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Sublaminar Decompression and Fusion in the Management of Stenotic Lumbar Degenerative Disorders

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ABSTRACT

Background Data: Lumbar degenerative disorders may result in low back pain, leg pain and limitation of walking distance that can disturb the patients' life. Several surgical procedures have been used to treat spinal canal stenosis ranging from minimal invasive to extensive decompression and fusion. However, recurrence of symptoms or instability may occur postoperatively.

Purpose: To evaluate efficacy and safety of sublaminar decompression and fusion in the management of lumbar degenerative disorders.

Study Design: Prospective clinical case study.

Patients and Methods: Twenty patients including; 7 central canal stenosis, 5 degenerative disc disease, 4 foraminal and central stenosis, and 4 central stenosis and spondylolisthesis patients were enrolled in this study. All were treated with sublaminar decompression and fusion. Pre- and post-operative clinical evaluation included Visual Analogue scale (VAS) for back and leg pain, Oswestry Disability Index (ODI). Pre- and post-operative measurement of anteroposterior thecal diameter, thecal cross-sectional area, right and left foraminal height were obtained using MRI and CT-scan. The mean follow up duration was 13.85±8.30 (Range, 8-33) months.

Results: VAS of leg pain improved from 7.3±1.4 to 2.4±0.9, VAS of the back pain improved from 7.4±0.9 to 2.3±0.5. ODI improved from 76±7.5 to 29.5±8.3. Anteroposterior thecal diameter changed from 10.4±1.4 mm to 14.1±1.1mm. Thecal sac cross sectional area improved from 134.2±19.6 mm^2 to 184±20.4 mm^2. Right foraminal height changed from 4.4±0.5 mm to 5.4±0.5 mm and left foraminal height changed from 4.2±0.5 mm to 5.2±0.5 mm. The mean time to achieve bone fusion in our series was 8.1 months and the fusion rate was 95%.

Conclusion: Sublaminar decompression and fusion is safe and effective procedure in treatment of stenotic degenerative spinal disorders. It achieves high fusion rate without serious complications**. (**2018ESJ166**)**

Keywords: sublaminar decompression; spinal fusion; degenerative disorders; lumbar spine

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INTRODUCTION

The increased population age and prevalence of degenerative spinal disorders resulted in an increase of the number of spinal fusion procedures. Spinal degenerative disorders include spinal canal stenosis, foraminal stenosis, degenerative scoliosis, and spondylolisthesis.[5]

Postero lateral fusion and laminectomy with instrumentation was the standard treatment option for spinal stenosis.[10] In this procedure, decompression is achieved by laminectomies which involves removal of spinous process, interspinous ligament, supraspinonous ligament, entire lamina, ligamentum flava and partial facets leaving only very small surface of transverse processes and remaining facet joints allowed for fusion; this explains high incidence of pseudarthrosis reaching up to 27 to 30%.[5]

Kebaish et al,[5] in 2017 described a new technique, sublaminar decompression, which includes partial laminectomy and facetectomy providing a wide central, foraminal and lateral recess decompression while leaving maximum bone posteriorly and postero-laterally to allow adequate fusion.

This study aims to evaluate efficacy and safety of sublaminar decompression and fusion in the management of lumbar degenerative disorders.

MATERIAL AND METHODS

Between February 2015 and December 2017, 20 patients were enrolled into a prospective study to be treated with sublaminar decompression and posterior spinal fusion with instrumentation. Patients were selected according to the following inclusion criteria; 1) Adult patients (>18 years old) with degenerative lumbar canal stenosis, 2) Degenerative lumbar pathologies associated with leg and back pain and/or mechanical instability that necessitate both decompression and fixation. We excluded patients presenting with degenerative spinal lumbar pathologies in association with infections, trauma, or tumors.

The mean age was 47.7±10.4 (Range, 30-60) years. There were 6 males and 14 females. The preoperative pathology was as follow; 7 central stenosis, 5 degenerative disc disease (DDD), 4 foraminal and central stenosis, and 4 central stenosis with spondylolisthesis. Visual Analogue Scale (VAS) for both leg and back pain were assessed preoperatively and at the last follow up, with 0 meaning no pain and 10 meaning maximum pain. Functional outcome was measured using the Oswestry Disability Index (ODI). The mean follow up period was 13.85±8.30 (Range, 8-33) months. The 20 patients were followed up both clinically and radiologically.

Radiologically: Plain X-Ray (anteroposterior, lateral and lateral dynamic views), computed tomography (CT) and Magnetic Resonance Imaging (MRI) were done to all of our patients and the following parameters were measured using the Surgimap (version: 2.2.13) computer program; anteroposterior thecal diameter (mm), thecal cross-sectional area (mm2), right and left foraminal height (mm); these measurements were obtained using preoperative MRI and CT. Fusion was evaluated through plain X-ray films as bridging bone seen posteriorly and postero-laterally. CT-Scan was performed in patients where still symptomatic without bridging bone seen in plain X-ray films.

Operative Procedures:

All patients had been given intravenous 3rd generation Cephalosporins 2 hours preoperatively and a Foley catheter was applied to monitor fluid balance. All patients had general hypotensive anesthesia and endotracheal intubation. All patients were placed in prone position with hips extended and knees slightly flexed to preserve or restore lumbar lordosis.

After sterilization and draping a straight posterior midline incision was done followed by subperiosteal dissection to expose the planned levels of decompression and instrumentation. Then pedicle screws were prepared using free hand technique for the planned levels of

instrumentation. Screw entries were closed using bone wax until the decompression was completed to allow visualization and decompression of the lateral recess.

The posterior part of the facet joint was excised using straight osteotome on each side. The midline structures including the interspinous and supraspinous ligaments were excised using Lexell rongeur. A laminar spreader was used to distract the interspinous space to visualize the moving articulating facet joint then using a straight osteotome the inner part of the inferior articular process was excised thus facilitating more distraction.

The midline entry was now achieved through the central bare area and the ligamentum flavum was then removed from center going lateral on both sides using Kerrison rongeur. Then, with the usage of small curved up osteotome the anterior portion of the lamina is excised on both sides together with the ligamentum flavum to completely decompress the dura centrally. Bilateral foraminotomy and lateral recess decompression were done using Kerrison rongeur and tips of superior articular processes were removed with the use of a small osteotome.

Pedicular screws were inserted through the prepared tracks and rods were tightened on both sides. Arthrodesis was achieved through decortications of the laminae, spinous processes and the transverse processes of the involved levels then the autogenous local bone graft harvested from excised bones was placed prepared fusion bed. Harvested local bone graft was enough for adequate fusion in all of our patients. A suction drain was inserted and the wound was closed layer by layer. (Figure 1)

The suction drain was removed when discharge became less than 100 ml in 12 hours. All patients were advised to walk on the 2nd postoperative day and were discharged from hospital 4 days postoperatively. X-rays were done immediately postoperatively and at 6 weeks, 12 weeks and then every 3 months postoperatively. CT and MRI were done to all patients 1 month postoperatively and postoperative assessment was done using the same measures taken preoperatively.

Statistical Analysis:

All statistics were performed using SPSS 23.0 for windows (SPSS Inc., Chicago, IL, USA).

RESULTS

The total number of operated levels in our 20 patients was 32 levels. Single level procedure was performed in 13 patients (65%), 2 levels in 3 patients (15%), 3 levels in 3 patients (15%) and 4 levels (5%) in one patient. L4-5 level was operated in 15 patients, L5-S1 in 9 patients, L3-4 in 5 patients and L2-3 in 3 patients. The mean estimated operative blood loss (EBL) was 564±157.3 (Range, 350-800) ml. The mean operative duration was 127.5±35.3 (Range, 85-200) minutes.

The VAS of leg pain improved from 7.3±1.4 (Range, 4-9) to 2.4±0.9 (Range, 1-5) at the last follow up showing 67.1 % improvement. The VAS of the back pain showed 67.1 % improvement at the last follow up as it has changed from 7.4±0.9 (Range, 6-9) to 2.3±0.5 (Range, 1-3). The ODI improved from 76±7.5 (Range, 60-90) to be 29.5±8.3 (Range, 20-50) showing 61.2% improvement at the last follow up ($P<0.001$) (Figure 2).

The anteroposterior thecal diameter changed from 10.4±1.4 (Range, 6-13) mm to 14.1±1.1 (Range, 12-16) mm at the last follow up with 35.6% percent of improvement ($P<0.001$). The thecal sac cross sectional area improved from 134.2±19.6 (Range, 110-170) mm^2 to 184±20.4 (Range, 150-220) mm^2 showing 37.1% improvement at the last follow up ($P<0.001$) (Table 1, Figure 3,4).

The right foraminal height changed from 4.4±0.5 (Range, 3.7-5.2) mm to 5.4±0.5 (Range, 4.6-6.1) mm with 22.7% correction rate at the last follow up. The left foraminal height changed from 4.2±0.5 (Range, 3.3-5.1) mm to 5.2±0.5 (Range, 4.4-6.1) mm showing 23.8% correction rate at the last follow up ($P<0.001$). The rate of union was 95% as only one patient did not achieve bone

union one-year postoperative. The mean time to achieve union was 8.1 months. (Figures 5-8)

Two dural tears were reported and repaired intraoperatively with no postoperative consequences. One patient presented with nonunion after one year, the rod was broken and pseudarthrosis was documented. Patient's surgery was revised with revision of instrumentation and bone grafting and interbody fusion.

Table 1. Pre- and Post-operative Radiological Data in the Study Group (N=20)

Parameters	Pre-Operative	Post-Operative	Change%	Paired t	P value
Anteroposterior thecal Diameter	10.4±1.4(6-13) mm	14.1±1.1 (12-16) mm	35.6 %	-17.21	<0.001**
Right foraminal diameter	4.4±0.5(3.7-5.2) mm	5.4±0.5 (4.6-6.1) mm	22.7%	-18.163	<0.001**
Left foraminal diameter	4.2±0.5(3.3-5.1) mm	5.2±0.5 (4.4-6.1) mm	23.8%	-15.289	<0.001**
Thecal sac Cross sectional area	134.2±19.6(110-170) mm^2	184±20.4 (150-220) mm^2	37.1%	-21.403	<0.001**

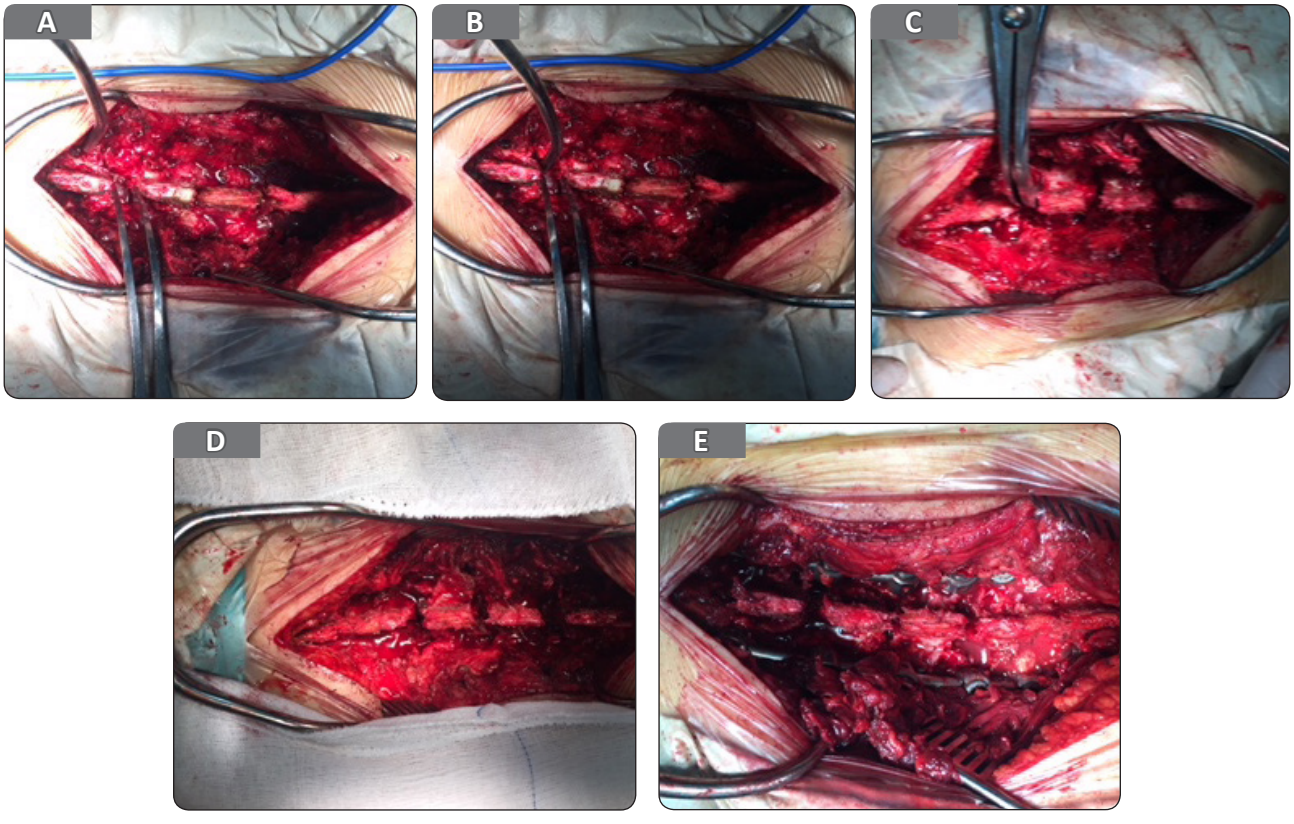

Figure 1. Intraoperative images describing the steps of sublaminar decompression and fusion procedure in lumbar 2-5 levels and final construct (A): excision of supraspinous and interspinous ligaments and preparation of screw tracts. (B): excision of the inferior articular process of the facet joint. (C): distraction using laminar spreaders. (D): sublaminar excision of the ligamentum flavum and removal the tips of superior articular process (E): final construct.

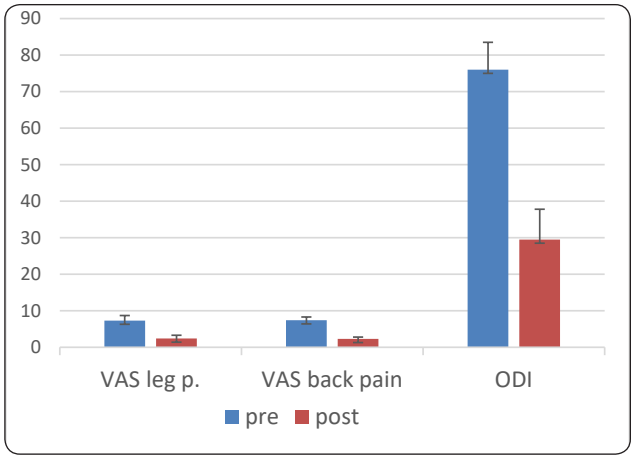

Figure 2. Bar graph showing difference between pre- and post-operative VAS of back and leg pain and ODI.

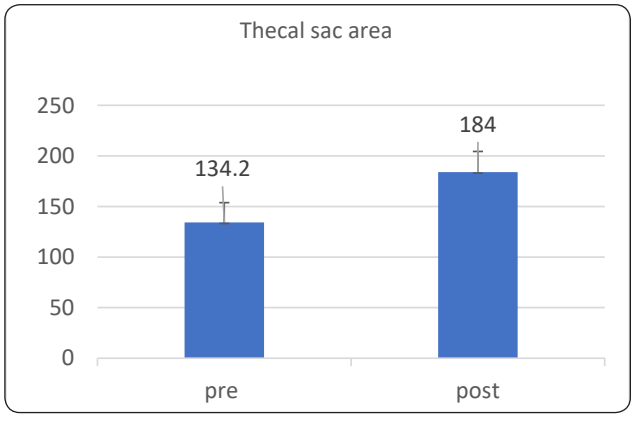

Figure 3. Bar graph showing the difference between pre- and post-operative thecal sac cross sectional area.

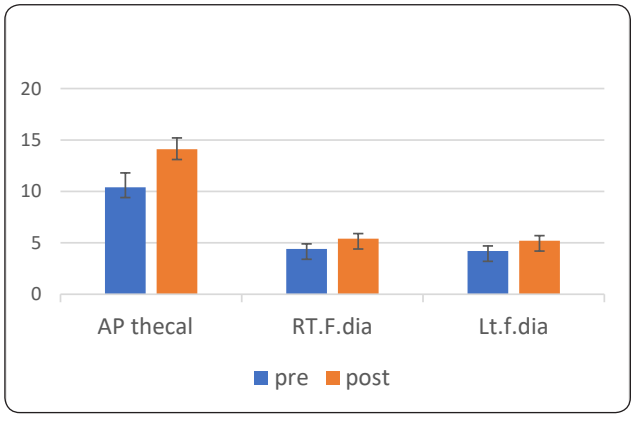

Figure 4. Bar graph showing difference between pre- and post-operative anteroposterior thecal diameter, right foraminal diameter, left foraminal diameter and thecal sac cross sectional area in mm. (AP: Anteroposterior, Rt.F.dia: Right foraminal diameter, Lt.F.dia: Left foraminal diameter)

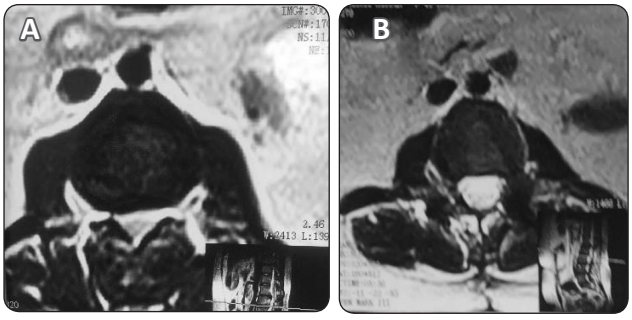

Figure 5. (A) Pre- and (B) post-operative axial T2 MRI of L2-3 level showing central lumbar spinal canal decompression.

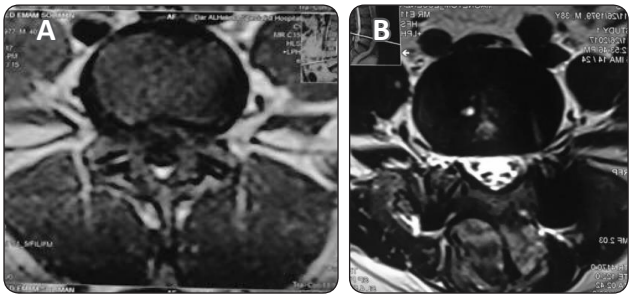

Figure 6. (A) Pre- and (B) post-operative axial T2 MRI of L4-5 level showing bilateral foraminal decompression.

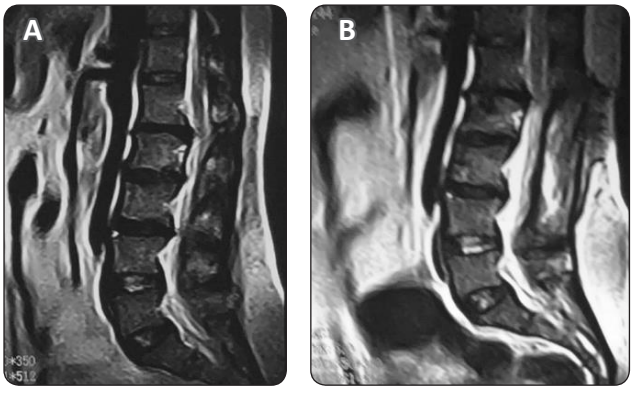

Figure 7. (A) Pre- and (B) post-operative sagittal MRI showing adequate decompression of the spinal canal.

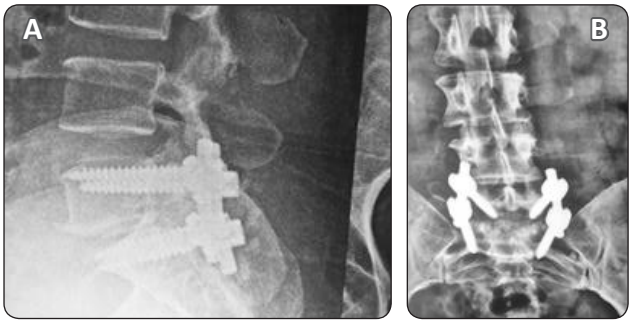

Figure 8. Plain X ray (A) AP and (B) lateral views showing bony fusion of L5-S1 level with preservation of lamina and spinous process.

DISCUSSION

Although several surgical procedures have been described to treat lumbar spinal canal stenosis ranging from minimally invasive procedures to complete laminectomy and facetectomy with or without fusion, recurrent stenosis or instability is still a relatively postoperative common problem.[1,11]

Unlike laminotomy in which foraminal and lateral recess decompression are limited,[9] the sublaminar decompression technique adequately decompresses the central canal, neural foramina, and the lateral recesses.[10] Nakaie et al,[7] described wide fenestration technique allowing mainly adequate central decompression. Also, in microsurgical bilateral decompression using unilateral approach is adapted mainly to central canal decompression especially if the canal is oval or rounded not trefoil.[5] The efficacy of sublaminar decompression has been confirmed both clinically and radiologically in this study. The VAS of leg pain significantly improved from 7.3±1.4 (Range, 4-9) preoperatively to 2.4±0.9 (Range, 1-5) postoperatively. The anteroposterior thecal diameter improved from 10.4±1.4 (Range, 6-13) preoperatively to 14.1±1.1 (Range, 12-16) at the last follow up with 35.6% improvement (P<0.001) compared to Peddada et al,[10] study (10.4 mm preoperatively to 13.0 mm postoperatively) with 25% improvement. The right foraminal height increased from 4.4±0.5 (Range, 3.7-5.2) to 5.4±0.5 (Range, 4.6-6.1) mm with 22.7% improvement compared to Peddada et al,[10] study that showed 13% change as the right foraminal height increased from 4.6 to 5.2 mm. The left foraminal height changed from 4.2±0.5 (Range, 3.3-5.1) to 5.2±0.5 (Range, 4.4-6.1) mm showing 23.8% correction rate at the last follow up(P<0.001) that was comparable to Peddada et al,[10] study that showed 24% change as it has been corrected from 4.2 to 5.2 mm.

In our study, improvement of leg pain VAS was comparable to that of other studies using minimal invasive techniques for management of lumbar canal stenosis. A large retrospective study using micro-endoscopic decompression for management of 583 patients with lumbar canal stenosis, in which mean leg pain VAS improved from 8 preoperatively to 2 postoperatively.[4] In another study,[2] patients with degenerative lumbar canal stenosis have undergone bilateral decompression from unilateral approach, the VAS improved from 7±0.72 preoperatively to 2±0.72 postoperatively.

The sublaminar decompression offers a large surface area for bony fusion dorsally along the intact lamina and poster laterally along the transverse processes and the facet joints that is not offered in other decompressive techniques as in wide laminectomies in which the only surface allowed for fusion is the posterolateral surface along the small transverse processes. Laminotomy as decompressive procedure offering small area for posterior bony fusion depending on the amount of bone removed from the lamina.[3]

The mean age was 47.7±10.4 years old comparing to other studies, mean age was 60 (Range: 19-78) [10] and 65.6±10.6 years.[6] The mean operative time was 127.5±35.3 (Range, 85-200) minutes that was comparable to Liu et al,[6] study who reported an operative time of 126.6 minutes for sublaminar trimming laminoplasty alone that was increased up to 259.7 minutes for the whole procedure. However, the mean operative time was less than that of Peddada et al,[10] study which was 322 minutes but this may be due to their long fusion segments and some patients have deformity correction.

The mean ODI improved from 76±7.5 (Range, 60-90) to 29.5±8.3 (Range, 20-50) showing 61.2% improvement at the last follow up (P<0.001). This was comparable to Liu et al,[6] study with improvement of 69.9% of ODI at the last follow up. In our study, we had 95% fusion rate which was more than that in the study of Peddada e al,[10] study that showed 88% fusion rate. The pseudarthrosis of our study 5% was comparable to the study of Nayak and Sannegowda[8] as they showed 5.4% pseudarthrosis rate.

The main weak points in this study were the relatively small sample size, short follow-up, and lack of control group.

CONCLUSION

Sublaminar decompression and fusion is safe and effective procedure in treatment of stenotic degenerative spinal disorders. It achieves high fusion rate without serious complications.

REFERENCES

1. AHulen C: A Review of the Significance, Indications, Techniques, and Outcomes of Revision Lumbar Laminectomy Surgery. Semin Spine Surg 20(4):270–6, 2008
2. Abouelmaaty E, El Molla S: Assessment of Clinical Outcome of Bilateral Decompression through Unilateral Approach in Lumbar Canal Stenosis. Egy Spine J 21:24-32, 2017
3. Boden SD, Schimandle JH, Hutton WC: An experimental lumbar intertransverse process spinal fusion model: Radiographic, histo-logic, and biomechanical healing characteristics. Spine 20:412–420, 1995
4. Kabil M, Ebrahim K: Microendoscopic bilateral Decompression via Unilateral Approach in Single and Multiple Level Lumbar Canal Stenosis: A Series of 583 Cases. Egy Spine J 25:6-16, 2017
5. Kebaish KM, Elder BD, Lo SL, Witham TF: A New Technique for Spinal Canal Decompression in the Treatment of Stenosis in Degenerative Spinal Conditions. Clin Spine Surg 30:14–19, 2017
6. Liu WJ, Hong SW, Liou DY, Lu TW: Clinical outcomes following sublaminar trimming laminoplasty for extensive lumbar canal stenosis. Eur Spine J 23:80–86, 2014
7. Nakai O, Ookawa A YI: Long-term roentgenographic and functional changes in patients who were treated with wide fenestration for central lumbar stenosis. J Bone Jt Surg Am 73(8):1184–91, 1991
8. Nayak MT, Sannegowda RB: Clinical and Radiological Outcome in Cases of Posterolateral Fusion with Instrumentation for Lumbar Spondylolisthesis. J Clin Diagnostic Res 9(6):17–21, 2015
9. Nemani VM, Aichmair A, Taher F, Lebl DR, Hughes AP, Sama AA, Cammisa FP, et al: Rate of Revision Surgery After Stand-alone lateral lumbar interbody fusion for lumbar spinal stenosis. Spine 1;39(5):E326-31, 2014.
10. Peddada K, Elder BD, Ishida W, Lo SL, Goodwin CR, Boah AO, et al: Clinical outcomes following sublaminar decompression and instrumented fusion for lumbar degenerative spinal pathology. J Clin Neurosci 30:98–104, 2016
11. Thomas NW, Rea G.L, Pikul BK, Mervis LJ, Irsik R, McGregor JM: Quantitative outcome and radiographic comparisons between laminectomy and laminotomy in the treatment of acquired lumbar stenosis. Neurosurgery 41:567–574, 1997

الملخص العربى

استخدام تحرير ما تحت الصفيحة العظمية مع الصهر في علاج اضطرابات الغضروف القطني التنكسي

البيانات الخلفية: قد تتسبب اضطرابات الغضروف القطني التنكسي في حدوث الام أسفل الظهر و الام بالطرفين السفليين و عدم القدرة على الوقوف أو المشي لمسافات طويلة و التي قد تتسبب في بعض الأحيان في التأثير السلبي على الحياة اليومية للمرضى. هناك العديد من الطرق الجراحية التي تستخدم في علاج ضيق القناة العصبية التي تتراوح ما بين التدخل المحدود لتحرير الأعصاب و حتي التحرير الجراحي الكامل للقناة العصبية مع صهر الفقرات.

الغرض: تقييم مدى فاعلية و أمان استخدام تحرير ما تحت الصفيحة العظمية في علاج المرضى الذين يعانون من اضطرابات الغضروف القطني التنكسي.

تصميم الدراسة: هذا البحث هو دراسة استطلاعية أجريت على عشرين مريض. و قد تضمن فحص المرضى اكلينيكيا عدة قياسات لمقارنة شدة الألم و نشاط المرضى اليومي قبل و بعد اجراء العملية. وكذلك تم عمل الأشعة السينية و المقطعية و الرنين المغنطيسي و ذلك لتقييم مساحة القناة العصبية و الثقبة الفقرية اليمنى و اليسرى قبل و بعد اجراء العملية.

المرضى و الطرق: تم علاج ٧ مرضى يعانون من ضيق بالقناة العصبية القطنية و ٥ مرضى يعانون من امراض الغضروف القطني التنكسي و ٤ مرضى يعانون من ضيق القناة العصبية لجذور الأعصاب القطنية و ٤ مرضي يعانون من ضيق بالقناة العصبية المصاحب للتزحزح الفقاري القطني بواسطة تحرير ما تحت الصفيحة العظمية للفقرات القطنية مع الصهر.

النتائج: لقد حدث تحسن كبير في كل من الام الظهر و الطرفين السفليين و قد تأكد بالأشعة زيادة مساحة القناة العصبية و الثقبة الفقرية اليمنى و اليسرى بعد العملية. و قد حدث التحام بين الفقرات في ٩٥ ٪ من الحالات وكان متوسط الفترة اللازمة لحدوث الالتحام ١,٨ شهر.

الاستنتاج: تحرير ما تحت الصفيحة العظمية للفقرات مع الصهر كان فعال في علاج أضطرابات الغضروف القطني التنكسي و حقق معدل التحام جيد و لم يتسبب في مضاعفات خطيرة.