



**ORIGINAL RESEARCH PAPER**

**Orthopaedics**

**PERCUTANEOUS CD FIXATION OF SPINE IN SPINAL FRACTURES/ INSTABILITY BY FREE HAND TECHNIQUE**

**KEY WORDS:** percutaneous; spondylolisthesis; spinal fractures.

<b>Dr. Ashok Kumar Patnala*</b>	Professor and Head of the Department, Department of Orthopaedics, Andhra Medical College, Visakhapatnam, A.P. India. *Corresponding Author
<b>Dr. Sravan Raju Nimmaka</b>	Junior Resident, Department of Orthopaedics, Andhra Medical College, Visakhapatnam, A.P. India.
<b>Dr. Kanugula Saibharath</b>	Junior Resident, Department of Orthopaedics, Andhra Medical College, Visakhapatnam, A.P. India.
<b>Dr. Kanakala Nikhil</b>	Junior Resident, Department of Orthopaedics, Andhra Medical College, Visakhapatnam, A.P. India.

**ABSTRACT**

**Introduction:** Lumbar spondylolisthesis is frequently found in adults as a result of spondylolysis or facet degeneration. The slipped segment produces abnormal positioning of the vertebrae in relation to each other along the spinal column and causes mechanical back pain and compression of neural structures. The initial treatment in most symptomatic patients with lumbar spondylolisthesis is nonoperative supportive care, which consists of a combination of pain medications, bracing, and physical therapy. Surgical intervention is indicated if the symptoms are disabling and they interfere with work despite supportive care, if there is progression of the slippage degree (SD) on serial radiologic examinations, or if there are overt neurological deficits 1,2. Pedicle screw placement is the most popular method in lumbar spinal instrumentation for achieving successful fusion. Recently, to reduce surgical damage to the normal muscular structures during pedicle screw placement, C-arm-guided percutaneous pedicle screw fixation (PPSF) was introduced, and it has become increasingly popular in spinal surgery. Percutaneous transpedicular fixation systems have become more widely used in recent years mainly for the treatment of dorsal, dorsolumbar, and lumbar instability. **Aim & Objectives:** The present study is aimed at evaluating the functional outcome with percutaneous pedicle screw fixation for spinal fractures & spinal instabilities by free hand technique in patients without neurological deficits. **Materials & Methods:** The present dissertation is a study of 25 consecutive cases of spinal fractures and spondylolisthesis who attended the orthopaedic emergency or outpatient department of Andhra medical college, Visakhapatnam from 2017 to 2019. All the cases were examined clinically followed by radiographic confirmation. **Results:** In total 25 patients spinal fractures 16 and instability 9, whose mean preoperative ODI scores is 81.04% and the mean postoperative score is 22.6%. The total postoperative moderate disability patients are 15 and minimal disability patients are 10. **Conclusion:** "PERCUTANEOUS CD FIXATION OF SPINE IN SPINAL FRACTURES/INSTABILITY BY FREE HAND TECHNIQUE" is one of the better methods and is suggested for grade 1 & grade 2 spondylolisthesis and spinal fractures, also by which can reduce the morbidity and improve the function.

**INTRODUCTION**

Lumbar spondylolisthesis is frequently found in adults as a result of spondylolysis or facet degeneration. The slipped segment produces abnormal positioning of the vertebrae in relation to each other along the spinal column and causes mechanical back pain and compression of neural structures. The initial treatment in most symptomatic patients with lumbar spondylolisthesis is nonoperative supportive care, which consists of a combination of pain medications, bracing, and physical therapy. Surgical intervention is indicated if the symptoms are disabling and they interfere with work despite supportive care, if there is progression of the slippage degree (SD) on serial radiologic examinations, or if there are overt neurological deficits 1,2.

Percutaneous pedicle screw insertion is novel and recently reported technique. Magerl initially reported the first use of percutaneous pedicle screw instrumentation in 1977 and later reemphasized it in 1984. He first used external fixation devices but the concept was recently changed to percutaneous internal fixation for segmental lumbar instability as a form of minimally invasive spine surgery.

This new technique can be used in a wide variety of spinal disorders such as disc pathologies, listhesis and trauma. Successful percutaneous placement of pedicle screws requires surgical skill and experience because of a lack of dorsal anatomic surface landmarks. Fluoroscopy-based guidance is effective and accurate in percutaneous placement of lumbar pedicle screws 18.

Claimed disadvantages of percutaneous screws include potentially longer operative times, the need for a steady learning curve, loss of surgeon control or tactile feel, and an inability to visualize open anatomy. Moreover, the implant can be difficult to compress or distract.

**AIM & OBJECTIVES**

The present study is aimed at evaluating the functional outcome with percutaneous pedicle screw fixation for spinal fractures & spinal instabilities by free hand technique in patients without neurological deficits.

**MATERIALS & METHODS**

The present dissertation is a study of 25 consecutive cases of spinal fractures and spondylolisthesis who attended the orthopaedic emergency or outpatient department of Andhra medical college, Visakhapatnam from 2017 to 2019. All the cases were examined clinically followed by radiographic confirmation. The age, sex of the patient, their symptoms and duration of the symptoms were noted.

They were examined clinically. Straight leg raising test was done followed by neurological examination of the lower limbs. All the patients were then subjected to the radiological examination of the lumbosacral spine by obtaining antero-posterior, lateral (flexion and extension views), oblique views to show spinal fractures, spondylolysis and spondylolisthesis. MRI and X-rays were done in all the cases to facilitate evaluation of the root compression disc changes, spinal cord changes.

**Inclusion Criteria:-**

- Patients with > 18 years
- thoracic, thoracolumbar or lumbar instability
- Thoracolumbar fractures
- Spondylolisthesis

**Exclusion Criteria:-**

- spinal fractures and instability with neurological deficit
- patients with more than one pain.
- extensive disruption of bone anatomy
- prior posterolateral fusion
- vertebral rotation-scoliosis
- high grade spondylolisthesis
- severe osteoporosis
- tumor or infection at the instrumented level.
- Patients with severe comorbidities such as uncontrolled hypertension , diabetes mellitus, ischemic heart disease , malignancy in other parts of the body which precludes spine surgery
- Patients not compliant for long term follow up

**OPERATIVE PROCEDURE:-**

1. Operative Room set up, anaesthesia and Patient positioning  
Preoperative planning is useful in determining the proper starting point and screw trajectory. The percutaneous posterior fixation of the dorsolumbar spine is performed under general anaesthesia. The patient should be positioned prone, on top of chest rolls with the abdomen free, but a knee chest position is preferably avoided. It is confirmed that adequate fluoroscopic images of the pedicles can be obtained in both an AP and lateral view before proceeding . While adjustments in patient positioning is allowable, tables that limit good AP fluoroscopy should be largely avoided.

**2. Initial Skin Incisions and Pedicle Identification**

Through cross wire technique using K-wire, superiolateral aspect of the pedicle identified and skin incision approximately 2cm given. K-wire is advanced in to the pedicle in fluoroscopic lateral image after confirming in AP image. Both AP and lateral radiographs confirm that the apt starting point has been determined .The pedicle is roughly a cylindrical structure. The perfect starting point is at the intersection of the facet and the transverse process. As the pedicle is navigated, the trajectory should be aimed toward the medial wall, but not approach it too closely .

**3. Pedicle Screw Placement**

(a) Pedicular access: entry point by Kwire widened with bone awl for screw placement in both AP and lateral C-ARM images. Precautions taken to keep entry in upper half of pedicle and advanced up to 2/3rd part of vertebral body in lateral image. As the awl advances towards the base of the pedicle , it should approach the pedicle centre on the AP image.

(b) sound for pedicle breach identification: it is to confirm that all the pedicle walls are intact without any breach before placing the pedicle screw.

(c) Dilatation of the Lumbodorsal fascia: The fascia and muscle must be dilated to allow for screw placement. dilators are used to gently make a path of the appropriate dimension .

(d) Screw placement: Poly axial pedicular screw is placed by confirming in AP and lateral images and advanced up to 2/3rd part of vertebral body in upper half of the pedicle.

(e) Second Screw Placement: The process is repeated for the second screw on the same side. After inserting both, the screw assemblies should be at approximately the same height outside of the patient. Both assemblies should move freely following insertion .

**4. Rod Placement**

(a) Measurement of Rod: The appropriate rod length may be determined by placing the rod templates into the two screw extenders. If the template is beyond the line of a particular rod length, the next size rod must be used. After determining rod

size, the templates are removed before rod insertion .

(b) Passing the Rod: rod will be placed after insertion 2 screws on either side. connecting rod pre-bend before placing to match with lumbar lordosis. The path of the rod is prepared by a long rod passing through one incision to the other through the paraspinal muscle mass. The muscle mass gets split in to path of blunt rod passed from one incision to the other. Pass the rod through the screw heads so the tapered tip of the rod is completely through the distal screw as verified by lateral fluoroscopy .

(c) Final Tightening: After verifying with AP, lateral, and oblique views that the rod is seated in the heads of both screws, the set screws can be tightened. Before final tightening the set screws, distractor used to distract the two vertebrae for maintaining the height of vertebral body in fractures and correcting the spondylolisthesis in instability. Final tightening is achieved with the final torque limiting driver by tightening until the set screw heads shear off .

5 .Closure is accomplished with a few interrupted stitches in the fascia and skin suture and dressing applied

**POST OPERATIVE MANAGEMENT**

Bracing for standalone rods and screws is controversial, especially in trauma cases. To assist in fusion, we usually braced these patients for 3 months after percutaneous transpedicular placement, especially in trauma cases. Early ambulation was encouraged, as it improves prognosis and shortens recovery. Postoperative bracing was al- ways used for instrumentation mediated fusion. Immediately on the third postoperative day the patient is made ambulant. Postoperative routine AP and lateral plain radiographs were performed within 48 hours after surgery. Sutures removed on the 10th post-op day. Most of the patients were relieved of the symptoms on the third day. The patient is discharged with the advice not to lift heavy weights for six months.

**POSTOPERATIVE CLINICAL EVALUATION**

The patient is advised regular fallow up for two years at regular intervals of 10th day, 1month, 3months and 6months. The patients were examined for any neurological deficit, further slip and relief of the symptoms and functional scoring by ODI low back ache scoring & pain evaluation by VAS scoring system.

**OBSERVATIONS & RESULTS:-**

**Gender Distribution:** In total no of 25 cases, male 17(68%) and females 8(32%) male predominance with male female ratio.

**Age Distribution:** In the present study average age range was 21-60 years. mean age was 35.64 years. Median age group was 38 years. Most common affected age group was 21-30 years. male patients are common in 2nd,3rd decade. Females patients are more in 3rd and 4th decade.

**Pathology Versus Gender:** In total 17 males 14 spinal fractures and 3 instability. In total 8 females 2 spinal fractures and 6 instability. It implies spinal fractures are more common in males and instability is more predominant in females.

**Age Versus Pathology:** INSTABILITY MALE FEMALE In current study spinal fractures 16 and instability 9. And fractures are more common in males of 2nd and 3rd decade. Instability predominant in females of 3rd and 4th decade.

In this study spondylolisthesis most common at L5-S1 level, total 7 and next L4L5 level i.e 2. Isthmic spondylolisthesis are most common at L5-S1 level and degenerative spondylolisthesis are most common at L4-L5 level.

**Level Versus Spinal Fracture:** In present study we observed, most of the spinal fractures are at lumbosacral junction next upper lumbar and lower lumbar region.

**RESULTS:**

**VAS (VISUAL ANALOGUE SCALE) SCORING**

Visual analogue scale for pain assessment. It measures 0 to 10, 0 as no pain and 10 means the worst pain. The mean average VAS score for pain is 8.12 and the postoperative VAS score is 2.8.

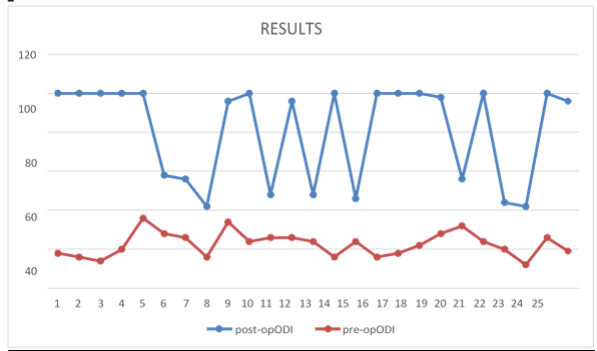
**ODI(OSWESTRY DISABILITY INDEX) SCORING:**

**Interpretation Of Scores:-**

0% to 20%: minimal disability:
21%-40%: moderate disability:
41%-60%: severe disability:
61%-80%: crippled:
81%-100%:

**Clinical results by ODI SCORING:**

In total 25 patients spinal fractures 16 and instability 9, whose mean preoperative ODI scores is 81.04% and the mean postoperative score is 22.6 %. The total postoperative moderate disability patients are 15 and minimal disability patients are 10.



**Functional Results In ODI Scoring**

**DISCUSSION:**

Lumbar spinal fusion was first performed by Albee and Hibbs in the early 1900's for the surgical management of spinal deformity related to pott's disease. Due to its initial success, the indications for this technique were later expanded to include traumatic injuries and scoliosis. Boucher et al first described the pedicle screw in 1959 and Roy-Camille reported a dorsal construct consisting of a pedicle screw and plate several years later. Spinal pedicle screw fixation has continued to undergo modifications since its inception. Its effectiveness in the management of a variety of spinal disorders has made it a mainstay in the armamentarium of most spine surgeons. However, an undesired consequence of this technique is the iatrogenic paraspinal muscle injury that occurs during the exposure for screw placement.

From a technical perspective, it is also easier to achieve the desired lateral to medial pedicle screw trajectory as there is not a wall of soft tissue that prevents the angulation of the instruments (as that can be encountered in the conventional open surgery). This is particularly helpful in obese patients, as more extensive exposure and retraction can be avoided. Operative time is also significantly decreased; it takes only one hour for the surgeon to place four screws and two rods. In the present study patients with spinal injury and instability who attended the OPD and emergency of orthopaedic dept. King George hospital, Visakhapatnam were included in the study. 25 cases which fulfill the inclusion criteria were included. All the cases are operated by single surgeon under similar operative environment. A complete study of these cases had been conducted. All the necessary data was collected which included demographic details of the patients, clinical history, clinical examination, routine investigations and special investigations and surgical treatment was done.

**AGE DISTRIBUTION:**

In this present study average age range was 21-60 years.

mean age was 35.64 years. Median age group was 38 years. Most commonly affected age group was 21-30 years.

**Gender Distribution:**

In present study of 25 patients, males 17 and females 8 with male predominance overall. In which spinal fractures in males 14 and in Females 2, spondylolisthesis 3 in males and 6 in females. Males more predominant in spinal trauma where as females are predominant in instability.

**Indications For Surgery:**

Current study of 25 patients with spinal fractures in 16 and spondylolisthesis in 8.

**Table: Indication For Surgery In Different Studies**

Indication For Surgery (current Study)	No. of Patients
Traumatic fracture	16
Spondylolisthesis	8
Mohamed M. Mohi Eldin et al 58 study	
Spondylolisthesis	22
Traumatic fracture	14
Discogenic pain	4
Prafulla Kumar Sahoo et al 63 study	
Traumatic fracture	4
Spondylolisthesis	6
Discogenic pain	4
Tuberculosis of lumbar vertebra	4
	1

**Intraoperative Bloodloss:**

The major advantages of percutaneous placement of pedicle screw is avoiding bigger midline incision as in conventional open method and avoiding traction force on paraspinal muscles for longer duration, minimising intraoperative infection, avoiding denervation of paraspinal muscles as in open method and minimising intraoperative bloodloss. In present study average loss of blood per case is around 55ml.

**Operating Time:**

As there is no need of full exposure of bony anatomy, large incision with paraspinal muscle dissection can be avoided which decreases the operative time but initially there was long duration of surgery due to learning curve surgeon skills. In present study average operating time is around 65 minutes. Ming Yang et al Comparison of clinical results between novel percutaneous pedicle screw and conventional open pedicle screw fixation for thoracolumbar fractures with no neurological deficit study shows decreased operating time in minimally invasive pedicle screw fixation, average operating time is 51.55 minutes and in open technique it is 96.6 minutes (p<0.001). Qinpeng Zhao et al, the operation was completed successfully in total 38 patients. A total of 152 screws were placed. The mean operation time was 90.7 ± 21.9 min, and the average intraoperative bleeding amount was 89.2 ± 31.9 ml.

**Shorter Period Of Hospitalisation And Recovery:**

The rationale behind minimally invasive techniques is less tissue damage, reduced back pain leading to a shorter rehabilitation period, and faster return to work and resumption of daily activities. In present study average hospital stay of each patient after surgery is 5 days.

**Clinical Results:**

In total 25 patients spinal fractures 16 and instability 9, whose mean preoperative ODI scores is 81.04% and the mean postoperative score is 22.6%, the total postoperative moderate disability patients are 15 and minimal disability patients are 10.

**Table:13: Oswestry Disability Index Score In Different Studies**

Study	PRE-OP ODI(%)	POST-OP ODI(%)	FINAL FOLLOWUP
Present study	81.04	32.6	22.6

Qinpeng Zhao et al72	44.6	24.4	5.9
Ho-Seok Oh et al74	35.9	18.6	9.5

7) Butt mF, FArooq m, mir B, DhAr As, hussAin A, mumtAz m. Management of unsta- ble thoracolum- bar spinal injuries by posterior short segment spinal fixation. *Int Orthop* 2007;31: 259-264.

**COMPLICATIONS:**

a) Superficial / deep infection: Due to advantage of minimal incision in this technique there is a minimal exposure at wound site and so intra-operative and postoperative infections can be minimized. In present study 2 patients presented with superficial infection and that was treated successfully with antibiotics.

b) screw loosening: in present study we used polyaxial screws and excluded severe osteoporotic spine cases and none of the cases showed any signs of screw loosening or screw blackout.

c) implant failure rates: in present study we fixed one level above and one level below to the pathological level with polyaxial pedicle screws by free hand technique. On postoperative follow up none of the patients showed implant failure or screw loosening. And there was no occurrence of prominence of the implant.

d) neurological deficits: in the present study we excluded all the patients with neurological deficits and postoperative follow up in regular intervals of 10 days, 1 month, 3 months and 6 months didn't show any newly occurrence of neurological deficits. No other major complications like neuromuscular injury, spinal cord injury, dural tear and none of the cases need revision surgery.

**CONCLUSION**

The present study of "PERCUTANEOUS CD FIXATION OF SPINE IN SPINAL FRACTURES/INSTABILITY BY FREE HAND TECHNIQUE" was conducted in Andhra medical college/King George Hospital between 2017-2019. We have included 25 cases in total with 16 cases being fractures and 9 cases of instability. We have chosen this method of fixation because of many disadvantages of open procedures like longer post-op period, blood loss, paraspinal muscle necrosis leading to stiffness and spasm and loss of posterior stabilizing structures. All these disadvantages we have overcome by our free hand technique of "PERCUTANEOUS CD FIXATION OF SPINE IN SPINAL FRACTURES/INSTABILITY BY FREE HAND TECHNIQUE" where we have devised our own method of placing the screws and passing the rod which results in earlier mobilization, less post-operative morbidity, early recovery and better function. This free hand technique is feasible to do even in a peripheral set up as it doesn't need any special equipment. The only disadvantage is being a less invasive procedure has a steep learning curve which was refined from case to case and finally we have reduced the operating time and exposure.

Hence, we concluded that our method "PERCUTANEOUS CD FIXATION OF SPINE IN SPINAL FRACTURES/INSTABILITY BY FREE HAND TECHNIQUE" is one of the better methods and is suggested for grade 1 & grade 2 listhesis and spinal fractures also by which can reduce the morbidity and improve the function.

**REFERENCES:**

- 1) Zdeblick TA. A prospective, randomized study of lumbar fusion. Preliminary results. *Spine (Phila Pa 1976)* 1993;18:983-91.
- 2) Shi L, Chen Y, Miao J, et al. Reduction of slippage influences surgical outcomes of grade II and III lumbar isthmic spondylolisthesis. *World Neurosurg* 2018;120:e1017-23.
- 3) Sakeb N, Ahsan K. Comparison of the early results of transforaminal lumbar interbody fusion and posterior lumbar interbody fusion in symptomatic lumbar instability. *Indian journal of orthopaedics*. 2013 May 1;47(3):255.
- 4) Foley KT, Gupta SK. Percutaneous pedicle screw fixation of the lumbar spine: pre-liminary clinical results. *J Neurosurg* 2002;97:7-12.
- 5) Hu R, Mustard CA, Burns C (1996) Epidemiology of incident spinal fracture in a complete population. *Spine (Phila Pa 1976)* 21(4):492-499
- 6) Denis F, Armstrong GW, seArls K, mAttAl. Acute thoracolumbar burst fractures in the absence of neurologic deficit. A comparison between operative and nonopera- tive treatment. *Clin Orthop Relat Res* 1984: 142-149.