



RADIOLOGICAL EVALUATION OF PEDICLE SCREW FIXATION IN THORACOLUMBAR SPINE STABILIZATION BY FREE HAND TECHNIQUE

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(ABSTRACT) **Introduction:** Pedicle screw fixation is the preferred modality of fixation throughout the vertebral column because of its proven effectiveness in stabilizing all three columns even in a deformed spine. With no use of imaging, the duration of the procedure is substantially reduced, this decrease reflects progressively in post-operative prognosis as probability of surgical site infection is minimal. Further curtailed duration of prone position also helps in reducing the morbidity associated with the surgery. In this study we have attempted to evaluate the safety and accuracy of pedicle screw placement at thoracolumbar spine by free hand technique using post-operative computed tomography analysis. **Objectives;** To evaluate the efficacy of free hand technique in safe and accurate placement of pedicle screw post operatively using CT image. **Study design :** Prospective. **Study population :** Patients undergoing posterior stabilisation with pedicle screw fixation by free hand technique. **Sample size:** 100 patients. **Study period:** March 2014 until September 2020. **Study setting:** Department of Orthopaedics, Chengalpattu Govt Medical College and Hospital. **Results ;** There is statistically significant association in ODI and VAS score among study participants during follow up ($P < 0.05$). **Conclusion:** Free hand technique provides a safe and accurate method of pedicle screw placement without radiation harm to surgeon, theatre staffs and the patients. Free hand technique by reducing the duration of surgery, indirectly decrease complications like surgical site infection, anaesthetic complications

KEYWORDS : Pedicle screw, VAS – Visual Analogue Scale, CT – Computer Tomography.

INTRODUCTION

Pedicle screw fixation is the preferred modality of fixation throughout the vertebral column because of its proven effectiveness in stabilizing all three columns even in a deformed spine¹. This advantage has been translated to superior clinical results in cases of trauma, instability, deformity and neoplastic destruction. It is the most frequently used implant for spinal fixation which allows stabilisation in flexion, extension, translation, rotation and lateral bending². With pedicle screw there is no need of intact posterior element or need to place the implant in the neural canal and fixation covers all three column and extends anterior to instantaneous axis of rotation. These advantages have helped to overcome problems due to earlier devices like hook-rod and wire-rod constructs³.

Placement of pedicle screws remains technically demanding, particularly in the cervical and thoracic region because of the smaller size and more complex morphology of pedicles. Because of this, the freehand pedicle screw insertion techniques and image guided techniques have been widely developed to guide placement. A successful placement of the screw depends entirely on surgeon ability and great experience is demanded to obtain good results.

With no use of imaging, the duration of the procedure is substantially reduced, this decrease reflects progressively in post-operative prognosis as probability of surgical site infection is minimal. Further curtailed duration of prone position also helps in reducing the morbidity associated with the surgery. In this study we have attempted to evaluate the safety and accuracy of pedicle screw placement at thoracolumbar spine by free hand technique using post-operative computed tomography analysis at Chengalpattu Government Medical College and Hospital, Chengalpattu.

AIMS AND OBJECTIVES

To evaluate the efficacy of free hand technique in safe and accurate placement of pedicle screw.

METHODOLOGY:

Study design: Prospective

Study population: Patients undergoing posterior stabilisation with pedicle screw fixation by free hand technique.

Inclusion Criteria

1. Age above 18 years
2. Thoracolumbar Spinal Injuries- Burst/Wedge Compression Fracture
3. Spondylolisthesis
4. Degenerative Disc Disease
5. Tuberculosis
6. Patient willing for written consent

Exclusion Criteria

1. Age less than 18 years
2. Severe kyphotic or scoliosis
3. Cervical Spine Injuries
4. Patient unfit for general anaesthesia.
5. Bleeding diathesis

Sample size : 100 patients

Study period : March 2014 until September 2020.

Study setting: Department of Orthopaedics, Chengalpattu Govt Medical College and Hospital

All the patients were initially assessed in the outpatient department or casualty according to their presentation and then they underwent a detailed evaluation of their hemodynamic, spine, neurological status and other injuries, if associated with trauma. The patients were interviewed; their epidemiological, historical, subjective and physical findings were noted

Technique:

All pedicle screws were inserted using the freehand technique. After exposure, a straight awl was used to disrupt the cortical bone at the entry point described above. A straight, blunt-ended gearshift was used to cannulate the pedicle to the desired depth based on the sagittal and axial trajectory. A ball-ended feeler was used to search for breaches. After the typical tapping and probing was repeated, an appropriate size screw was placed. To decrease the operative time, the markers were not used. Intraoperative fluoroscopy was used for initial localization of the correct level and then again for a final anteroposterior and lateral radiograph.

Postoperative Computed Tomography Scan was done after the surgery to see the position of pedicle screws. And during the following up, standard anteroposterior and lateral films were taken to assess spinal injury, reduction, decompression, internal fixation, and fusion for all patients.

OBSERVATIONS:

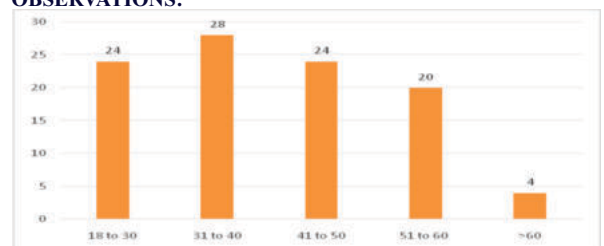


Figure 1: Age wise distribution of study participants

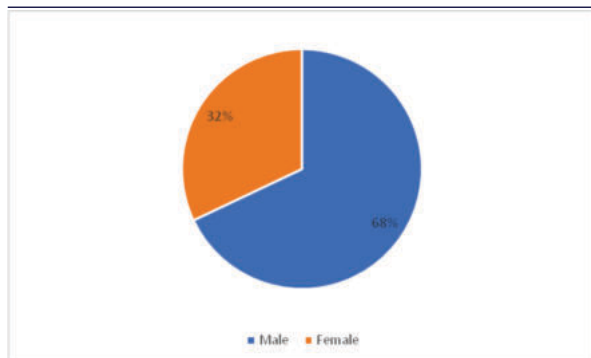


Figure 2: Sex wise distribution of study participants

Table 1: Distribution of degenerative disorder among study participants

Degenerative disorder	Frequency	Percentage
IVDP	20	20
Spondylolisthesis (LIST)		
Grade 2	8	8
Grade 3	24	24
DDD	4	4
Trauma	44	44
Total	100	100

RESULTS

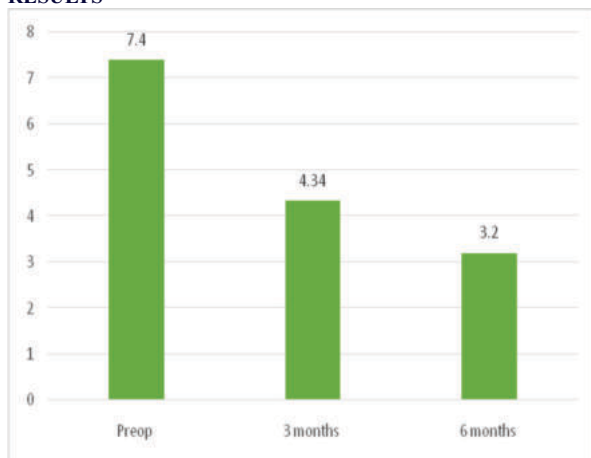


Figure 3: Comparison of mean VAS score among study participants

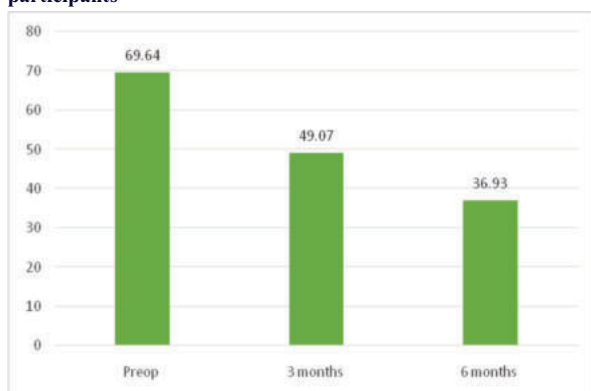


Figure 4: Comparison of mean ODI score among study participants

Table 2: Distribution of complication among study participants

Complication	Frequency	Percentage
RP	92	92
UI	4	4
Infection	2	2
Total	2	2

Post operative CT evaluation of position of pedicle screw.

Total p: 100 patients 486 pedicle screws

Table 3. pedicle screw position in Post OP CT

No breach	387	79.6%
Lateral breach	74	15.2%
Superior breach	25	5.14%
Medial breach	0	0
Inferior breach	0	0

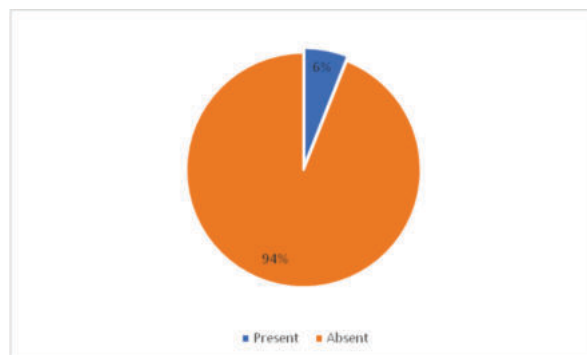


Figure 7: Distribution of deficit among study participants

DISCUSSION:

Three column fixation using pedicle screws in posterior spinal fusion is the most commonly used form of posterior instrumentation. However, the inherent anatomy involved maintains the technically demanding nature of their placement. However, pedicle screws remain technically demanding to place, particularly in the cervical and thoracic region because of the smaller size and more complex morphology of pedicles. Additionally, complications related to the use of screws are potentially serious, including: screw misplacement, pedicle fracture, screw rupture, bending or loosening, vertebral canal violation, dural tear, vascular or visceral problems, and postoperative neurologic symptoms or pain. Because of this, the freehand pedicle screw insertion techniques and image guided techniques have been widely developed to guide placement. Pedicle screw accuracy is defined as having the entire screw contained within the cortices of each respective pedicle.

Using a geometric model, Rampersaud⁴ et al showed the mean maximum permissible translational/rotational screw placement error in the thoracic and lumbar spine to be 0.6 mm/2.6 degrees and 2.0 mm/6.3 degrees, respectively. In light of these difficulties, many assistive techniques have been devised to facilitate the accurate placement of pedicle screws⁵. Although these expensive pieces of equipment and techniques slightly increase placement accuracy, these methods have increased cost and relied on technology which is still not without flaws. These modalities have also been associated with increased operative time and radiation exposure to both the patient and the surgeon

Freehand pedicle screw insertion technique relies on tactile feedback of the surgeon and the use of anatomical marks to determine correct screw entry point, without the aid of intraoperative image-guided systems or explorative laminectomy, with no or limited use of intraoperative fluoroscopy.

While the freehand methods are effective and widely employed, the main shortcoming of freehand technique is the rather long learning curve, as the successful placement of the screws depends entirely on surgeon ability and great experience is demanded to obtain good results.

There are several studies that have indicated that free-hand technique is both as accurate as the fluoroscopy-guided placement, but also harmless in terms of radiation. In our study of 100 cases, post operative CT confirmed acceptable placement of the pedicle screw. The complications in our study were, 6 cases had post-operative sensory deficit, 4 cases had radiculopathy and 2 cases with surgical site infection and 2 patients with urinary incontinence. Amato⁶ et al in his study, applied around 424 pedicle screws in 102 patients under fluoroscopic guidance in degenerative disorders involving lumbar vertebrae.

CONCLUSION

Free hand technique provides a safe and accurate method of pedicle screw placement without radiation harm to surgeon, theatre staffs and the patients. Free hand technique by reducing the duration of surgery, indirectly decrease complications like surgical site infection, anaesthetic complications etc

Limitation Of this Study: There were no case of spinal deformity. Paediatric population was not included in our study

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