

## Surgical Management of Symptomatic Adult Lytic Spondyloptosis by Modified/Three Stage Gaines Procedure: Case Report

Charanjit Singh Dhillon<sup>1\*</sup>, Mithun Jakkan<sup>1</sup>, Narendra Reddy Medagam<sup>1</sup>.

<sup>1</sup>Centre for SPINE Surgery, MIOT Hospital, Chennai.

\***Corresponding Author** :Charanjit Singh Dhillon, Centre for SPINE Surgery, MIOT Hospital, Chennai. E-mail: [drdhillonc@hotmail.com](mailto:drdhillonc@hotmail.com)

**Received date: May 28, 2018; Accepted date : June 29, 2018; Published date: July 16, 2018.**

**Citation this Article:** Charanjit Singh Dhillon, Surgical management of symptomatic Adult lytic Spondyloptosis by modified/Three stage Gaines procedure: case report, J Orthopaedics and Surgical Sports Medicine.1(1); **Doi: 10.31579/2641-0427/003**

**Copyright** : © 2018 Charanjit Singh Dhillon et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

### Abstract

Spondyloptosis or complete anterior dislocation of the L5 vertebrae over S1 is a rare clinical condition. Generally, the surgical management of spondyloptosis includes either posterior long segment in-situ fusion (with total disregard for altered biomechanics) or restoration of lumbosacral kyphosis by reduction of spondyloptosis using multi-staged procedures. Reduction is possible in spondyloptosis only after sacral dome osteotomy or L5 Corpectomy with interbody fusion of L4 over S1 as described by Robert Gaines. We present our case of a manual laborer who was treated successfully by modified/Three stage Gaines procedure.

### Case Report

A 29 year old male, manual laborer, presented to us with complaints of severe low back pain and bilateral sciatica. There was no history of trauma. He had spondyloptosis of L5 over S1 with modified Newman's score of 10+10. The patient underwent three staged modified Gaines procedure to reduce L4 over S1 after anterior L5 Corpectomy to achieve restoration of Lumbosacral lordosis and strong interbody fusion between L4 and S1. The reduction was maintained at end of eighteen months and he was able to resume his job as manual laborer.

### Introduction

Spondylolisthesis is a slipping of all or part of one vertebra forward on the other [1]. Meyerding, an obstetrician, described four degrees of slip in spondylolisthesis according to the slip percentage [2]. Grade III, IV and V (spondyloptosis) are collectively classified as High grade spondylolisthesis (HGS) with slip percentage more than 50% [3,4]. These comprise of total less than 5% of total spondylolisthesis with spondyloptosis being very rare (less than 1%) [3,5]. HGS respond poorly to conservative treatment and treatment of choice is often operative (3,4,5,6,7,8).

Spondyloptosis is defined as a condition where L5 vertebral body is completely dislocated from the sacrum anteriorly [6,7]. It was originally described by Neugebauer [9]. Patients usually display classical symptoms of low back pain, stiffness with hamstrings tightness without or with radicular symptoms or cauda equina syndrome [3,4,5,7]. Generally, the surgical management of spondyloptosis includes either posterior long segment in-situ fusion or reduction of spondyloptosis using multi-staged procedures. Traditional treatment by in situ posterolateral arthrodesis totally disregards the lumbosacral kyphosis and the altered lumbosacral biomechanics and has been associated with pseudarthrosis rates up to 50%. Even with successful posterolateral fusion, the graft is in an unfavorable biomechanical environment, owing to it being under tension, which can allow for progression of lumbosacral kyphosis (slip angle) and sagittal translation (slip). Open reduction of spondyloptosis after L5 Corpectomy(Gaines Procedure) improves the biomechanical situation by reducing lumbosacral kyphosis and restoring lumbosacral lordosis, but is associated with neurologic deficits in up to 30% of patients. We present our case of a manual laborer who was treated successfully by modified/Three stage Gaines procedure.

### Case report

A 29 yr old male patient, manual laborer, presented to us with complaints of severe low back pain and bilateral sciatica. The low back pain was insidious in onset and gradually progressive.

The pain worsened with all activities of daily living and improved partially with rest. He was unable to walk more than 500 meters at a stretch due to pain. There was no history of trauma preceding the onset of his symptoms. The Oswestry Disability index (ODI) score at the time of initial presentation was 70. He was given a trial of conservative management in form of analgesics, corset and activity modification for over 6 months. However he did not have any significant relief.

On examination, patient was unable to stand erect until he flexed his hips and knees. He had flattened buttocks, with severe hamstrings tightness and a positive step sign. Neurological examination revealed sensory blunting in bilateral L4 and L5 dermatome (50%) and weakness in right extensor hallucis longus (EHL) and right Tibialis anterior (TA) muscle (power 3/5).

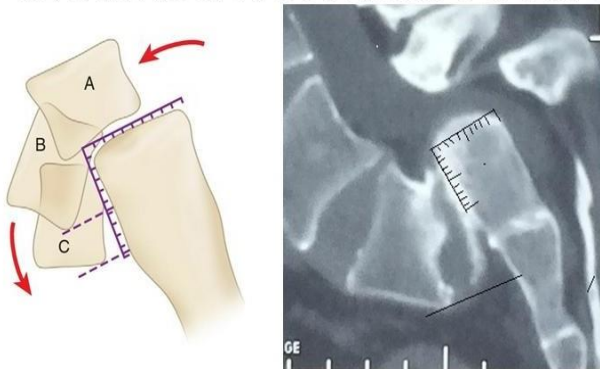
X-ray revealed spondyloptosis of L5 with the L5 superior end plate was lying below the S1 superior end plate (figure-1).



**Figure 1:** Pre-op X-ray showing L5 superior end plate was lying below the S1 superior end plate

The L5 vertebra has not just translated forward and dropped into pelvis but also rotated sagittal plane along transverse axis so that the inferior endplate of L5 was facing the anterior surface of S1 body. His modified Newman's score was 10+10 (Figure-2).

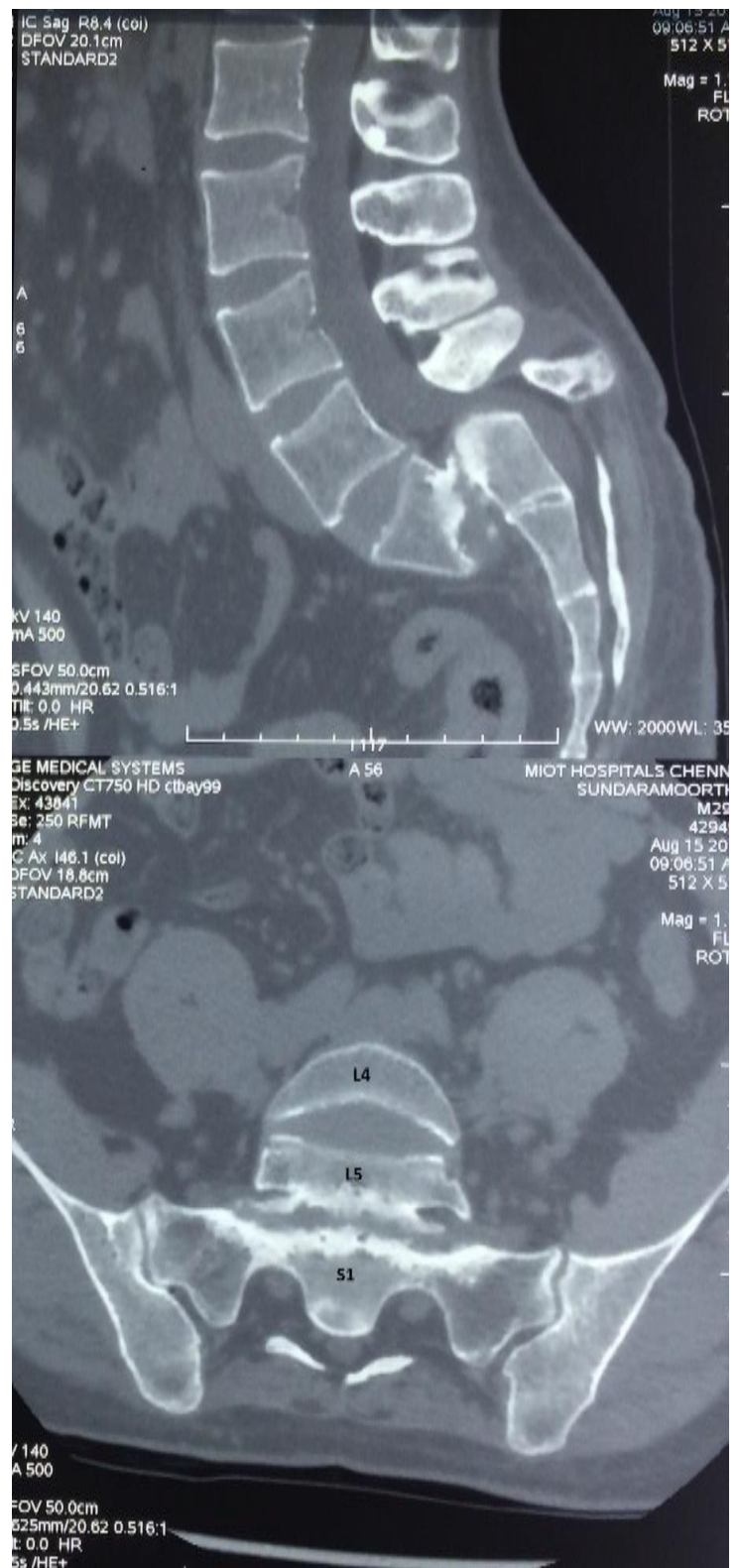
## Modified Newman's Score



**Figure 2- Modified Newman's Score-** Modified Newman spondylolisthesis grading system. Degree of slip is measured by two numbers—one along sacral endplate and second along anterior portion of sacrum: A = 3 + 0; B = 8 + 6; and C = 10 + 10. Reference-De wald RL. Spodylolisthesis, In Bridwell KH The text book of spinal surgery, second ed. Philadelphia: Lipincott-Raven, 1997

**Figure 2:** Modified Newman's Score

MRI Scan showed compression of the dural sac at L5S1 level with severe bilateral L5 neural foramina compression. CT Scan showed unsuccessful attempts at natural fusion between inferior endplate of L5 and anterior surface of S1 in the form of developing osteophytes(Figure-3). Dynamic flexion and extension X-rays and traction X-rays showed no mobility at L5 S1 region.



**Figure 3-** CT Scan showing anteversion of L5 body (the inferior endplate of L5 facing the anterior surface of S1 body). Axial section shows L4, L5 and S1 vertebral bodies all in single axial cut.

The patient was counseled regarding various options for treatment including non-surgical management. The option of leaving the listhesis uncorrected with possibility of further worsening of neurological status was informed to patient. Frank discussions regarding the morbidity of surgery and the technical difficulties in obtaining reduction of spondyloptosis along with the possibility of worsening the preexisting right TA muscle weakness to complete foot drop and the possibility of retrograde ejaculation following anterior surgery was discussed with patient and his family in his native language. After thorough discussion with the patient and after fully understanding the pros and cons of operative procedure, he consented for surgery. A three staged anterior-posterior-anterior intervention was planned for reduction of spondyloptosis, in single session of anesthesia.

During first stage, anterior transperitoneal approach to L5 and S1 vertebra was done through Pfannenstiel incision. Major Neurovascular structures were dissected and secured by blunt dissection with the help of vascular surgeon. L5 body was identified. Complete L5 corpectomy up to base of pedicles was done along with excision of L4L5, L5S1 disc. Completeness of corpectomy was confirmed intra-operatively with image intensifier. Wound was closed temporarily in single layer and sterile dressings applied.

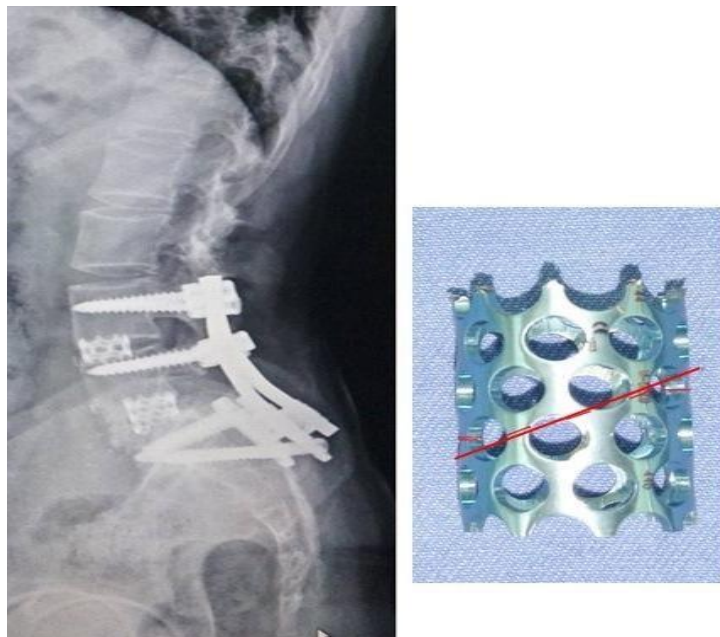
In second stage, with the patient in prone position, midline sub-periosteal exposure of spine was done from L2 to S2. Polyaxial pedicle screws of 6.5mm (Medtronic-Legacy) were inserted in L3, L4 pedicles on either side. Colorado sacral plate (Medtronic) with pedicle screws in S1 and alar screws in S2 was used to form base of the distal construct. All screws were inserted under fluoroscopic guidance. Posterior elements of L4 and L5 were excised and bilateral L4, L5 nerve roots were decompressed till they exited the neural foramina. Rods were firmly secured to sacral plate and gradual reduction of L4 over S1 was achieved without undue tension on the roots. Wound was closed in layers after complete hemostasis.

In third stage anterior abdominal wound was reopened. The empty corpectomy space was reconstructed with an appropriate size Harm's prototype cage contoured in lordosis and filled with bone graft (figure-3). L3L4 disc space was identified and curetted and fused with cages filled with bone graft. The position of cage was confirmed by image intensifier. Stability of cages was checked intra-operatively. After complete hemostasis, wound was closed in layers over drain.

Patient was stable and withstood the surgical procedure without any hemodynamic complications. Nevertheless right EHL and right TA continued to remain weak in the immediate post-operative period (Pre-op right EHL and TA muscle power was 3/5). This was in spite of inspection of L4 and L5 roots during the reduction maneuver to prevent any undue nerve root tension.

The patient was mobilized after 48 hours with lumbar corset. He was instructed to walk with hips and knees slightly flexed for the first one month to reduce the traction on L4 and L5 nerve roots. Sutures were removed after 12<sup>th</sup> postoperative day and patient was discharged in stable condition. He was refrained from activities such as lifting weights, sitting cross legged, bending forwards for up to 6 months.

On regular follow-up, his right EHL and TA power improved gradually over a period of 6 weeks and he was able to walk comfortably upto 2km by the end of 6 months. At the follow up of 18 months, he had significant symptomatic improvement with postoperative ODI score to 8. Radiology showed solid fusion with maintenance of sagittal balance (Figure-4).



**Figure 4:** Showing Harms cage cut obliquely to attain 20 degrees of lordosis. Contoured harms cage in the interbody space between L4 and S1 to achieve lumbosacral lordosis.

He was able to return to his job as a manual laborer by 6 months (Figure-5).



**Figure 5:** Followup X-ray at 18 months showing complete fusion.

## Discussion

Spondyloptosis or complete anterior dislocation of the L5 vertebral body over S1 is a rare clinical condition. It is perhaps the most challenging pathology faced by the spinal surgeon. The ideal method of treatment of this rare situation is still a subject of controversy. On one extreme are conservative surgeons who recommend posterior long segment in situ fusion with no attempt at reduction [10,11,12,13] while on the other extreme are adventurous surgeons who recommend partial or complete reduction of spondyloptosis and correction abnormal sagittal alignment with instrumentation (14,15,16,17). Reduction of forward translation of L5 over S1 is possible in cases where lower end plate of L5 vertebra is at, or above the level of Superior end plate of S1 vertebra. In severe cases, reduction can also be attempted by sacral dome osteotomy [14]. However in our case, L5 superior end plate was lying below superior end plate of S1 vertebra into the pelvis, so reduction with sacral dome osteotomy was technically difficult.

In 1985, Gaines et al [15], popularized a two staged surgical technique for reduction of the spondyloptosis. In the first stage L5 vertebral body was excised up to the base of pedicles. The second stage under separate anesthesia was performed after few days wherein the loose neural arch and pedicle of L5 were removed from posterior approach with gradual reduction and docking of L4 over S1 achieving bone on bone contact, stabilized by transpedicular instrumentation [14, 15]. K Karla et al in 2010 reported a modified Gaines technique for case of spondyloptosis (patient with modified Newman’s criteria score of 10+6), where they performed partial L5 corpectomy and reduced the deformity [17]. In our patient the L5 vertebral body was displaced below the level of superior end plate of S1 with modified Newman’s score was 10+10 [16], hence reduction by partial corpectomy of L5 vertebra was difficult.

We modified Gaines procedure into three stages. The first stage was similar to that described by Gaines [15, 16]. In second stage, pedicle screws were inserted in L3 and L4. For sacral fixation, we deliberately used Colorado sacral plate with S1 sacral screw and S2 alar screw to use the combined strength of S1 pedicle and S2 alar screws to enhance distal fixation. L3 and L4 vertebral body were sequentially reduced to the distal sacral fixation. Due care was taken to observe the L4, L5 and S1 roots and to look for any tension on the nerve roots during reduction maneuver. In this case we were able to achieve complete reduction of L4 over S1 while maintaining lumbosacral lordosis.

In stage three, we had to bridge the corpectomy defect as well as we had to maintain lumbosacral lordosis of around 20 degrees that we had achieved in posterior reduction. Since, there was no such commercially available cage; we used Harm’s prototype cage of appropriate size which was customized to required lordosis by cutting the cage obliquely around the circular lattice to achieve desired lordosis (Figure 6).



**Figure 6:** Follow up at 18 months Post-op showing spine range of movements and TA recovery.

In classical Gaines procedure the L4 vertebral body is directly docked on to the superior endplate of S1 achieving direct bone on bone fusion between L4 and S1 vertebral bodies. As a result there is no lordosis between L4 and S1 vertebral bodies. Also in between L4 and S1 pedicles there are two nerve roots (L4 and L5) exiting through the common foramina which are subject to overcrowding and compression since no cage is used between L4 and S1 vertebral bodies. In our case we were did not dock L4 vertebral body directly on S1 superior end plate but left considerable gap in between the two endplates to attain wider neural foramina height. The gap was reconstructed with a 20 degree lordotic cage to restore lumbosacral lordosis and thus ensuring better biomechanics at lumbosacral junction compared to classical Gaines procedure.

Foot drop is the most commonly reported complication in many studies, where reduction maneuver was performed [13, 14 ,15 16]. Hu SS in 1996 mentioned the rate of neurological complications of around 25% and complications such as root injury, cauda-equina syndrome, injury to hypogastric plexus during anterior procedure [19,20]. In Gaines study, 23 out of 30 patients had clinical deficit in L5 root following their reconstruction. However, 21 out of 23 patients in Gaines study having root deficits, recovered fully from 6 weeks to three years following their reconstruction [16]. According to DM Petraco, 71% of strain occurs on L5 nerve root in second half of reduction maneuver in high grade listhesis and correction of the lumbosacral kyphosis may be protective for L5 nerve root [18].

Our patient already had EHL and TA weakness over right side before surgery. The possibility of worsening of the neurology was discussed with the patient before surgery. In spite of close intraoperative monitoring for root tension there was no improvement in TA and EHL strength in the immediate post-op period. Nevertheless over a period of 6 months the patient recovered completely and was able to resume his work as manual laborer. At the end of 18 months of follow-up, our patient recovered clinically with ODI score of 8 from 70. Radiological parameters were measured using PACS (picture archiving and communication system) software and these parameters showed improvement to acceptable level (Table-1).

Pelvic Parameters	Pre-op (Degree)	Post-op (degree)
Pelvic Incidence	52	52
Pelvic Tilt	27	19
Sacral Slope	25	33
Lumbo-Sacral Angle	-7 (kyphosis)	20 (lordosis)

**Table 1:** Comparison of Pelvic parameters before and after surgery

## Conclusion

The modified/Three stage Gaines procedure is technically safe and effective technique to correct the deformity, achieve lumbosacral lordosis and fusion in case of severe spondyloptosis, provided done with experienced hands. The use of a wedged interbody cage instead of direct bone on bone docking of L4 over S1 (as done in classical Gaines procedure) helps to reinstate lumbosacral lordosis restoring normal biomechanics and gain extra height of neural foramen between L4 and S1 pedicles where two exiting roots L4 and L5 are residing in the common lateral recess.

Transient post-op L4 and L5 root neuropraxia is possible and the patient needs to be counseled regarding its possibility pre-operatively. However, this is an isolated case and need larger case series and long term follow-up for becoming a standard procedure in correcting such severe spondyloptosis.

## References

1. Wiltse LL, Newman PH, Macnab I. (1976); Classification of spondylolysis and spondylolisthesis. *Clin Orthop Relat Res.* (117):23-29.
2. Meyerding H. (1932); Spondylolisthesis: surgical treatment and results. *Surg Gynecol obstet.*54:371-377.
3. Avraam Ploumis, Paraskevas Hantzidis, Christos Dimitriou.(2005); High-grade dysplastic spondylolisthesis and spondyloptosis : Report of three cases with surgical treatment and review of the literature. *Acta Orthop. Belg.*71, 750-757.
4. Marcos Antonio Tebet. (2014); Current concepts on the sagittal balance and classification of spondylolysis and spondylolisthesis. *Discipline of Orthopaedics and Traumatology. Revbras Orthop.* 49(1):3–12.
5. Peter G Passias MD, Caroline E. Poorman, Sun Yang, Anthony J. Boniello, Cyrus M. Jalai et al. (2015); Surgical treatment strategies for high grade spondylolisthesis: A systematic Review: *International Journal of Spine Surgery* January, 9 -50;.
6. Boos N, Marchesi D, Zuber K, Aebi M. (1993); Treatment of severe spondylolisthesis by reduction and pedicular fixation. *Spine* 18:1655-1661.
7. Ankit Syal et al: (2014); L5-S1 Spondyloptosis: Surgical Treatment by Two Staged Gaines Procedure: Case report. *International journal of scientific research*, 2277-8179.
8. Hresko MT, Labelle H, Roussouly P, Berthonnaud E. (2007); Classification of high grade Spondylolisthesis based on pelvic version and spine balance: Possible rationale for reduction. *Spine (Philadelphia,PA, 1976).* 32(20):2208-2213.
9. Neugebauer FL (1882); Aetiologie der sogenannten spondylolisthesis. *Arch Gynaekol* 20: 133-184.
10. Bohlman HH, Cook SS: (1982); One-stage decompression and posterolateral and interbody fusion for lumbosacral spondyloptosis through a posterior approach. *J Bone Joint Surg (Am)* 64:415-418.
11. Grzegorzewski A, Kumar SJ: (2000); In situ posterolateral spine arthrodesis for grades III, IV and V spondylolisthesis in children and adolescents. *J Pediatr Orthop* 20:506-511.
12. Peek RD, Wiltse LL, Reynolds JB, Thomas JC, Guyer DW, Widell EH: (1989) ; In situ arthrodesis without decompression for Grade III or IV isthmic spondylolisthesis in adults who have severe sciatica. *J Bone Joint Surg (Am)* 71:62-67.
13. Molinari RW, Bridwell KH, Lenke LG, Ungacta FF, Riew KD: (1999); Complications in the surgical treatment of pediatric high grade, isthmic dysplastic spondylolisthesis: A comparison of three surgical approaches. *Spine*, 24:1701-1711.
14. Kan Min, Thomas Liebscher, Dominique Rothenfluh. (2012); Sacral dome resection and single-stage posterior reduction in the treatment of high-grade high dysplastic spondylolisthesis in adolescents and young adults. *S785–S791.*
15. Gaines RW, Nichols WK: (1985); Treatment of spondyloptosis of two stage L5 vertebrectomy and reduction of L4 onto S1. *Spine* 10:680-686.
16. Gaines RW. (2005); L5 vertebrectomy for the surgical treatment of spondyloptosis: thirty cases in 25 years. *Spine* ,30 (Suppl):66-70
17. K Karla, S. Kohli, S. Dhar. (2010); A modified Gaines procedure for spondyloptosis. *Vol.92-B, No.11.*
18. DM Petraco MD, Jeffrey M Spivak MD, (1996); An anatomic evaluation of L5 nerve stretch in spondylolisthesis reduction. *Spine* 21: 1133-1139.
19. Hu SS, Bradford DS, Transfeldt EE, Cohen M. (1996); Reduction of high grade spondylolisthesis using Edwards instrumentation. *Spine*; 21: 367-371.
20. De wald RL. Spodylolisthesis, In Bridwell KH, Dewald RL eds, (1997); *The text book of spinal surgery*, second ed. Philadelphia: Lipincott-Raven.