Original Article

Posterior Cervical Arthrodesis by Lateral Mass Screws Fixation – A Long term Follow-up Study

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ABSTRACT

Aim: Posterior cervical arthrodesis using lateral mass fixation by screws and rods is a very well known technique which has gained much popularity in the last two decades. We present here clinical results of 27 patients who were operated for cervical instability of different etiologies by lateral mass fixation at our institution. Results with long term follow up were analyzed.

Materials and Methods : All the patients admitted with cervical spine instability and having indication for posterior stabilization were subjects of the study. A total of 27 cases were operated during February 2010 to January 2015. A standard posterior lateral mass screw fixation and or pedicle screw fixations were done according to the requirement. Results were analyzed during regular followup which ranged from 6 months to 2 years.

Results: Neurologic improvement to the extent of self ambulation was seen in 8 of the 14 patients with traumatic quadriparesis. All patients in the non trauma group showed good clinical improvement. There were 6 deaths in this series in the peri-operative period, not related to the surgical procedure but due to the attendant medical problems. Good fusion was achieved in all the cases at the end of 3 months. There was no evidence of hard ware failure at the end of 2 year follow-up.

Conclusion: This study concludes a good clinical improvement and stable construct with good fusion during the log term follow up. This procedure has several advantages over traditional wiring techniques. Over all it is very safe and efficacious procedure in the hands of an experienced surgeon.

Keywords: Lateral mass fixation, posterior cervical arthrodesis, neurovascular relation

INTRODUCTION

Posterior cervical spine arthrodesis by lateral mass fixation is a popular method for the past three decades [1, 2] Initial attempts at posterior cervical fixation by spinous process wiring was done by Harda in 1891. This system was modified by figure of eight wiring by Roger in 1942 and then by Bohlman with triple wiring technique. In 1980s Roycamille introduced the technique of lateral mass fixation of cervical spine. Later Grob and Magerel modified the drilling trajectory of lateral mass of cervical spine in a divergent orientation. Since then lateral mass fixation by plates and screws has become the most popular technique for treating cervical spine instability by posterior approach of various etiologies. [2, 3]

MATERIALS AND METHODS

During February 2010 to January 2015 a total of 27 patients were operated by lateral mass fixation for cervical spine instability of different etiologies. 20 patients had cervical trauma, 5 had atlanto axial instability and 2 cases of cervical degenerative pathology were included in this study. There were 21 males and 8 female patients with age group ranging from 11- 54 years and a mean of Neurological examination showed total loss of neuronal function below the level of the lesion in 7 patients presented following trauma, Grade 2-3/5 power in 7 patients and 6 patients were neurologically intact. At admission all the patients were evaluated by plain X-ray cervical spine AP and lateral views. In few patients CT cervical spine was done. All the patients have undergone MRI examination with a standard protocol. All the patients presented following trauma had locked facet dislocations of which 8 were bilateral and 4 were unilateral. All patients with locked facets and with atlanto-axial dislocations were put on cervical traction

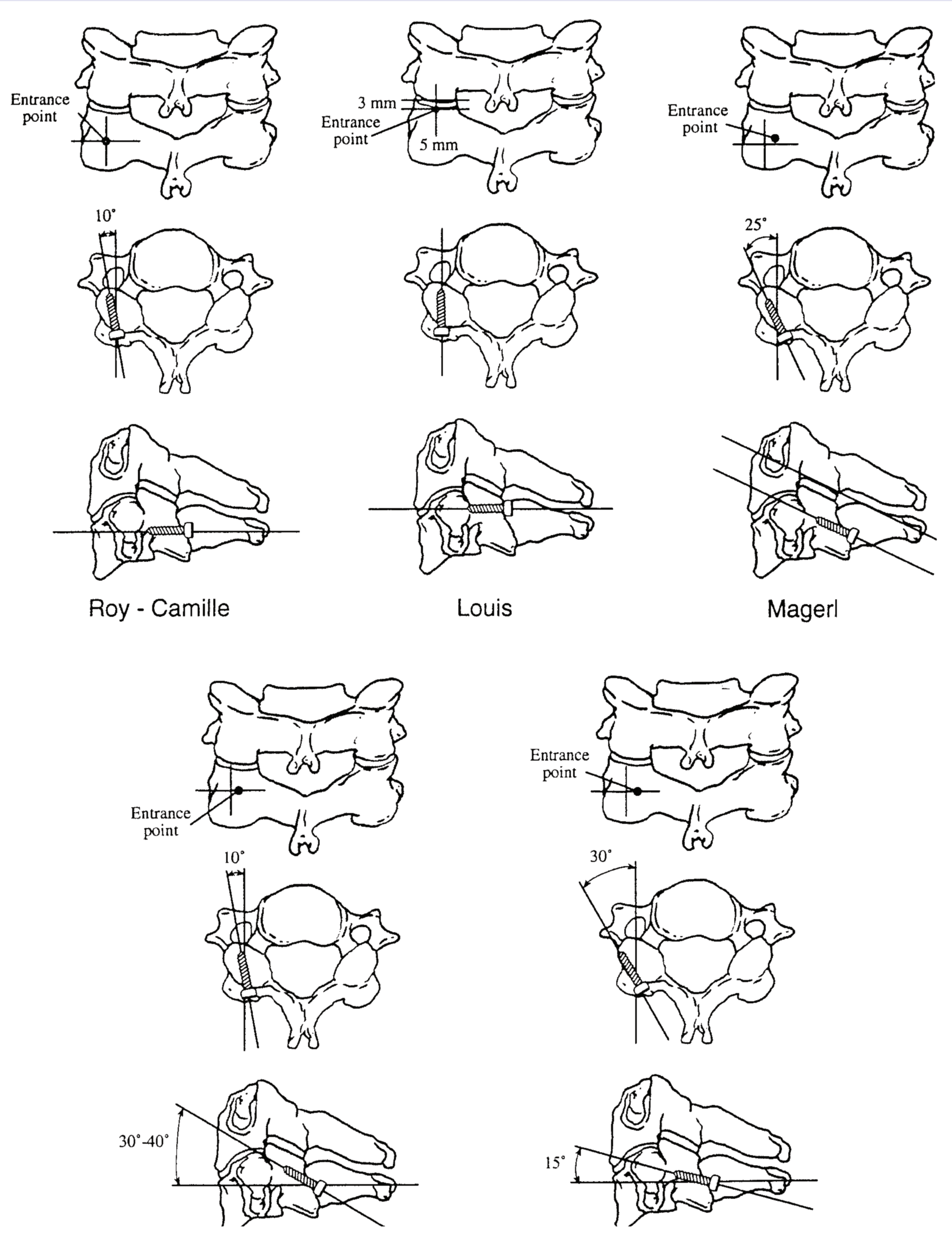

Figure 1: Various techniques for lateral mass screw

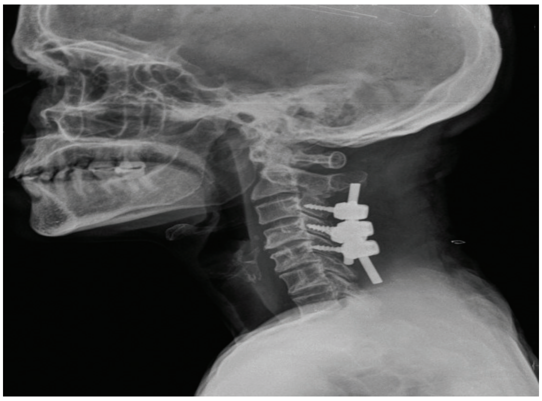

Figure 2: a) Showing lateral mass screws fixation of C3, C4, C5

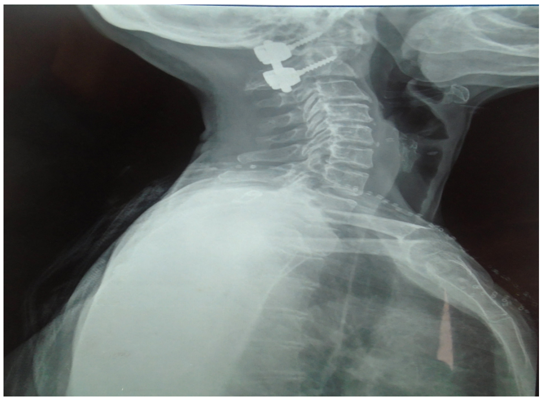

Figure 2: b) Showing lateral mass screws fixation of C1 & C2

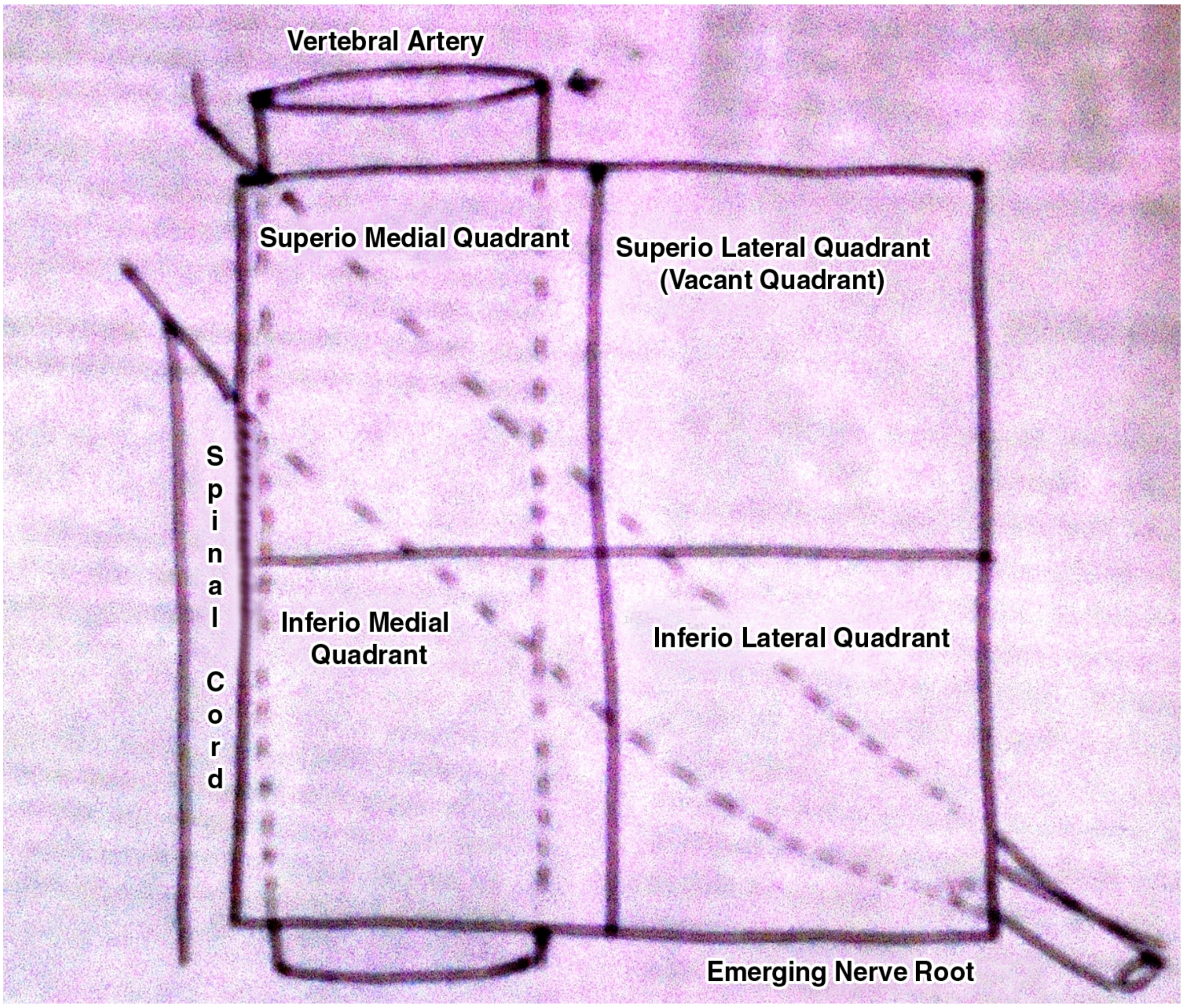

Figure 3: Lateral mass quadrants and anatomical relations of neurovascular structures

pre-operatively. Acceptable reduction was achieved in 11 patients and in rest open reduction was tried on the table during surgery. In patients with atlanto axial dislocations, lateral mass screws were placed in to the atlas and pedicle screws were placed in to the axis vertebra to achieve fixation. Similarly in one case of cervico-thorasic junction instability pedicle screws were placed in to C7 and T1 along with lateral mass screws in to C6. Majority of the traumatic dislocations were found at C5-C6 (10 Cases) followed by C4-C5 in 7 cases and C6 over C7 in 3 cases. In 2 cases where the lateral mass was involved in fracture the adjacent level lateral mass was taken for fixation. For majority of the cases two level fixation was done and for cervical spondylotic myelopathy three level fixation was done.

Surgical technique

All the patients were operated in prone position with head in neutral position maintaining slight flexion with skull traction in situ. Vertical midline skin incision is given and dissection deepened by retracting the paraspinal muscles exposing the cervical lamina and the whole extent of the lateral mass laterally. For locked facets which could not be reduced preoperatively we try to manipulate the facets and achieve the reduction under vision.

Once reduction is achieved we maintain the neutral position of the head and lateral masses are prepared for screw placement. The entry point in to the lateral mass was 1mm medial to the centre of the lateral mass. We drill the bone from the entry point vertically and perpendicular to the surface of the lateral mass for about 2-3 mm and then redirect the drill superiolaterally at an angle of 15-20 degrees till we penetrate the opposite cortex.

This technique will avoid the breakage of the cortex at the entry point. The superiolateral trajectory can be easily achieved by resting the drill against the lower spinous process which is immediately below. Once drilling is done, we will tap the track and a screw is threaded in to the track. Normally 12-14 mm poly axial screw of 3.5 mm diameter will suffice in most of the cases to get a good bony purchase. Once all the screws are placed in position we open the facet joint, thoroughly decorticate the articulate surfaces and pack small pieces of bone chips retrieved from the excised spinous process.

Finally we tighten the rods in neutral position maintaining the reduction. We use fluoroscopic check at the end of the procedure to look for the alignment of the screws and reduction achieved or not. (Figure-2) For atlas we select the entry point after retracting the C2 nerve root below and down which will expose the lateral mass of atlas as well as atlanto axial joint. The entry point is from the middle of the lateral mass below the posterior arch of atlas and drill is directed 15 degrees medially with little cranial orientation. Here we don't try to penetrate the opposite cortex in view of risking the carotid or hypoglossal nerve.

The screw size for atlas is 18-24mm length with 3.5mm width depending on the selection of entry point. (Figure-1) All the patients were immobilized in a hard cervical collar post-operatively and we routinely perform neurological examination in the immediate post operative period to check for any neurological deterioration. Follow-up examination and x-rays were taken at discharge, at 3m, 6m and at 1year follow-up to asses the standard of bony fusion achieved and for any hardware failure.

RESULTS

A total of 82 screws were placed in to the lateral masses of the cervical vertebra excluding C2 and C7 where pedicle screws were placed to achieve fixation. Immediate follow-up x-ray in all the cases and CT scans were done for few patients in the immediate post operative period to confirm reduction achievement and all the patients were immobilized in a hard cervical collar for three weeks.

There were 6 deaths in this series in the pre operative period, not related to the surgical procedure but due to the attendant medical problems. All deaths happened in trauma cases with profound neurological involvement with compromised respiratory function in the pre operative period. No deaths were observed in any of the elective surgeries.

Neurological improvement was seen in 8 out of 14 cases of trauma at the end of 3m to the extent of self-ambulation. All the patients in the non traumatic group (7 patients) showed good clinical improvement. All the patients were followed at regular intervals of 3 weeks and at 3 months later on for a period of 2 years to asses the maintenance of reduction and achievement of solid fusion at the site. There were no immediate complications related to the procedure. There was no evidence of neurovascular injury either during the procedure or immediately following the surgery.

There was CSF leak in one case of badly traumatized cord injury during the procedure. This was managed conservatively in the post-operative period and he responded well. There was no complication post operatively related to the hardware in the form of screw pull-out or breakage of the screw. Good fusion was achieved in all the cases at the end of 3 months. There was no evidence of hard ware failure at the end of 2 year follow-up.

DISCUSSION

The anatomy of cervical lateral mass has been described by Roy-Camillie et al and Ebraheim et al. The area of lateral mass is the part lateral to the lamina and between the inferior margins of adjacent inferior facets. The superior, inferior diameters of the lateral mass range from 11-15 mm from C3 down to C6 and the thickness varies between 11-13mm. [5, 6] Anatomical relations between the screw trajectories and neuro vascular structures.

Lateral mass is solid quadrangular piece of bone roughly measuring about 10mm in thickness. Among the previously mentioned techniques Roy Camille and Magerl techniques are the leading techniques of posterior plating of cervical spine. [7, 8] If the lateral mass is divided in to 4 quadrants the supero medial and inferomedial quadrants immediately overlie the vertebral artery. The infero-lateral quadrant over lie the exiting nerve root which is coursing obliquely behind the lateral mass. [8, 9] The supero lateral quadrant is devoid of any neuro-vascular structure and ideally suits the screw placement. (Figure-3)

The Roy Camille technique employs placement of screw from the centre of lateral mass in a perpendicular manner and angled 10 degrees lateral in transverse plane. Magerl technique involves placing the entry point 1-2mm medial to the centre of the lateral mass and directing the screw in a superior-lateral manner about 25 degrees laterally and parallel to superior articular surface in to the superior-lateral quadrant which is devoid any neuro-vascular structures behind.

Hence this technique of screw placement requires little longer size in view of the oblique trajectory and offers better strength to the construct. [10, 11] Anderson et al modified Magerl technique. They recommended that the starting pointfor screw insertion be 1mm medial to the center of the lateral mass and direction be 30-40 degreescephalad (parallel to facet joint) and 10 degrees lateral. Lateral mass fixation increases segmental stability in flexion by 92% and in extension by 60% where as spinous process wiring improves stability in flexion by 33% but fails to prove stability in extension.[11] In our experience also they have prooven safe and effective.

Complications related to the insertion of lateral mass screws are generally limited to injury to neuro vascular structures. [12] Heller et al predicted a maximum of 3.6% incidence of nerve root injury with screw placement by using Roy Camille and Magerl technique. In oue series there were no complications related to neuro vascular structures.

CONCLUSION

This study reviews a clinical series of 27 patients operated by lateral mass fixation with poly axial screws and rods for cervical instability of different etiologies with good long term results and very less morbidity. This procedure has several advantages over traditional wiring techniques. This procedure can be performed in the absence of posterior elements; no violation of spinal canal, good anatomical reduction is possible by slight manipulation of the screws, can be performed at multiple levels and is an excellent technique for atlanto-axial arthrodesis also. How ever a sound anatomical knowledge of lateral mass is very essential for correct placement of screws and to avoid injury to the neuro vascular structures behind the lateral mass. We conclude that both Roy Camille and Magerl technique can be followed for screw placement, Magerl technique has slight advantage of avoiding the nerve root injury and a longer screw can be placed to achieve a good bony purchase. Over all it is very safe and efficacious procedure in the hands of an experienced surgeon.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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