Original Research Article

A study on management of high grade spondylolisthesis

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Abstract

Background: Spondylolisthesis is defined as a displacement of one vertebra over the next lower vertebra in the sagittal plane. High-grade spondylolisthesis (HGS) is defined as greater than 50% slippage of a spinal vertebral body relative to an adjacent vertebral body as per Meyerding classification, and most common location being L5/S1 followed by L4/L5. The treatment of symptomatic high grade lumbo sacral spondylolisthesis has its own technical difficulties for surgical stabilization and fusion unlike low grade listhesis. We used single transvertebral fibular graft and implant stabilization to the vertebra one level above the pathological vertebra via posterior approach to treat the high grade spondylolisthesis of lumbo sacral spine.

Materials and methods: Prospective study done from January 2012 to January 2016 for the management of High grade spondylolisthesis (Grade 3 and Grade 4), patient aged between 15-60 years. Total 15 patients were included in the study. High grade listhesis patients who were not willing for surgery were excluded from the study. All the patients were operated posteriorly with pedicle screw and rod stabilization with trans vertebral single fibular graft with posterolateral fusion was done under fluoroscopic guidance

Results: Preoperative and post-operative status was analyzed in reference to the clinical symptoms and radiological evaluation. All the patients showed improvement following surgery without any implant failure.

Conclusion: This procedure is technically simple, safe and effective method to treat high grade listhesis with no additional peri operative or postoperative complications.

Key words

High grade spondylolisthesis, Transvertebral single fibular graft, Stabilization.

Introduction

Low Back pain is one of the major health problem encountered in medical practice. It accounts for major disability and economic loss worldwide. There are numerous causes for backache. Spondylolisthesis is one among them.

Spondylolisthesis is defined as a displacement of one vertebra over the next lower vertebra in the sagittal plane. The clinical syndrome of spondylolisthesis was first described in 1782 by the Belgian obstetrician Herbiniaux, long before an understanding of its pathophysiology, when he reported a bony prominence anterior to the sacrum that created an impediment to vaginal delivery in a cohort of his patients. The term spondylolisthesis coined by Kilian in 1854 is derived from the Greek words, spondylos, meaning "vertebrae" and olisthesis, meaning "to slip." Spondylolisthesis shows a strong familial association, with an incidence in first-degree or second-degree relatives of approximately 25% to 30% and there is no sex predilection [1]. It is gaining importance as one of the main causes of backache in young athletes. This condition is progressive and many times it may get stabilized on its own without morbidity. But most of the time if not treated it may lead to instability pain and neurological problems.

High-grade spondylolisthesis (HGS) is defined as greater than 50% slippage of a spinal vertebral body relative to an adjacent vertebral body as per Meyerding classification, and most common location being L5/S1 followed by L4/L5 [2].

Although more than 50% of translation in the sagittal plane is used to define HGS, it is the associated rotational component in the sagittal plane that often plays a greater role in prognosis and overall management [3].

High-grade spondylolisthesis (HGS) may remain asymptomatic for long periods. It presents with instability pain and neurological symptoms at some stage. Asymptomatic spondylolisthesis of any grade can be left alone without any treatment. The treatment of symptomatic high grade lumbosacral spondylolisthesis has its own technical difficulties for surgical stabilization and fusion unlike lowgrade listhesis. In symptomatic high grade listhesis various treatment modalities were described with their set of limitations and complications. Broadly two major treatment policies were practiced.

- Decompression with an attempt at correcting deformity, implant stabilization and fusion.
- In situ fusion with or without implant stabilization along with decompression. Fusion can be anterior or posterior interbody fusion, transsacral and posterolateral fusion or combination of above.

Reduction and stabilization with fusion will achieve symptomatic relief, a more physiological spinal alignment and sometimes also help in gaining some body height and better cosmetic appearance.

In situ fusion offers good clinical improvement, stabilization and fusion but does not correct the deformity. If significant clinical improvement is possible with some residual deformity and minimal surgery related complications, it may be a good surgical option rather than opting for a technically difficult procedure with greater surgical risk.

Posterolateral fusion in situ is widely practiced for spondylolisthesis of any grade. Posterior lumbar inter body fusion (PLIF) started gaining importance in high-grade spondylolysthesis but has some technical difficulties because of sacral architecture and spinal angulations. They may not allow a good bone-graft placement or spacer in place and also provide small area for bony fusion.

Speed in 1938 proposed L5 – S1 transvertebral fibular graft through anterior approach [4]. Bohlman modified Speeds procedure and proposed L5 – S1 transsacral fibular grafting along with posterolateral fusion and posterior

decompression as a treatment option in high-grade spondylolysthesis. This procedure offers interbody fusion along with widely accepted posterolateral fusion to deal with instability along with posterior decompression for neurological symptoms in simpler way. Bohlman used two-split fibular grafts on either side as strut grafts impacted through two laterally placed tunnels [5]. This procedure later had very few modifications. We used single transvertebral fibular graft and implant stabilization to the vertebra one level above the pathological vertebra via posterior approach.

This study is done to discuss the technique and outcomes of modified technique in management of high grade spondylolisthesis and their outcome treatment modalities were described with their set of limitations and complications.

Aim

To analyse the outcome and advantages of stabilization using in situ fusion of high-grade listhesis with technical modification of Speed's and Bohlman's procedure.

Materials and methods

Prospective study done from september2013 to January 2016 for the management of High grade spondylolisthesis (Grade 3 and Grade 4), patient aged between 15-60 years. Total 15 patients were included in the study. High grade listhesis patients who were not willing for surgery were excluded from the study.

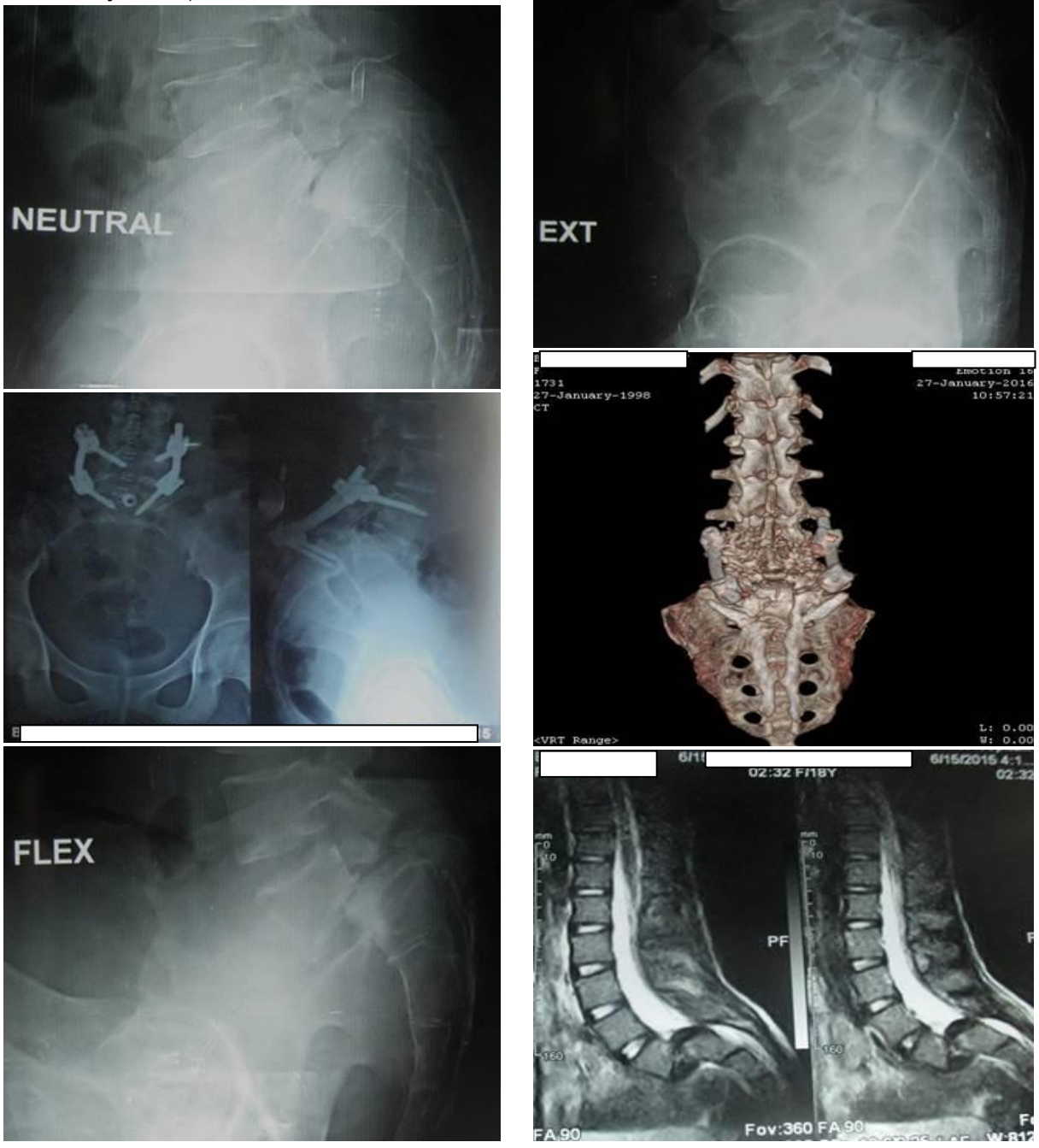
Detailed case history of the patient who has been posted for surgery was taken to assess if the patient falls under inclusion criteria or not. After explaining the surgical procedure, consent of each patient taken.

Preparation of patient

- The operation was performed with the patient prone under general anesthesia. A standard posterior midline approach exposure was carried out from L3 to the sacrum and sub periosteal muscle stripping was done upto transverse processes. Decompression of L5-S1 space is done in case of canal stenosis.
- Posterior pedicle screw instrumentation was placed from L4 to S1. Distraction done as much as possible. Laminectomy of S1 was then performed for exposure of the S1-2 inter space, the S2 nerve root and the S2 pedicle. The dural sac is retracted toward the midline between the S1 nerve root and the S2 pedicle to reveal the entry site.
- Under Fluoroscopic guidance, a guide wire is advanced from this entry point through S1 and across the lumbosacral disc space into the L5 vertebral body. A variable diameter cannulated reamer is used to make a bony tunnel. Fibula harvested and shaped. Fibula impacted in the bony tunnel across L5 and S1.Sacral osteotomy anterior to dural sac for decompression was done whenever required.
- Autologous bone harvested from posterior iliac crest along with hydroxy apatite (G-bone) was used for posterolateral fusion. Suction drain kept for 24 hours.
- Patient was allowed to walk as tolerated post operatively. Post operatively all the patients received Inj. Tramadol 50 mg intravenously for every eight hours for three days.
- All patients underwent check X rays of lumbosacral spine after surgery on post-operative day one. No brace applied.
- All Patients were followed up in the Neurosurgery out Patient Department (OPD) after 14 days, 3 months, 6 months, and 12 months. On every visit digital X-rays of Lumbosacral spine AP view and Lateral view were taken and slip angle was calculated along with fusion. At the end of one year a CT scan of spine with 3D reconstruction was taken to assess bone fusion. Bone fusion was defined by the presence of bridging

trabecular bone between transverse process and sacrum. On every follow up detailed clinical examination was performed and any deficits were documented. VAS (pain score) was documented preoperatively and on follow up. Oswestry disability index (ODI) was documented preoperatively and on follow up.

Figure - 1: Illustrative case images showing pre-operative and post-operative imaging (with sound bony fusion).



Results

Our study included total of 15 patients. Among them 11 were female (73%) and 4 were male (27%). Age range was 15-58 years with average age being 34.53 years.

Out of 15 patients 14 patients complained of instability pain (93.3%) and there was neurogenic claudication in 9 patients (60%). Radicular pain was noted in 10 patients (66.66%).On presentation five patients complained of weakness in lower limbs, seven patients presented with numbness, one patient presented with urinary incontinence.

On examination, ten patients had step deformity, four patients had spine tenderness on percussion, five patients (33.33%) had motor deficits in form of EHL weakness and seven patients had sensory deficits over S1 dermatome (46.6%). Straight leg rising test (SLRT) was positive in ten of them (66.66%) and two patients had diminished ankle jerk.

Visual analogue scale (VAS)

Pre-operative VAS ranged from a score of 5 to 8 out of ten with average being 6.33 out of ten.
On discharge VAS ranged from a score of 1 to 4 out of ten with average being 2.73 out of ten.
On one year follow up VAS ranged from a score of 0 to 2 out of ten with average being 0.73 out of ten.

SLIP angles

Pre-operative slip angle ranged from ten degrees to twenty one degrees with an average slip angle of 15.93 degrees.

On discharge slip angle ranged from nine to twenty degrees with an average slip angle of 14.4 degrees.

On one year follow up, slip angle ranged from nine to twenty degrees with average slip angle of 14.27 degrees.

Intra operatively, pseudoarthrosis was noted in ten patients and root compression was noted in eleven patients. Duration of surgery ranged from 120 minutes to 200 minutes with an average duration of surgery being 161 minutes. Blood loss during surgery ranged between seventy ml to three hundred and eighty ml with average blood loss of 186 ml.

All patients had implant stabilization with posterior decompression and posterolateral fusion. Nine out of fifteen patients underwent anterior decompression additionally.

Post-operative mobilisation of patients ranged from 2 days to 5 days with average of 3.4 days.

OSWESTRY DISABILITY INDEX (ODI)

ODI at the time of presentation was ranging from 42% to 60% with an average of 50.25%.
On six months follow up ODI ranged from 6%to 16% with an average ODI of 11.33%.
At one year follow up ODI ranged from 4%to 14% with an average ODI of 8.67%.

Complications

Infection: One patient (6.66%) developed superficial surgical site infection and the same was treated on antibiotics based on culture report and regular sterile dressings.

EHL weakness: Out of six patients, who had EHL weakness preoperatively, four improved and in two patients it persisted. No new deficits noted.

Bladder involvement: The patient who had urinary incontinence prior to surgery recovered and another patient had transient urinary incontinence which subsided by itself. None of the patient had implant failure or graft failure.

All patients were back to their work by an average of 3.67 months (ranging two to six months). Radiological evaluation showed 100% fusion with no evidence of pseudarthrosis, malunion or non-union.

Discussion

High-grade spondylolisthesis (Meyerding grades III–V) is an uncommon condition, which is quite difficult to treat if symptomatic. Treatment of the symptomatic slips is either in situ fusion or reduction and stabilization. Some authors recommend anatomical reduction of the dislocated vertebra followed by fusion; however, they vary in their techniques in that it can be a reduction with external fixator as a staged procedure before fusion using internal fixation [6] or posterior decompression and fusion before slow reduction in extension followed by anterior fusion [7]. Some may perform only partial reduction of the high-grade slip [8]. Reduction probably improves the morphological appearance of the trunk with the recovery of a normal spine alignment and posture at the cost of increased risk of neurological deficit.

Another popular method of reduction is performed by Gaines procedure which involves removal of L5 vertebral body and reducing the L4 vertebral body on S1 and then stabilizing with transpedicular instrumentation. However, this is associated with 25% reoperation rate with delayed union resulting in implant failure. It is also associated with 75% early neurological deficit [9]. In situ fusion, on the other hand, does not change the abnormal anatomy but has fewer neurological complications, with satisfactory results [10, 11].

Poussa, et al. categorically stated that fusion in situ is definitely better than reduction and fusion in high grade spondylolisthesis with respect to long-term clinical outcome [12]. Though posterolateral fusion is regarded as the gold standard for the treatment of mild spondylolisthesis [11, 12], it has been shown to be associated with inferior fusion rates in high-grade spondyolisthesis [13, 14]. There is recent evidence in the literature that suggests that circumferential fusion not only improves the fusion rate but also appears to provide the best long-term results especially in young patients. Circumferential fusion is currently recommended for high-grade spondylolisthesis [14]. Circumferential 360 fusions in high-grade spondylolishesis can be performed by combining anterior and posterior techniques or by a posterior transsacral fixation with pedicle screw instrumentation. As the complications resulting from the anterior approach are extensive and that it is a two-stage procedure, the all-posterior approach using transsacral fixation and fusion seems to be favoured [15]. Posterior transsacral interbody fusion can be achieved by using a fibular strut graft across the middle of the segment to be fused.

In our study we used a single intact fibular graft. This Intact fibular graft is used to replace tibia which due to remodeling will take entire body weight. Tibialisation of fibula is a standard established procedure. Hence, we opted for single intact fibular graft so that it takes the entire tarsal weight transmission to pelvic girdle more effectively.

In this study the commonest presentation was instability 14/15 (93.33%). Nine (60%) patients had claudication. Ten (66.66%) had radicular pain. EHL weakness was noted in 5 patients (33.33%). Sensory deficits were noted in 7 patients over S1 dermatome (46.6%). Urinary incontinence was seen in one patient. Straight leg raising test was positive in 10 patients (66.66%). Ankle reflex was diminished in two patients.

Postoperatively in all the patients, instability pain and claudication was resolved. In one patient radicular pain persisted for 1 month which

resolved later after liberal usage of analgesics. In one patient who presented with urinary incontinence recovered post operatively but another patient developed transient urinary incontinence post operatively which resolved by four weeks. Post-operative SLRT was negative. No sensory deficits noted on recent follow up.

The diminished ankle reflex noted in the two patients preoperatively persisted postoperatively. One patient had transient weakness of dorsiflexion of foot in the lower limb from which fibular graft was harvested and it subsided within two weeks.

Conclusion

- This procedure is technically simple with no additional perioperative or postoperative complications.
- This procedure is both safe and effective method to treat high grade listhesis.
- This procedure is useful in achieving 360 degrees insitu fusion.
- This procedure has good functional outcome in terms of reduction of pain and disability, early ambulation and back to work.

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