Original Article

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Clinical and Radiological Evaluation of Cervical Spondylotic Myelopathy Operated With Posterior Decompression and Lateral Mass Fixation- a Retrospective Review with Minimum Two Years Follow-Up

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Abstract

Objective: There is controversy in surgical management of cervical spondylotic myelopathy (CSM); a few group encourage only laminectomy or laminoplasty while the others emphasize on lateral mass fixation along with laminectomy. Cervical lordosis is an important factor for maintaining posture neck and preventing postoperative axial neck pain. Literature has reported that cervical lordosis less than -20 degrees is often responsible for neck pain. The purpose of this study was to evaluate clinical outcome and radiological parameters after posterior cervical laminectomy and fixation in CSM.

Material and Methods: This retrospective study included 37 patients operated with posterior cervical decompression and lateral mass screw fixation with minimum two-year follow-up. All patients were operated for CSM. All were operated by a single surgeon and followed up at six weeks, twelve weeks, six months, one year and yearly afterwards. Clinical outcome and radiological parameters were analyzed for clinical improvement [European Myelopathy Score (EMS)] and cervical lordotic angle.

Results: Average age 68±8.3 years. The cervical lordotic angle of -23.02±4.19 degrees was maintained in patients operated with lateral mass screw fixations along with laminectomy at final follow-up. The EMS and VAS score showed significant improvement postoperatively from 15.7 to 13.6 ($p<0.05$) and 8.1 to 1.5 ($p<0.05$), respectively. Three patients had postoperative C5 palsy that recovered completely within three months. Two patients expired within a few months after surgery due to acute myocardial infarction and respiratory arrest, respectively. There were three patients who had postoperative C5 palsy, which recovered completely within three months postoperatively. There was no permanent postoperative neurological deficit noticed in the series.

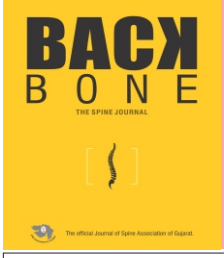
Conclusion: Posterior cervical lateral mass screw fixation for CSM gives satisfactory clinical outcome and maintains cervical lordosis. Lateral mass fixation with decompression helps preventing postoperative progressive kyphotic deformity of cervical spine after multilevel cervical laminectomy.

Keywords: Cervical Spondylotic Myelopathy; Lateral Mass Screws; Cervical Lordosis; European Myelopathy Score.

Introduction

Roy Camille introduced the art of posterior cervical fixation [1]. Over the last four decades, this technique has seen a lot of development and controversies due anatomic structures of cervical spine [2]. The initial methods of posterior cervical fixations involved the use of wires around the spinous process, which was reported to have proven long-term effectiveness without any special skill or live x-ray monitoring [3-5]. The need for lateral mass fixation arose especially in patients with severe osteoporosis [6-8]. Multilevel cervical laminectomy with lateral mass fixation is now accepted as one of the standard procedure for cervical spondylotic myelopathy [9-12]. Hamdan et al. noted that combing posterior decompression with lateral mass screw- rod in patients with CSM was effective in improving or at least maintaining cervical alignment with the good functional outcome [12]. However, controversy still exists where a few groups encourage only laminectomy or laminoplasty without fixation [13-19].

It has been widely reported that gradual loss of cervical lordosis is a frequent cause of postoperative axial neck pain after cervical laminectomy [20]. Though little literature is available to know the exact cervical lordotic angle in people with different ethnicity, maintenance of cervical lordosis of more than 20 degrees has been shown to reduce cervical symptoms [20]. In a few recent studies, obliteration of cervical lordosis



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and development of cervical kyphosis after cervical laminectomy was found in up to 47 percent patients which can be associated with postoperative axial neck pain [15-19]. However, little information is available on clinical outcome and maintenance of cervical lordosis after laminectomy and lateral mass fixation.

In this study we have reviewed and analyzed the surgical outcome of 37 consecutive cases of cervical spondylotic myelopathy (CSM) that were treated with cervical laminectomy and lateral mass fusion. The patients were analyzed for postoperative functional and clinical outcome, postoperative cervical lordosis and complications.

Material and Methods

This retrospective analytical study has been conducted in 37 patients operated for CSM. All patients underwent multilevel posterior cervical laminectomy and lateral mass screw fixation (Fig. 1 A-D). Hospital ethics committee approved the purpose and methods of study. Data was analyzed for clinical and functional outcome using EMS (European Myelopathy Score) [21], VAS (Visual Analogue Score), postoperative cervical lordosis and complications.

The single surgeon after taking written and informed consent of the procedure performed all surgeries. All procedures were performed under general anesthesia with image intensifier (IITV) guidance. Intraoperative neuromonitoring (IONM) was implemented in all patients to monitor spinal cord signals and thus reducing the risk of neurological injury. After subperiosteal dissection in prone position, the lateral masses of cervical spine were exposed. The lateral mass of the respective vertebra was divided into four quadrants as reported by Pait et al [22]. The entry point of screw was identified 1-2 mm medial and inferior to the midpoint of the lateral mass and angled 20-25 degrees superior and laterally (Fig. 2 A). This was done to prevent injury to the vertebral artery and spinal cord. After marking the entry point, high-speed electrical 3 mm burr was used with to and fro movement followed by 3.2 mm tap to create passage for the 3.5 mm screws (Fig. 2 B). Lateral mass screws were then inserted on both the sides of the vertebra using free-hand technique (Fig. 2 C)[23]. One side was fixed with a rod correcting or maintaining cervical lordotic angle around 20-30 degrees (Fig. 2 D). Following the fixation on one side, laminectomy and decompression was performed. Similar lordotic curve was given to the second rod and fixation completed (Fig. 2 E-F). Posterolateral fusion with bone graft was done before the closure of the wound.

The cervical lordotic angle was measured using the posterior tangent method from C2 to C7 vertebra on 37 lateral cervical X-rays (Fig. 3 A-B) [20, 24]. Each X-ray was measured three times and average value was taken. The data of 37 X-rays was then compiled and average with standard deviations attained.

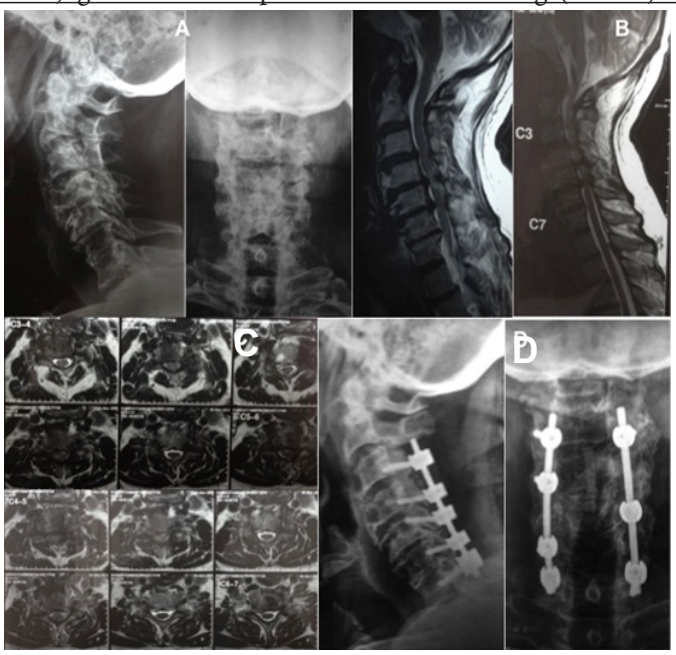

Figure 1: Male patient aged 79 years with cervical spondylotic myelopathy. (A) preoperative plain AP and lateral view x-rays (B) preoperative MRI had abnormal T2-weighted signal in the spinal cord at level of C4–C5 disc on sagittal image (C) preoperative MRI shows multilevel cervical steosis from C3-C6 levels on axial images and (D) postoperative plain AP and lateral view x-rays view showing laminectomy and fixation.

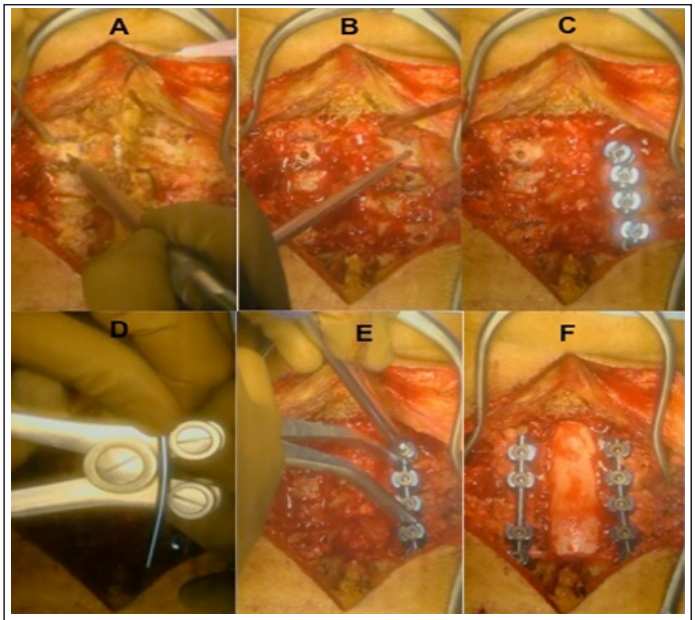

Figure 2: Shows steps of surgery. (A) entry point taken with burr 1-2 mm medial to the center of the lateral mass (B) serial tapping of entry holes created with burr in to lateral mass (C) insertion of lateral mass polyaxial screws (D) rod-contouring for 20-30 degree lordosis (E) rod-screw fixation with application of minimal distraction to achieve lordosis and (F) final decompression of cord with bilateral lateral mass screw fixation.

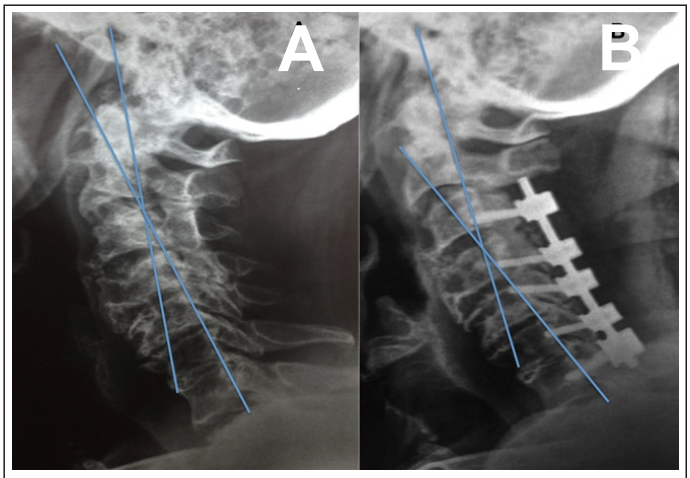

Figure 3: Shows measurement of cervical lordosis using posterior tangent line thorugh the posterior body of C2 and C7 in (A) preoperative 16 dgrees which improved (B) postoperatively to 22 degrees on cervical lateral x-rays.

All lordosis angles were compared with preoperative angles to see any significant changes using paired t-test.

During the postoperative period, the patients were assessed and managed for any complications, improvement in EMS score, C5 pain and dressings. Physiotherapy programs were also carried in the postoperative stage. All patients were followed up clinically and radiologically at six weeks, twelve weeks, six months, one year and then yearly. All data were compared using paired t-test and level of significance was kept below p value 0.05.

Results

There were 28 males and 9 females with an average age of 68±8.3 years were included in this study. All patients were operated by multilevel posterior cervical laminectomy and lateral mass fixation. Screws of 14-16 mm length and 3.5 mm width were used for fixation. There were twelve and twenty patients who underwent fixation from C2-C7 and C3-C7, respectively (Table 1).

Preoperative cervical lordotic angle was 14.1±3.1 degrees, which was significantly improved postoperatively to 23±4.2 degrees (paired t-test, $p<0.05$) and maintained at final follow-up (Fig. 3 A-B). The EMS score showed significant improvement from preoperative score of 15.7 to postoperative score of 13.6 (paired t-test, $p<0.05$) (Table 1). The VAS score also showed significant improvement from preoperative score of 8.1 to postoperative score of 1.5 (paired t-test, $p<0.05$), which showed there was significant reduction of postoperative neck pain (Fig. 3). Postoperative stiffness of neck was also improved with time in most patients.

The average hospital stay was 5.4±1.3 days. The patients were admitted on the first day and underwent preoperative evaluation. The surgery was performed on the second day. Third to fifth days were usually meant for post-operative rehabilitation and mobilization. Postoperatively all patients were encouraged to stand or walk as much as possible along with limb strengthening physiotherapy.

Table 1. Demographics of the patient population under study.

Total Number of patients	37
Males	28
Females	9
Average age	68±8.3 years
Fixation C2-C7	12
Fixation C3-C7	25
Cervical lordosis Pre-Operative	14.10±3.08 degrees
Cervical lordosis Post-Operative	23.02±4.19 degrees ($p<0.05$)
EMS Pre-Operative	13.60±0.80
EMS Post-Operative	15.70±1.20 ($p<0.05$)
VAS Pre-Operative	8.1±1.50
VAS Post-Operative	1.5±0.80 ($p<0.05$)
Average Follow-up period	36.6±9.2 months

Table 2. Intra- and post-operative complications encountered in patients with posterior fixation of cervical spine after laminectomy.

Complications Encountered	Number (n=37)	Percentage
Injury to Nerve Roots Secondary to Screw	0	0
Damage to Vertebral Artery	0	0
Dural Tear and CSF leak	0	0
C5 nerve root pain (>2 VAS score)	3	8.1
Screw loosening and pullout	0	0
Wound Infection	0	0
Respiratory Arrest	1	2.7
Cardiac Arrest	1	2.7
DVT	0	0
Total	5	13.5

There was no intraoperative injury to vertebral artery, nerve root damage or dural tear. However, three patients had postoperative C5 palsy with severe pain in shoulder and arm with weakness in shoulder abduction (Table 2). All symptoms resolved and weakness improved within three months of surgery after physiotherapy. None of them required a revision procedure. No patient experienced a pull out or breakage of implants. Two patients expired during perioperative period. One had acute myocardial infarction after two months of surgery. Though he had recovered neurologically, his co-morbidities of diabetes and hypertension further deteriorated his condition. Another patient expired following respiratory arrest and kidney dysfunction due to ongoing treatment for multi drug resistant pulmonary infection. He had significant neurological improvement postoperatively and started walking with stick from second postoperative day. However, his respiratory condition deteriorated after five days of surgery with development of consolidation patch in right lung that decreased his oxygen saturation. The cause of sudden deterioration was due to rupture of one of the bulla in the lung. He was immediately shifted to ventilator and maintained;

however, due to history of multi-drug resistant pulmonary infection, his condition further deteriorated and developed with multi-organ failure. He succumbed on ninth postoperative day with development of cardiorespiratory arrest and acute renal shut down.

Discussion

Maintenance of alignment and adequate decompression are the most important factors in achieving good clinical outcome as micro motion in degenerated cervical spine can lead to continuous irritation of the already compromised cord and can cause progression of neurological injury [25, 26]. Lateral mass screw fixation has been considered an effective technique for stabilizing and maintaining cervical spine alignment after cervical laminectomy [27-29]. There are various schools of thoughts for lateral mass screw fixations and decompression in literature. A few groups encourage fixation with decompression while others lay emphasis on laminectomy or laminoplasty without fixation. Our study has demonstrated efficacy and effectiveness of lateral mass screw fixation as none of our patient had postoperative cervical kyphosis or worsening neurology and postoperative axial neck pain significantly.

As per studies published in literature, approximately 46 percent patients can develop postoperative cervical kyphosis after laminectomy without fixation over a period of time [13, 15, 18, 30]. McAviney et al. have shown that patients who has preoperative cervical lordosis of less than 20 degrees have higher cervicogenic symptoms due to gradual loss of cervical lordosis or development of cervical kyphosis in future [20]. Kumar et al. noted that cervical laminectomy with posterior fusion/fixation is useful in the treatment of patients with CSM with straight or lordotic spines and multilevel compression. It addresses the dynamic and compressive forces that are important in the pathogenesis of CSM, resulting in minimal complications and possible improvement in long-term outcomes [31]. In our study, we have shown that preoperative cervical lordosis was 14 degrees (i.e. less than 20 degrees) that may be the cause of postoperative severe neck symptoms in follow-up. With posterior cervical approach, using lateral mass fixation we have achieved significant correction or maintenance of cervical lordosis to 23 degrees and none of our patients had significant neck symptoms for at least two-year follow-up. Significant improvement in postoperative EMS score also adds to the benefit of surgery (Fig. 3). This proves the effectiveness of fixation along with decompression procedures. An important finding in all operated patients was that there was no worsening of neurology or progressive cervical kyphosis. The cervical lordosis in our patients was maintained more than 20 degrees, which was thus considered to be an important factor in reducing cervical symptoms [20].

Currently, laminoplasty and laminectomy are the methods of decompression employed to reduce cervical spinal cord stenosis. Laminoplasty has been a preferred method especially in relation with cervical kyphosis. However, long-term effectiveness of laminoplasty in achieving the desired outcome is a major concern due to higher rate of restenosis causing cord compression. A study conducted by Wafa et al. reports significant improvement in VAS after laminectomy. However, the results after laminoplasty were not significant [2]. Moreover, it was seen that fusion might be needed in patients with preexisting cervical kyphosis. Since decompression alone creates instability in the cervical spine, this leads to micromotion at each level. This micromotion may lead to gradual development of cervical kyphosis and cervicogenic neck pain. There is also a theoretical possibility of additional spinal cord injury following such an event. Here, we report a unique study of decompression and posterior fixation of cervical spine where besides significant improvement in the European Myelopathy Score, there was preservation of cervical lordosis and reduction of pain.

A review by Anderson et al in 2009 had concluded that laminectomy with fusion (arthrodesis) is an effective strategy to improve functional outcomes in chronic spondylotic myelopathy and ossified posterior longitudinal ligament [32]. However, little information is available on the amount of maintained cervical lordosis. Ours is a first kind of study that showed significant improvement in EMS score and prevention of deterioration of pain and cervicogenic symptoms with a lordotic angle of more than 20 degrees. We believe that in cervical spondylotic myelopathy, laminectomy with posterior fixation not only improves neurological symptoms, it also reduces postoperative cervicogenic symptoms [33].

Barbarawi et al. also found the lateral mass screw fixation a safe and efficient technique [34]. In accordance with our study, they also found no neural or vascular injury as a result of screw position. However, repositioning of screw was needed in 0.9 percent of their study group. However, we feel that using free-hand technique as described by Eldin et al. none of our patients required revision surgeries [23]. In a study by Barbarawi et al. showed 13.6 percent of the patients with C5 pain in postoperative period in contrast to 8.5 percent in our study. They had 5.4 percent patients with superficial wound infections and zero mortality rates. None of our patients had any kind of wound infections but 2 of them diseased due to pre-existing co-morbidities. However, postoperative lordotic angle was not calculated in the study conducted by Barbarawi et al [34]. Our data emphasize that an angle of more than 20 degrees as an important factor to reduce cervicogenic symptoms.

There are a few limitations encountered in this study, however, the benefits outnumber the limitations. Patients had decreased neck movement after fixation of cervical spine. However, they

did not have any problem in daily activities. This was due to the neck mobility permitted between occiput to C1 and C1- C2. Additionally none of our patients developed any complications related with adjacent level degeneration or myelopathy. We also agree that this is a retrospective study without any controls group involving only decompression surgeries. However, literature published by others has shown development of cervical kyphosis after laminectomy or laminoplasty of cervical spine without instrumentation and fusion [15-17]. Therefore, we believe that our study will focus the effectiveness of decompression and lateral mass fixation in patients with cervical spondylotic myelopathy in future.

Though there are still controversial beliefs in the mode of treatment of cervical spondylotic myelopathy, posterior decompression and lateral mass screw fixation seems to be the recommended procedure. According to Komotar et al. when indications permit, a multilevel laminectomy is an effective and safe method of neural element decompression. Recognizing the potential for spinal instability is essential to prevent neurologic compromise and intractable axial neck pain caused by deformity progression [35]. This not only relieves the patients of CSM symptoms but also provides long-term stability and prevents progressive cervical kyphosis. Moreover, in comparison with other fixation techniques, lateral mass fixation is safer, has higher success rates and low co-morbidities. The newer poly-axial screw rod systems are also more constrained and essentially avoid screw pullout.

Conclusion

We report that decompressive cervical laminectomy with lateral mass fixation is a safe and reliable technique for posterior stabilization of cervical spine in patients with CSM. Satisfactory results can be achieved with a long-term follow up of the patients. The incidence of neurovascular complications is low and avoidable. Moreover, maintenance of cervical lordosis and prevention of degenerative progressive kyphosis can prevent after fixation following laminectomy.

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