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LOWER CERVICAL FRACTURE AND DISLOCATIONS;

NEUROLOGICAL AND RADIOGRAPHIC OUTCOME OF CERVICAL PEDICLE SCREW FIXATION, A SINGLE CENTRE 40 PATIENT EXPERIENCE.

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ABSTRACT… Objectives: The aim of our study is to determine the outcome of cervical pedicle screw fixation for fractures/dislocations of the cervical spine at our set up in Karachi, Pakistan. **Study Design:** A prospective case series. **Period**: 04 years duration from January 2013 to December 2016. **Setting:** Tertiary Care Centre in Karachi, Pakistan. **Method:** All the patients who were included in the study signed a full informed consent. The inclusion criterion was all the patients who cervical spine fracture/dislocation, presented to us within 24 hours of injury and were operated at our set up. Data was collected in a predesigned proforma which included a complete history and physical examination, age, gender, cause of injury, co morbidities, pre-operative radiological findings, past medical and surgical history. Serial X rays, MRI and CT scans were taken at 3, 6, 12 and 24 months post operatively for evaluation of stability, fusion and any complication such as deformity. The American Spinal Cord Injury Association impairment scale was utilized in all the patients at follow ups to determine the sensory and motor function improvement post operatively. Data was analyzed using IBM SPSS for windows version 21. **Results:** The study population consisted of n= 40 patients of which n= 28 were male and n= 12 were female with a mean age of 45.2 years. The various types of injuries sustained by the patients were as follows, n= 6 (15%) cases of cases had compression fractures (vertical), n=15 (37.5%) had flexion rotation injury and n=19 (47.5%) had flexion compression fractures respectively. While the division of bony injuries in the patient was as follows, n=5 (12.5%) had cervical spinal burst fracture with dislocation, n= 15 (37.5%) patients had joint facet fracture with dislocation bilaterally along with compression fracture of the vertebral body, n= 14 (35%) patients had facet joint fracture with dislocation bilaterally and n= 6 (15%) had unilateral fracture dislocation of joint facet. Complications such as injury to the vertebral artery, spinal cord, nerve root were not observed in any of the patients in this series, all the patients achieved full bony fusion at the 6 month follow up as observed on radiographic images. We also did not find any incidence of screw penetration into the pedicle, similarly no incidence of screw breakage or loosening was observed. N=24 patients with incomplete injury of the spinal cord showed improvements in their ASIA impairment scale, the patients n= 15 who had a complete spinal cord injury failed to show any improvement post operatively, but reported some decrease in pain and numbness post operatively. **Conclusion:** For fractures/dislocations of the cervical spine the cervical pedicle screw is a reliable and effective method and provides good stability and bony fusion. However the technique is dependent on surgeons experience and the extensive use of pre-operative imaging to select the best insertion site of the screws as individualized for every patient accordingly.

Key words: Cervical Spine; Dislocation; Fracture; Fixation; Pedicle Screw.

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INTRODUCTION

One of the most devastating injuries of the axial skeleton is the injury to the cervical spine and it requires a meticulous fixation of the spinal column as the neck is vulnerable to future insults and is anatomically a region of supreme importance. The features of an efficient fixation system of the spine are prompt stabilization, limited injury to the spinal cord and roots, improved bony fusion, less deformity and limited use of external fixation.[1] Procedures which utilize the posterior approach such as lamina hooks and sub laminar

wires, spinous process wiring fail to provide the appropriate stabilization of the spinal column, and they are limited in the fact that they can only be applied on an intact lamina.[2,3,4] In case of fractured lamina or the need for laminectomy for decompression of the spine, extended fixation along with bone grafts are done. Some authors believed that the lateral mass screw system provided good outcomes, but the pull out strength of this system is limited as it is an exclusive posterior column fixation. Patients being treated with this technique also require external immobilization (halo vest or other such apparatus) to secure the fusion of bone and it is also limited by the fact that this procedure cannot be used in diseased and weaken bone such as in osteoporosis.[5,6,7,8] The pedicle screw fixation system was introduced in the year 1994 by Abumi et al for fixation of the traumatic lesions involving the spinal column.[9] The cervical pedicle screw system consists of three column system for fixation and has multitude of biomechanical benefits for the stability of the cervical spine. These biomechanical advantages of the pedicle screw system provide a significantly better stability of the cervical spine as compared to other procedures such as lateral mass screw fixation and combined anterior and posterior fixation of the cervical spine. According to a study by Jhonston et al cervical pedicle screws were found to have lower rate of loosening of the screw as well as it has a stability and strength in fatigue tests, they compared cervical pedicle screw with lateral mass screws in their study.[10] These results are also supported by a study by Rhee et al, who studied the various types of fixations on cadavers, and showed that the pedicle screws provide greatest stability.[11] The aim of our study is to determine the outcome of cervical pedicle screw fixation for fractures/dislocations of the cervical spine at our set up in Karachi, Pakistan.

MATERIALS AND METHODS

The type of study is a prospective case series, conducted for a period of 4 years duration from January 2013 to December 2016, at a tertiary care centre in Karachi, Pakistan. All the patients who were included in the study signed a full informed consent to partake in the study, in case of unconscious patients the consent was obtained from next of kin. The inclusion criterion was all the patients who agreed to participate in the study, were over 18 years of age, had cervical spine fracture/dislocation, presented to us within 24 hours of injury and were operated at our set up. The exclusion criterion was all the patients who refused to participate in the study, were less than 18 years of age, presented to us after 24 hours of injury. Data was collected in a predesigned proforma which included a complete history and physical examination, age, gender, cause of injury, co morbidities, pre-operative radiological findings (all three modalities of X ray, CT scan and MRI), past medical and surgical history.

All the surgical procedures were performed under general anesthesia and the patient was placed on the operating table in a prone position with continuous traction to maintain the neutral position of the cervical spine. The incision was made in the midline posteriorly, the lateral mass and its margins were exposed after dissection of the paraspinal muscles and the relevant decompression and reduction was done as per need according to the type of fracture sustained. Screws were placed in the dorsal surface of the articular process, high speed burr was utilized to remove the cortical bone at the insertion site of the screw. Kirschner wire was placed as indicated by the pre-operative radiographs and intra operative X ray imaging. In case of laminectomy, the K wire was placed and a probe was utilized to make sure that the pedicle walls are made up of cortical bone. After that the appropriately sized pedicle screws were inserted, similarly rods were selected and placed as per the requirement and screws were tightened. Bone grafting was done on an intact lamina and in case of resected lamina, the cartilage was removed bone implants were placed (cancellous bone).

Postoperatively traction was removed and a cervical collar was put on all the patients, which remained for duration of 8 weeks. Some mobility such as sitting and walking was allowed from the first post-operative day. Serial X rays, MRI and CT scans were taken at 3, 6, 12 and 24 months post operatively for evaluation of stability,

fusion and any complication such as deformity. The American Spinal Cord Injury Association impairment scale was utilized in all the patients at follow ups to determine the sensory and motor function improvement post operatively. Data was analyzed using IBM SPSS for windows version 21. Continuous variable like age are expressed as mean and standard deviation while categorical variables like gender are given in frequency and percentage.

RESULTS

The study population consisted of n= 40 patients of which n= 28 were male and n= 12 were female with a mean age of 45.2 years with an age range between 24 and 65 years respectively. The various types of injuries sustained by the patients were as follows, n= 6 (15%) cases of cases had compression fractures (vertical), n=15 (37.5%) had flexion rotation injury and n=19 (47.5%) had flexion compression fractures respectively. While the division of bony injuries in the patient was as follows, n=5 (12.5%) had cervical spinal burst fracture with dislocation, n= 15 (37.5%) patients had joint facet fracture with dislocation bilaterally along with compression fracture of the vertebral body, n= 14 (35%) patients had facet joint fracture with dislocation bilaterally and n= 6 (15%) had unilateral fracture dislocation of joint facet. Other demographic variables of the patient population is listed in Table-I.

The patients were classified according to the American Spinal Cord Injury Association impairment scale (ASIA scale). N= 15 (37.5%) patients belonged to grade A which is a complete lack of motor and sensory function below the level of injury, n= 13 (32.5%) patients belonged to grade B which is some sensation below the level of the injury, n= 8 (20%) patients belonged to group C which is some muscle movement below the level of injury, but half of the muscles cannot move against gravity, n= 4 (10%) patients belonged to group D which is most of the muscles are spared below the level of lesion and strong enough to move against gravity, n=0 (0%) belonged to group E which is all neurologic functions are normal. Complications such as injury to the vertebral artery, spinal cord, nerve root were not observed in any of the patients in this series, all the patients achieved full bony fusion at the 6 month follow up as observed on radiographic images. We also did not find any incidence of screw penetration into the pedicle, similarly no incidence of screw breakage or loosening was observed. N=24 patients with incomplete injury of the spinal cord showed improvements in their ASIA impairment scale, the patients n= 15 who had a complete spinal cord injury failed to show any improvement post operatively, but reported some decrease in pain and numbness post operatively. The Asia impairment scale values are listed in Table-II. The Figures 1 and 2 shows the pre-operative, post-operative and at follow up radiographs and MRI scans of a patient who underwent cervical pedicle screw fixation for a C5 fracture dislocation.

Characteristic	Frequency (n=40)	Percentage
Gender		
Male	28	70%
Female	12	30%
Age in years (mean)	45.2	
Cause of cervical spine injury		
Road traffic accident	30	75%
Fall from height	6	15%
Blunt trauma	3	7.5%
Other	1	2.5%
Location of injury		
C4	2	5%
C4-5	3	7.5%
C5	15	37.5%
C5-6	7	17.5%
C6	13	32.5%

Table-I. Demographics and other variables of the patient population.

DISCUSSION

Currently the debate about the use of cervical pedicle screw fixation is on the technique utilized, Ludwig et al compared the computer assisted

Pre procedure	Frequency	Final follow up				
		A	B	C	D	E
A	15	15	0	0	0	0
B	13	0	1	0	4	8
C	8	0	0	0	1	7
D	4	0	0	0	0	4
E	0	0	0	0	0	0

Table-II. Outcome of the cervical pedicle screw fixation as measured by the American spinal cord injury association impairment scale (ASIA scale):

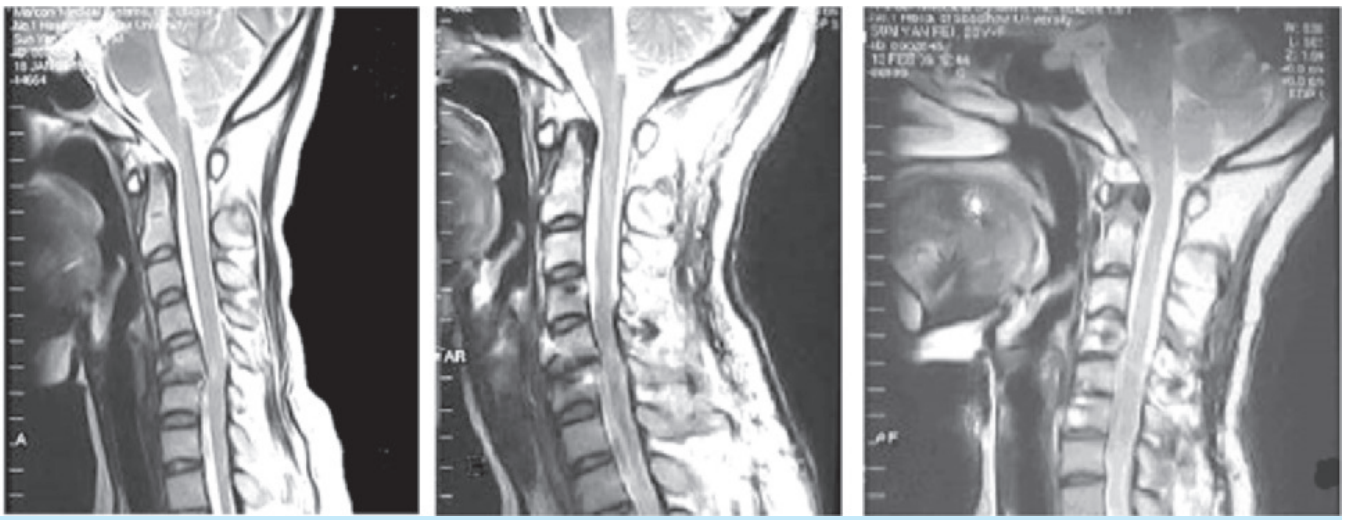

Figure-I. Pre-operative, post-operative and at follow up (at 12 months) MRI scans of a patient who underwent cervical pedicle screw fixation for a C5 fracture dislocation.

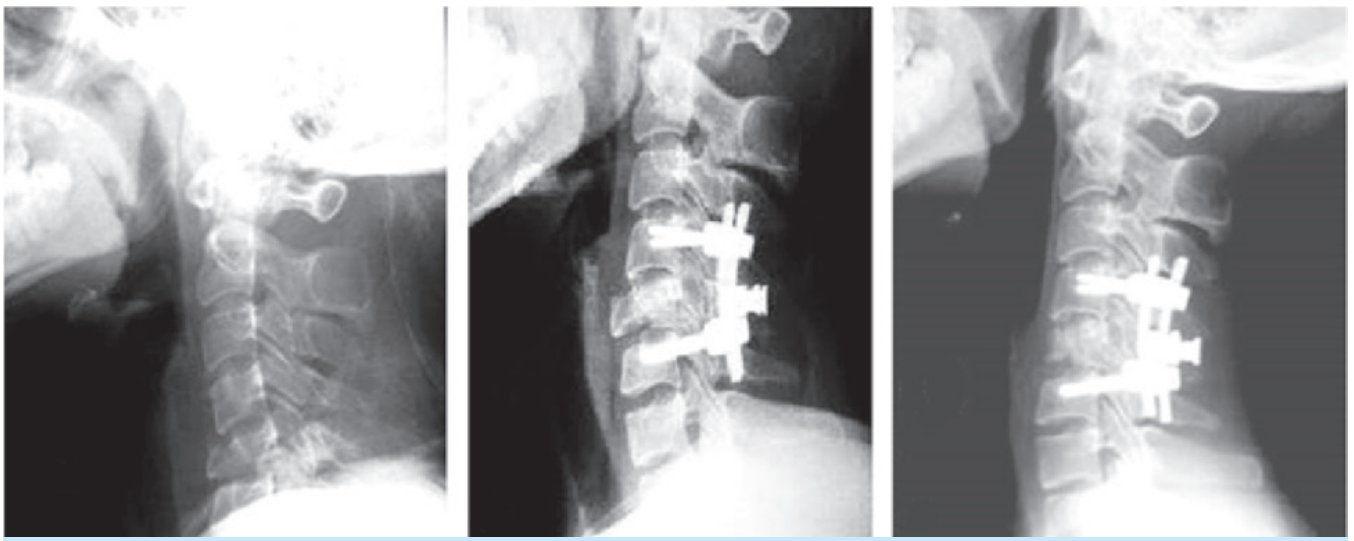

Figure 2: Pre-operative, post-operative and at follow up (at 12 months) lateral X rays of a patient who underwent cervical pedicle screw fixation for a C5 fracture dislocation.

insertion of screws with the Abumi technique, they compared the two techniques of 117 cadavers, and found no statistically significant difference in the rate of pedicle screw perforations, the values being 18% and 12% respectively.

They also observed a lower perforation rate with when a pedicle diameter of less than 4.5mm was utilized.[13] While Richter et al showed reduced rate of mal-position of the screw utilizing the computer assisted technique[14] and Mao et al showed

improved accuracy in screw positioning with a three dimensional localization device.[15] Fensky et al in their study showed that pedicle screws in the C1 spine were able to better handle toggle forces as compared with the lateral mass screws at the same level.[16] Also for complex fractures in the atlantoaxial joint the pedicle screw system provides a reliable treatment method as observed by Wang et al in their study.[17] The anatomic study done on cadavers by Liu Y at al also supports the use of pedicle screw fixation.[18] The screw insertion technique utilized in the pedicle screw fixation system depends upon the surgeon's proficiency and also the instrumentation and facilities that are available at the hospital. Also financial constraints are to be kept in mind. Especially in a third world country like Pakistan where resources are scarce, the computer assisted technique though appearing to be superior has its own fair share of complications, the increased movements during the procedure in order to explore the pedicle, increased operating duration and incorrect feedback, makes it not suitable at least for the time being in our population. Therefore we suggest that surgeons become competent in utilizing the conventional techniques. The insertion site for the screw and its trajectory should be individualized for each patient, detailed radiographic imaging post operatively can guide this process, X rays in various views such as antero-posterior, oblique and lateral views of the cervical spine and CT images are very helpful. This discrepancy in the selection of the screw insertion site exists despite there being adequate descriptions by various authors as there is no quantitative standard due to the multitude of variations in the anatomy of each individual patient governed by the gender and disease process. However as a general consensus the screw insertion point is selected to be the midpoint of the lateral mass (the right upper quadrant to be precise) in the C3 to C6 cervical spine, and in the midline of the lateral mass (inferior margin of the upper facet) in the C7 cervical spine. The angle at insertion is also an important point to consider when applying pedicle screws, a 10° cephalic tilt at the C3 and C4 level, and a similar 10° tilt but at the caudal angle at the C6 and C7 vertebra is recommended, and as for the C5 level the insertion of screw is to be done vertically. The Kirschner wire is inserted into the pedicle after due removal of the cortical bone with a drill which makes the entrance point visible, a modest resistance should be there in the Kirshchner wire as it is advanced. The major complications of this procedure if the injury to the spinal nerve roots and cord and the damage to the vertebral artery, which normally occurs at the time of insertion of the pedicle, the perforation of the pedicle screw causes these injuries and in a study of 134 patients by Yoshimoto et al they observed a perforation rate of 11.2%.[19] Another study by Abumi et al who conducted a case series of 712 screw insertions of them only 6.7% were found to have been perforated inside the pedicle, and of these perforations only three patients were reported to have neurovascular damage.[20] We did not find complications such as spinal cord or root injury, injury to the vertebral artery and these complications were not observed on follow up also, this could be due to the fact that we individualized the screw insertions for the patients accordingly. Our study has some limitations, the primary one being a low sample size, and lack of a long term follow up. We recommend further studies with large sample size and longer follow ups be conducted in Pakistan.

CONCLUSION

For fractures/dislocations of the cervical spine the cervical pedicle screw is a reliable and effective method and provides good stability and bony fusion. However the technique is dependent on surgeons experience and the extensive use of pre-operative imaging to select the best insertion site of the screws as individualized for every patient accordingly.

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