996) Back muscle injury after posterior lumbar surgery: a histologic and enzymatic analysis. Spine 21: 941-944.

18. Foley KT, Holly LT, Schwender JD (2003) Minimally invasive lumbar fusion. Spine 28:S26-S35.

19. Kornblatt MD, Casey MP, Jacobs RR (1986) Internal fixation in lumbosacral spine fusion: A biomechanical and clinical study. Clin Orthop 203: 141-150.

20. Heggeness MH, Esses SI (1991) Translaminar facet joint screw fixation for lumbar and lumbosacral fusion. Spine 16: S266-9S.

21. Deguchi M, Cheng BC, Sato K, Matsuyama Y, Zdeblick TA (1998) Biomechanical evaluation of translaminar facet joint fixation: A comparative study of poly-1- lactide pins, screws, and pedicle fixation. Spine 23: 1307-1312.

22. Ferrara LA, Secor JL, Jin BH, Wakefield A, Inceoglu S, et al. (2003) A biomechanical comparison of facet screw fixation and pedicle screw fixation. Spine 28: 1226-1234

23. Rajasekaran S, Naresh-Babu J (2005) Translaminar facetal screw (magerl's) fixation Neurol India 53: 520-524

24. Rupp R (1993) Magnetic resonance imaging evaluation of the spine with metal implants. Spine 18: 379-385.

25. Hsu J, Zuckermann JF, White AH, Wynne G (1987) Internal fixation with pedicle screws: Lumbar spine surgery. Mosby, St Louis.

26. Ginsburg HH, Scoles PV (1990) Scoliosis Research Society Morbidity and Mortality committee: Complication report. Scoliosis Research Society, Park Ridge

27. John C, Thomas C, Richard C, Mark G, Felix N, et al. (1998) Spinal Translaminar Facet Fixation: Simpler Alternative for Spinal Lumbar Fusion. Neurosurg 43: 717.

28. Sasso RC, Best NM (2006) Efficacy of translaminar facet screw fixation in circumferential interbody fusions as compared to pedicle screw fixation. J Spinal Disord Tech 19: 98-103.

29. Martin A, Anne FM, Dieter G (2009) Translaminar screw fixation of the lumbar spine: long-term outcome. Spine 34: 1492

30. Benini A, Magerl F (1993) Selective decompression and translaminar articular facet screw fixation for lumbar canal stenosis and disc protrusion. Br J Neurosurg 7: 413-418.