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MINI OPEN SPINOUS PROCESS SPLITTING LAMINECTOMY IN THE MANAGEMENT OF CERVICAL SPONDYLOTIC MYELOPATHY

Mini Open Spinous Process Splitting Laminectomy in the management of Cervical Spondylotic Myelopathy

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Abstract

Background Data: Muscle dissection associated with posterior approach to cervical spine usually results in local pain, muscle wasting and temporarily restricted neck movement. Use of muscle sparing spinous process splitting approach for cervical laminectomy allows decompression of the spinal cord and neural foramen if needed. Meanwhile, it does not require instrumentation, fusion and it preserves cervical spine stability.

Purpose: To assess the effectiveness of spinous process splitting approach for cervical laminectomy in cervical spondylotic myelopathy.

Study Design: Prospective clinical case study.

Patients and Methods: *Patient Sample:* Fifteen patients with cervical spondylotic myelopathy, eleven males and 4 females with mean age 66.4±6.6 (Range 44-71) years. All patients underwent muscle sparing spinous process splitting cervical laminectomy. *Outcome Measures:* Operative time and blood loss were recorded. Clinical outcome was assessed by the JOA score and VAS. MRI was done 6 months postoperative to assess decompression. Spinal stability and curvature index were assessed on plain cervical radiographs.

Results: No case of wound dehiscence was recorded. There was significant improvement of JOA scores and brachialgia and neck pain VAS scores at 6 months, the mean JOA recovery rate was 56.2%. No patient had postoperative kyphosis or instability and 66.6% of patients had improved modified Ishihara cervical curvature index. No neurological deterioration was recorded in the follow-up. No patient had newly developed axial pain. MRI revealed adequate decompression of the spinal cord in all patients.

Conclusion: The spinous process splitting cervical laminectomy allows good spinal cord decompression and preserves spine curvature and stability. The mini open approach and preservation of interspinous ligaments could play a role in wound dehiscence prevention. (2017ESJ133)

Keywords: Cervical spondylosis, spondylotic myelopathy, muscle sparing, spinous process splitting.

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Introduction

Cervical spondylotic myelopathy is common above the age of 55 years. Myelopathy could be secondary to degenerative spinal changes causing cervical canal stenosis and spinal cord compression.[7] Posterior cervical decompression is one of the surgical choices for multilevel cervical spondylotic myelopathy including fusion and non-fusion techniques.[2] Recently, the most likely used posterior approaches are laminectomy with posterior instrumented fusion or laminoplasty. Laminectomy alone is nearly forbidden due to the high rate of postlaminectomy kyphosis.[2,4] Non fusion surgeries were aiming to avoid adjacent-level disease and pseudarthrosis related to fusion surgeries.[6]

Despite cervical laminoplasty without fusion provides superior results than Laminectomy alone, it still has variable rates of postoperative kyphosis and axial neck pain. These complications could be related to muscle stripping and ligamentous disruption during posterior approach.[8,10] Spinous process splitting approach was described by Shirashi 2002[16] to avoid extensor muscles damage that is a major cause of postoperative persistent axial pain, cervical kyphosis and instability.

The aim of this study was to evaluate the use of spinous process splitting approach for cervical laminectomy in cervical spondylotic myelopathy with six month follow up.

Patients and Methods

This prospective clinical case study was conducted from January 2016 to January 2017 and included fifteen consecutive patients (11 males and 4 females) and the mean age at surgery was 66.4±6.6 years (Range 44-71). All patients presented with cervical myelopathy or radiculo-myelopathy with preserved cervical lordosis and no instability.

All patients had multilevel degenerative cervical spondylosis (49 levels: 11 triple level and 4 quadruple level) causing spinal canal stenosis with or without neural foraminal stenosis. Complete neurological assessment was performed (Table 1) and cervical myelopathy was scored according to the Japanese Orthopaedic Association (JOA) score for cervical myelopathy.[9]

Preoperative plain x-ray was performed with dynamic views to detect instability, modified Ishihara cervical curvature index (CCI) was measured, and MRI was performed to detect levels of cord compression. All patients had posterior cervical laminectomy using muscle sparing spinous process splitting technique, with or without foraminotomy. A written informed consent was signed before the study.

Surgical Technique:

As described by Shiraishi 2002[16] after induction of anesthesia, patients were positioned prone on a soft pillow in slight neck flexion and the shoulders were carefully retracted with tape. Under 3.5x magnifying loupe, a posterior midline mini-incision was made at the affected level. Monopolar electrocautery is used to dissect down to and through the ligamentum nuchae. A lateral view radiograph was obtained to confirm the proper level. The midline intervals between the right and left deep extensor muscles were identified and spread with a dissector to expose the cephalad halves of the laminae and ligamentum flavum at each space, the muscles were kept retracted using a 90 degree modified Gelpi self-retaining retractors and so both the upper and lower margins of spinous processes were exposed. (Figure 1 A).

Using a high speed drill with a fine 2-mm cutting burr, the spinous processes were split and then separated from each posterior arch using small osteotome, then the semispinalis cervicis and multifidus muscles were dissected bluntly laterally from each lamina. Corticotomy troughs were created on both sides at the laminofacet junction using a 2-mm high-speed cutting burr to thin the corticocancellous bone first, and then 1- to 2-mm Kerrison rongeurs were used to complete the corticotomy on both sides. If foraminotomy was planned it was done using high-speed cutting burr before complete removal of the laminae with a limit of medial facetectomy to less than 50%. The ligamentum flavum at lamina above and below were then removed using 1 to 2 mm Kerrison rongeurs and/or small curettes, the laminae were lifted up as one piece.

By removal of the self-retaining retractors the muscles looked coapted with very narrow dead space (Figure 1 B), suction drain was applied and meticulous closure was done in layers with special

attention to suture each split spinous processes to its half.

Postoperatively; all patients were allowed to sit up after a few hours and to walk on the first postoperative day. Postoperative neck collar was not applied. The suction drain was removed by the second or the third postoperative day.

Follow-up:

Clinical evaluation of all patients was done at first postoperative day and at 4, 12, 24 weeks in the form of clinical examination, pain scoring using VAS, JOA scoring and JOA recovery rate % calculation that is equal:

$$\text{JOA Recovery rate} = \frac{\text{(postoperative score-preoperative score) X 100}}{\text{(Full score-preoperative score)}}$$

Plain x-ray with dynamic views was done at 4, 12, 24 weeks to detect any instability, the modified Ishihara cervical curvature index (CCI) was measured at 24 weeks and compared with preoperative measurement to detect any change in cervical lordosis. MRI was done for all patients at 6 months to evaluate the decompression. Collected data were analyzed using SPSS software, 20. (SPSS Inc, Chicago, IL, USA) and Megastat software version 10.1 (McGraw-Hill). P-values less than 0.05 were considered statistically significant.

Results

The study included 15 patients; 11 had triple level laminectomy and 4 had quadruple level laminectomy. Foraminotomies were indicated in 6 patients (40%) for decompression of 10 foramina. The mean intraoperative blood loss was 123 cc (Range 80–210). The mean postoperative blood loss via suction drains was 40 cc (Range, 60–20). The mean operative time of 118 minutes (Range 80-160).

The mean preoperative JOA scores was 8.9±0.96 (Range 8-11), this had significantly improved at 6 months to 13.4±1.9 (Range 10-16) (P<0.0001) (Table 2). The mean 6 months JOA recovery rate was 56.2% (Range 22.2–85.7%). Forty percent of the patients had brachialgia, its mean VAS scores was significantly improved at 6 month follow up (P<0.001), while insignificant change was observed in the mean VAS scores for neck pain that was a complaint of 33.3% of the patients (P=0.67) (Table 2). No patient had newly developed axial pain postoperatively.

No patient in this study suffered from wound dehiscence. No patient had postoperative instability in the dynamic radiographs. No deterioration in modified Ishihara cervical curvature index (CCI), five cases (33.3%) kept the same CCI and ten cases (66.6%) had improved CCI. The total mean CCI has improved from 20.4±11.5 to 22±11.5 at 6 month follow up, this change was insignificant (P=0.66) (Table 2).

The correlation between the mean 6 months JOA recovery rate and other patients' data revealed significant high negative correlation with the number of levels (r=-0.78, P=0.0003) and significant high positive correlation with the Post CCI score (r=0.62, P=0.0068) (Table 3). No neurological deterioration was recorded in the follow-up period in this study. MRI that has been done at 6 month follow-up revealed adequate decompression of the spinal cord in all patients (Figure 2).

Table 1. Preoperative Neurological Symptoms and Signs

Parameters		Patients No. (%)
Symptoms	Clumsiness of the hands	5 (33.3%)
	Deficit of upper extremity motor function	7 (46.6%)
	Gait disturbances	9 (60%)
	Upper extremity sensory complaints	6 (40%)
	Lower extremity sensory symptoms	2 (13.3%)
	Bowel/bladder dysfunction	1 (6.6%)
Sign	Hand wasting	2 (13.3%)
	Spastic gait	10 (66.6%)
	Hyperreflexia	14 (93.3%)

Table 2. Comparison between Preoperative and Postoperative Scores

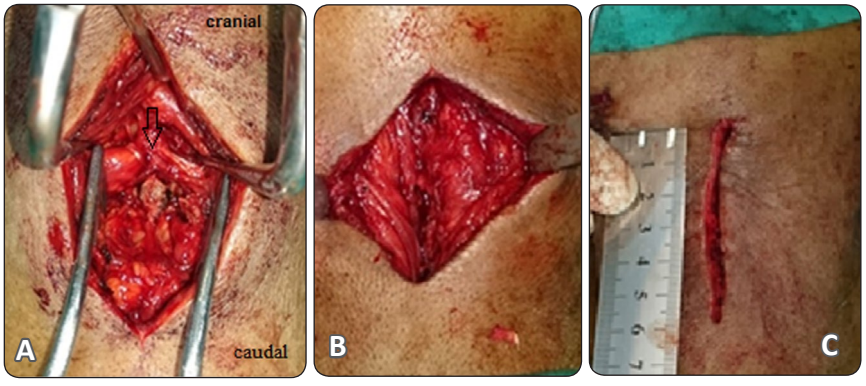
Scores	Pre-OP (Mean±SD)	Post-Op (Mean±SD) 6 months	P
JOA score	8.9±0.96(8-11)	13.4±1.9(10-16)	<0.0001*
CCI score	20.4±11.5(3-37)	22±11.5(3-40)	0.66
Neck VAS	2.1±0.7(1-3)	2±0.8(1-3)	0.67
Brachialgia VAS	3.4±1.6(1-6)	1.5±0.5(1-2)	<0.001*

Mann Whitney U-test: for non-normal distributed quantitative data
* Significant if P<0.05
JOA score: Japanese Orthopaedic Association score, **CCI** Ishihara cervical curvature index.

Table 3. Factors Affecting the Recovery Rate

JOA Recovery rate %	Factors	R	P
	Age	-0.43	0.054
	Sex (female > male)	0.25	0.18
	Pre JOA Score	-0.18	0.26
	No. of Levels	-0.78	0.0003
	Post CCI Score	0.62	0.0068

Spearman Correlation, for categorical and non-normal distributed quantitative data
Significant if P<0.05
r=0–0.2: very low and probably meaningless
r=0.2–0.4: a low correlation
r=0.4–0.6: a reasonable correlation
r=0.6–0.8: a high correlation
r=0.8–1.0: a very high correlation



Figures 1.
Intraoperative photograph: (A) the arrow show the spinous process with attached muscles before splitting, the area caudal to the arrow shows already split spinous process. (B) muscles looks coapted before closure at the end of the surgery. (C) the length of incision was about 6 cm to decompress 3 levels

Figures 2. (A) Preoperative lateral radiograph of 68-year-old man shows lordotic cervical curvature (CCI=34). (B) Preoperative T2-weighted sagittal MRI cervical spine with multilevel canal stenosis from both posterior and anterior. (C) 6 months postoperative lateral radiograph shows 4 levels laminectomy with preserved spinous processes (arrow) and same preoperative CCI. (D) 6 months postoperative T2-weighted sagittal MRI shows successful decompression of the spinal cord. (E) and (F) clinical photos for the patient at the first postoperative day with good active flexion and extension movement.

Discussion

Laminectomy has historically been the traditional surgical approach for multilevel cervical stenosis. However, the high rate of post laminectomy kyphosis, instability and consequently delayed neurological deficit urged other options to take the surgical choice priority as laminoplasty, laminectomy with fusion and anterior surgery.[1,7,15]

Many laminoplasty techniques have been developed to decrease postoperative kyphosis. Nevertheless, some studies have reported postoperative kyphosis after laminoplasty. Matsunaga et al,[13] reported development of post-operative kyphosis in 7% after laminoplasty compared to 34% after laminectomy. After 1 year follow up of cervical laminoplasty for OPLL, Lee et al,[11] found that thirty five out of fifty patients (70%) had kyphotic changes, and fifteen (30%) had lordotic changes, however, these kyphotic changes were not significantly associated with clinical outcomes. To limit postoperative kyphosis after laminoplasty, Ellwitz et al,[8] advised plate stabilization and meticulous preservation of the interspinous ligaments.

Shirashi et al,[17] was the first to describe the approach of spinous process splitting calling it skip laminectomy as an alternative to open door laminoplasty. Reviewing the literature; there is a widely accepted concept that care should be taken not to disrupt the muscular attachments to C2 spinous process during posterior approach for conventional laminectomy. Such disruption could lead to increased risk of C2-C3 kyphosis. If this is not possible, the C2 spinous process with its muscular attachments should be splitted, detached then reinserted at the end of the surgery.[12,15]

In the current study; the key surgical aim of the approach was to generalize the concept of muscular attachments preservation for all cervical vertebrae not only for C2 spinous process. Cervical muscles and ligaments have a major role in cervical spine stability. The extensor muscles are considered as dynamic stabilizer, while the posterior ligaments act as tension band or static stabilizers. These static stabilizers include the nuchal ligament, interspinous ligament, ligamentum flavum, and the facet joint capsules.[16] Preservation of as much stabilizers as possible may preclude postoperative spinal instability and axial pain.[14]

In this study; spinous processes were split with its muscular attachments and the interspinous ligaments and facet joint capsules were preserved, with no cases of postoperative instability, or newly developed axial pain. Shirashi et al,[17] in 2013 compared the spinous process splitting with open door laminoplasty. The CCI showed no significant difference between preoperative and postoperative, whereas postoperative CCI was significantly smaller than that of preoperative one after open door laminoplasty.

In the current study; no cases of postoperative CCI deterioration, otherwise 6 month CCI was improved in 66.6% of patients and the remaining had no change. This observation could be explained by the adequate decompression of the spinal cord that allowed painless extension with no increased posterior compression that was caused by shingling of the laminae and buckling of the ligamenta flava.

The incidence of infection after posterior cervical spine surgery was found to be around 16%. The most significant risk factors for SSI were found to be a traumatic etiology and postoperative use of a collar.[5] Wound dead space could be formed if the wound edges have not been closely approximated at all layers. This space allows blood to collect, providing an ideal medium for bacterial growth that may cause infection.[3]

In the current study; the mean postoperative blood loss via suction drains was minimal and no case had wound dehiscence. This observation could be a result of decreased dead space, tight closure aided by preservation of the interspinous ligaments, atraumatic handling of the paraspinal muscle and no use of postoperative collar.

Conclusion

The spinous process splitting cervical laminectomy allows good spinal cord decompression and preserves spine curvature and stability. This mini open approach and preservation of interspinous ligaments could play a role in wound dehiscence prevention. A larger study with long term follow up is advised for more evaluation of the long term effect of this approach on cervical stability.

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الملخص العربي

الفتح المحدود لشق الزوائد الشوكية وازالة الصفائح الخلفية فى حالات الاعتلال النخاعى العنقى الانحلالى

البيانات الخلفية :إن تشريح العضلات المصاحب للفتح الجراحى الخلفى للفقرات العنقية غالبا ما يؤدى الى ألم موضعى وهزال بالعضلات وتقييد مؤقت لحركة الرقبة. واستخدام شق الزوائد الشوكية لازالة الصفائح الخلفية مع المحافظة على العضلات يسمح بتخفيف الضغط عن الحبل الشوكى وكذلك عن مخارج الاعصاب عند الحاجة، كما أنها لا تتطلب تثبيت واندماج الفقرات وتحافظ على ثبات الفقرات العنقية.

الغرض : لتقييم تأثيرشق الزوائد الشوكية لازالة الصفائح الخلفية فى حالات الاعتلال النخاعى العنقى الانحلالى

تصميم الدراسة : دراسة مسبقة

عينة المرضى: خمسة عشر مريضا باعتلال النخاع العنقى الانحلالى: تتضمن الدراسة أحد عشر ذكرا وأربعة إناث، وكان متوسط أعمارهم عند الجراحة 66.4 ± 6.6 بمدى بين 44 و 71 عاما.

إجراءات النتائج: تم تسجيل مدة الجراحة والدم المفقود. النتائج السريرية تم تقييمها بحرز جمعية العظام اليابانية والحرز المضاهئ الابصارى. تم عمل أشعة رنين مغناطيسي بعد الجراحة بستة شهور لتقييم تخفيف الضغط. تم تقييم استقرار الفقرات و مؤشر التقوس بالصور الشعاعية العادية العنقية.

المرضى والطرق : خمسة عشر مريضا خضعوا لشق الزوائد الشوكية لازالة الصفائح الخلفية مع المحافظة على العضلات.

النتائج : لم تسجل اى حالة تفزر جرح. فى خلال ستة شهور حدث تحسن كبير فى حرز جمعية العظام اليابانية والحرز المضاهئ الابصارى بالنسبة لألم العضد، وكان متوسط معدل تعافى حرز جعية العظام اليابانية 56.2 %. لم يحدث تحدب او عدم استقرار بعد الجرحة، كما تحسن مؤشر ايشيهارا المعدل للتقوس العنقى فى 66.6 % من المرضى. لم تسجل حالات تدهور عصبى خلال فترة المتابعة. لم تحدث حالات ألم محورى جديد. وكشفت أشعة الرنين المغناطيسي عن تخفيف الضغط عن الحبل الشوكى بصورة مناسبة.

الاستنتاج: شق الزوائد الشوكية لازالة الصفائح الخلفية يسمح بتخفيف الضغط عن الحبل الشوكى بصورة جيدة كما يحافظ على استقرار الفقرات العنقية. الفتح المحدود والمحافظة على الاربطة البين الشوكية يمكنه منع تفزر الجرح.