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ORIGINAL ARTICLE

Accuracy of Inserting a Pedicle Screw Percutaneously to Fix Thoracic and Lumbar Spinal Fractures by Minimally Invasive Procedures: A Prospective Observational Study

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ABSTRACT

Aim: To assess the accuracy of inserting a pedicle screw percutaneously to fix thoracic and lumbar spinal fractures by minimally invasive procedures.

Study design: Prospective observational study.

Place and duration: This study was conducted at , Pakistan Institute of Medical Sciences Islamabad, Pakistan from March 2020 to March 2021.

Methodology: A total of 50 patients were evaluated, who had suffered from spinal injuries in the form of thoracic and lumbar spine fractures and were admitted for spinal surgery. Extensive CT scans were ordered for these patients and on the basis of these scans, the clinicians authorized and assessed the positioning for the percutaneous pedicle screw. However, in cases where the scans were not enough to visualize the exact placement of the pedicle cortex, an approach known as the cortical encroachment was applied. In cases where the need for the screw to be inserted laid outside the boundaries of the pedicle cortex the clinicians utilized a method known as the frank penetration. If placement for this screw was located outside the boundaries of the pedicle these boundaries were categorized in three types. Minor: if the displacement was less than 3 millimeters, moderate: where the placement lay between 3 to 6 millimeters and severe: where the placement was greater than 6 millimeters.

Results: At total of 380 screws were fitted percutaneously in 50 patients. A total of 281(74%) of these screws were fitted inside the pedicle, 53 screws (14%) were placed in such a way that they encroached the pedicle and 46 (12%) of the cases showed that the screws penetrated the pedicle. Minor screw penetration was in 32 (8.47%) cases, moderate penetration in 10 (2.58 %) and severe penetration in 3 (0.7%) cases. Among one of severe screw penetration post-operative neurological symptoms were noted.

Conclusion: Our study concludes that most of the pedicle positioning of screws were ideally placed, while in few cases there were Encroachment and perforation

Keywords: Thoracic spine, lumber spine, spinal injury, pedicel screw

INTRODUCTION

Correcting lumber and thoracic spinal fractures is an intensive and invasive procedure where the patient is bound for a lot of recovery time (1). This created the need for a non-invasive or minimally invasive procedure to help in correcting lumber and thoracic spinal fractures in an open spinal surgery (2). This dilemma was fixed with the use of inserting screws percutaneously in the pedicle cortex or its boundaries (3). There is a need to explore the different methods of determining the accuracy of inserting a percutaneous pedicle screw. Screw misplacement may cause neurological problems, so it is important to analyze the safety, reliability & accuracy of percutaneous thoracic or lumber screw (4). Postoperative screw positioning can be determined by doing computed tomography (5). Current study is planned to assess the accuracy of inserting a pedicle screw percutaneously to fix thoracic and lumbar spinal fractures by minimally invasive procedures

METHODOLOGY

A total of 50 patients presenting with traumatic spinal injuries were included in the study. This prospective observational study was conducted at , Pakistan Institute of Medical Sciences Islamabad, Pakistan from March 2020 to March 2021. Permission was taken from the ethical review committee of the institute. To address thoracic or lumber spine fractures 50 patients had traumatic spinal injuries, who went through percutaneous placement of 380 pedicle screws. This whole process took place within the first 7 days of traumatic spinal injuries. Patients that were having fractures due to retro pulsed bony segments were not included in the study. To utilize the length, intraoperatively CT scans were obtained (6). CT scans also made possible to plan the appropriate screw diameter. To insert 3.5 and 4.5mm pedicle screw classical percutaneous technique was utilized (7).

Three expert persons (spinal surgeon & 2 senior radiologists) evaluated screw location on thin-slice scans by the first postoperative week. To detect caudal screw penetration, most superior and inferior slice of each pedicle were assessed and for bone defects cortical walls of the pedicles were examined on CT scans (8). Postoperative neurological symptoms defects were assessed in all patients. Data was analyzed by using SPSS version 22

RESULTS

The results from this study showed that 50 patients who came with spinal or thoracic fractures were fitted for percutaneous screws in the pedicle. At total of 380 screws were fitted percutaneously. A total of 281 (74%) of these screws were fitted inside the pedicle and 53 screws (14%) were placed in such a way that they encroached the pedicle. A total of 46 (12%) of the cases showed that the screws penetrated the pedicle. (As shown in table 1) According to categorization of boundaries of the pedicle it shows that there was minor screw penetration in 32 (8.47%) cases, moderate penetration for 10 cases (2.58 %) and severe penetration for 3 cases (0.7%). In three cases severe screw penetration was noted, it was observed that one case had post-operative neurological symptoms. Table 2 shows the characteristics of the study cases while the Table 3 shows the classification of screw position in the spine.

Figure 1: CT scan showing image of mild penetration (>3mm) of screw in the pedicle.

Figure 2: CT scan showing image of moderate penetration (3mm-6mm) of screw in the pedicle.

Table 1: Positioning of screws

Pedicle positioning of Screws			
	Ideally Placed	Encroachment	Perforation
Vertebral Level	Number of screws (n=281)	Number of screws (n=53)	Number of screws (n=46)
L1	35	6	5
L2	31	5	4
L3	28	4	3
L4	26	4	2
L5	11	2	2
T7	17	5	3
T8	19	5	2
T9	24	4	5
T10	27	6	7
T11	25	5	7
T12	37	7	6

Table 2: characteristics of the study cases

Number		50		
Gender	Male	30	Female	20
Age (Years)	Range	20-65	Mean	45
Mechanism of spine fracture	Accident from a car or motorbike	30 (60%)	Fall from Height	20 (40%)

Table 3: Classification of screw position in the spine

Mal-positioning of pedicle screw	
Minor	When screw trajectory was <3mm
Moderate	When screw trajectory was 3-6mm
Sever	When screw trajectory was >6mm

Table 4: The number and percentage of pedicle encroachment and penetration of inserted screws

Screw Positioning	CT Scan Images				
	Axial	Lateral	Cranial	Caudal	
Encroachment penetration	21(5.5%)	10 (2.6%)	12 (3.1%)	10 (1.8%)	53 (14%)
Miner	15 (3.9%)	5 (1.3%)	5 (1.3%)	7 (1.3%)	32 (8.47%)
Moderate	6 (1.8%)	1 (0.5%)	1 (0.7%)	2 (0.5%)	10 (2.58%)
Severe	3 (0.2%)	0	0	0	3 (0.7%)

DISCUSSION

Regarding the misplacement rates during the process of inserting the pedicle screws percutaneously in the lumbar and thoracic region, the ranges for these screws were identified as 9 to 41% as opposed to a study which showed 8-30% (9). A Study done showed that to evaluate the placement positioning of the pedicle screw it is not enough to simply utilize roentgenograms (8). Another study showed that when compared to CT scans radiographs showed 10 times less the pedicle screw violations that had occurred (10).

A similar study conducted by clinicians showed that when evaluating the screw placement of 112 patients, 98% of these patients had their screws ideally placed in the pedicle (11). This was noted by analyzing their CT scans which were taken after the procedure (12). Studies have shown that the rate for severe pedicle penetration usually falls less than 5% (13). For our study we utilized the use of CT scans to analyze where to place the 380 screws in 50 patients. A total of 281 screws were ideally placed, 14% showed encroachment. Another 12% demonstrated screw penetration; mild (8.47%). Lumbar spine has lesser incidence of screw penetration than thoracic spine, 23 % incidence of screw penetration was reported according to a

study (14). In a study there was low risk of screw misplacement which was 5.3% (15).

CONCLUSION

Our study concludes that most of the pedicle positioning of screws were ideally placed, while in few cases there were Encroachment and perforation. Performance of percutaneous pedicle screw insertion should be done only by experienced spine surgeon. Further research needs to be conducted in order to estimate and establish the average rate of neurological injuries related to screw misplacement.

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