



Original Article

Pedicular lumbosacral spine fusion for adult/adolescent lumbar developmental high-grade spondylolisthesis

Mohamed Atef Elnokaly¹, Mohammed M. Adawi², Ahmed M. Nabeel²

¹Department of Neurosurgery, Faculty of Medicine, Helwan University, Cairo, Egypt. ²Department of Neurosurgery, Faculty of Medicine, Benha University, Benha, Al Qalubia, Egypt.

E-mail: *Mohamed Atef Elnokaly - mohamed_elnokaly@hotmail.com; Mohammed M. Adawi - moh.adawi@yahoo.com; Ahmed M. Nabeel - ahmed_m_nabeel@yahoo.com



*Corresponding author:

Mohamed Atef Elnokaly,
Department of Neurosurgery,
Faculty of Medicine, Helwan
University, Cairo, Egypt.

mohamed_elnokaly@hotmail.com

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ABSTRACT

Background: Few series report on the management of high-grade spondylolisthesis (HGS) in adolescents and young adults. This review highlights a series of six consecutive cases with developmental (dysplastic) HGS successfully managed with L3 or L4 to S1 transpedicular screw placement, rather than *in situ*/noninstrumented lumbosacral fusion.

Methods: The six patients with HGS, according to the Meyerding Grading, presented with low back pain and bilateral sciatica (2016–2020). Patients averaged 19.8 years of age and underwent posterior transpedicular L3 or L4-S1 screw fusions. They were all monitored for at least 6 postoperative months.

Results: None of the six patients developed any major perioperative/postoperative complications; only one patient had severe postoperative back pain that slowly improved over 3 months. All the patients were clinically improved postoperatively, uniformly demonstrated fusion on postoperative CT studies, and considered the operation worthwhile.

Conclusion: Posterior transpedicular screw fixation of the lumbosacral spine is an efficient and safe technique for the treatment of L3 or L4 to L5-S1 HGS. It is a suitable instrumented technique for managing adult/adolescent HGS and offers an alternative to the more typically performed *in situ*/noninstrumented L4-S1 procedures.

Keywords: Adolescent spine, Developmental spondylolisthesis, High-grade spondylolisthesis, In place fusion, Transvertebral fusion

INTRODUCTION

Lumbar spondylolisthesis is a common spinal problem and is presented in about 5% of the population. However, high-grade spondylolisthesis (HGS) according to the Meyerding^[6] grading [Table 1] remains a relatively uncommon subtype. When it presents in the pediatric and adolescent age groups, HGS is typically attributed to progressive congenital (dysplastic) spondylolisthesis.

The following pathology characterizes congenital spondylolisthesis; L5 subluxation over the sacrum due to pars defects, hypoplastic L5 and S1 facets, and a “dooming” sacrum.^[2] In both adolescents and adults, the majority of HGS has been managed utilizing posterior *in situ*/noninstrumented lumbosacral arthrodesis which has often been

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linked to significant pseudoarthrosis rates and other complications.^[7] Here, alternatively, we present six cases of pediatric/adolescent L5-S1 HGS successfully managed with transpedicular screw fixation.^[1]

MATERIALS AND METHODS

We retrospectively reviewed six consecutive patients with HGS (2016–2020), averaging 19.5 years of age [Table 2]. All had low back pain, with bilateral sciatica; 2 additionally demonstrated neurogenic claudication. Notable, none had focal neurological deficits. Preoperative radiographs uniformly showed congenital (dysplastic) bony anomalies resulting in Grade IV spondylolisthesis (HGS) at L5-S1 [Table 2].

All six patients underwent transpedicular L3 or L4 to L5-S1 fusions without reduction of the slip. Relief of symptoms (subjectively) was recorded over the minimum follow-up period of 6 postoperative months. Outcomes were evaluated utilizing the visual analog score (VAS) for low back pain and Oswestry disability index (ODI). Further, postoperative radiological bone fusion was documented over a minimum of 6 months on CT scans/plain radiographs. [Figures 1-3].

Surgical technique

Standard L3 or L4 through S1 laminectomies were performed [Figure 1c], accompanied by bilateral exposure of the transverse processes. Under C-arm guidance, 6.5mm thick,

and 55–65 mm long lumbar pedicular screws were inserted bilaterally from the S1 pedicle and directed anteromedially through the sacral promontory, crossing the L5-S1 disc space toward the vertebral body of L5 anteriorly, but stopping before its anterior cortex [Figure 1d]. Two pedicular screws were then inserted in either L3 or L4 bilaterally and connected to the sacral screws utilizing two rods; in five cases the fusion extended from L4-S1, while in one case, where the L4 facets were severely dysplastic, bilateral L3 screws were applied.

RESULTS

There were no major intraoperative complications (e.g., infections, hemorrhages or nerve injuries, and motor deficits), or long-term postoperative complications (e.g., instrumentation failure, slippage progression, or pseudoarthrosis) in these six patients [Figures 1-3]. However, one patient with L4 facet dysplasia underwent bilateral L3 rather than L4 proximal screws [Figure 1c]. The length of hospital stay ranged from 3 to 5 days [Table 3].

Outcomes

In 5 of 6 patients, radiculopathy improved on VAS and ODI scores (e.g., the latter went from 22 to 64%, mean 40.5% preoperatively, to 5-22% (mean 13.5%) postoperatively) [Table 4]. Only one patient had worsening low back pain postoperatively that gradually improved within 3 months. Fusions were successfully achieved in all six patients, as documented on postoperative lumbar CT scans.

DISCUSSION

Most patients with high-grade developmental spondylolistheses (HGS) develop significant slippage and symptoms during the adolescent growth period. Symptoms typically include; the onset of low back and sciatic pain that can evolve into a full-blown sciatic crisis.^[1,4]

Table 1: The Meyerding grading of spondylolisthesis according to percentage of anteroposterior slippage in the sagittal.

Grade	% Slippage
I	<25
II	25–50
III	50–75
IV	75–100
V (spondyloptosis)	>100

Table 2: Patient demographics and symptomatology and pathology breakdown.

Patient	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Mean
Gender	Male	Female	Female	Male	Female	Female	
Age	17	22	16	18	25	14	19.5
Occupation	Student	Housewife	Student	Student	Housewife	student	
Preoperative							
LBP	+	+	+	+	+	+	
Sciatica	Bilateral	Bilateral/clauding	Bilateral	Bilateral	Bilateral/clauding	bilateral	
Neurological deficit	-	-	-	-	-	-	
Deformity	Flexion	Flexion	None	None	Flexion	None	
Type	Dysplastic	Dysplastic	Dysplastic	Dysplastic	Dysplastic	Dysplastic	
Grade	Grade IV	Grade IV	Grade IV	Grade IV	Grade IV	Grade IV	
Level	L5-S1	L5-S1	L5-S1	L5-S1	L5-S1	L5-S1	

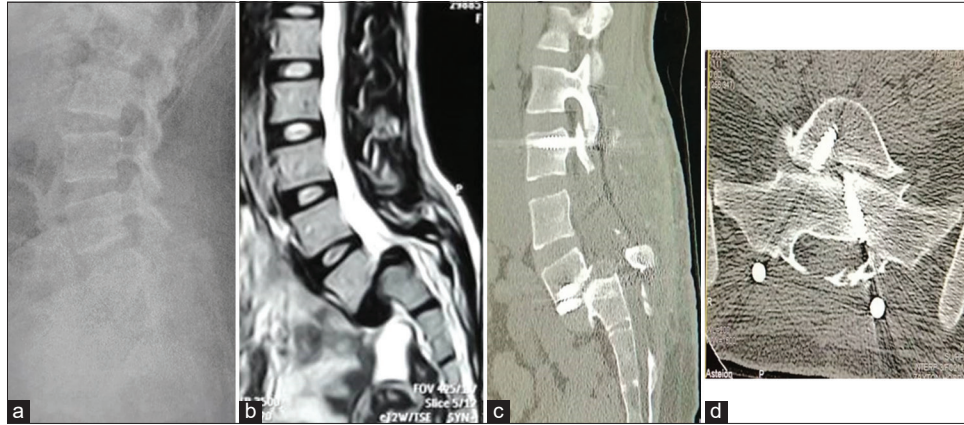


Figure 1: Female patient, house wife, 27 years old, presented by low back pain, bilateral sciatica and flexion attitude. Pre-operative image; (a) Plain x-ray lumbar spine, lateral view, (b) MRI lumbo-sacral spine, sagittal view showing HGS. Post-operative images CT lumbo-sacral spine, (c) sagittal view, showing the screws and limit of its reach, (d) axial view showing triangular arrangement of the transvertebral screws, 16 months following surgery.



Figure 2: Male student, armature soccer player 17 years old, presented with low back pain, bilateral sciatica and flexion attitude (Resembling tight hamstring). 56 months fu, returned back to his sport. Pre-operative images, (a) Plain x-ray lumbar spine, lateral view, (b) MRI lumbo-sacral spine, sagittal view showing HGS. Post-operative plain X-ray lumbar images, (c) lateral view, (d) anteroposterior view after screw placement, 21 months following surgery.

Table 3: Follow data breakdown.

Patient		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Mean
FU duration	Months	56	29	41	34	21	11	32
Operative duration	Minutes	150	210	150	180	200	210	183.3
Blood transfusion		No	No	No	No	yes	No	
Early complications		None	L4 Difficult screw	None	None	Prolonged postoperative back pain	None	
Late complications		None	None	None	None	None	None	
fusion		Fused	Fused	Fused	Fused	Fused	Fused	

Surgical techniques for HGS management have included posterior instrumented fusion, posterolateral interbody

fusion, stand-alone oblique interbody fusion, anterior fusion, L5 vertebrctomy with reduction and fusion, and



Figure 3: Female patient, 14 years student, the youngest in our series, present to us with low back pain and unilateral sciatica. Preoperative images; (a) Plain X-ray lumbar spine, lateral and (b) MRI lumbosacral spine, sagittal view showing Grade IV spondylolisthesis. Plain X-rays lumbar spine, (c) intraoperative c-arm image, showing the screws after fully inserted, while patient is in prone position, (d) early postoperative image, lateral view showing the screws in place with patient in standing position.

Table 4: Postoperative symptomatology changes.

Patient		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Mean
Postoperative	LBP	Improved	Slight improvement	Improved	Improved	Slight improvement	Improved	
	Sciatica	Improved	Improved	Improved	Improved	Improved	Improved	
	Neurological deficit	-	-	-	-	-	-	
	Deformity	Improved	Improved			Slight improvement	-	
VAS for LBP	Preoperative	6	8	6	7	7	5	6.5
	Postoperative	2	3	1	2	4	3	2.5
VAS for sciatica	Preoperative	5	8	7	8	8	5	6.8
	Postoperative	1	2	1	1	3	2	1.67
ODI	Preoperative	44%	64%	22%	25%	54%	34%	40.5%
	Postoperative	12%	22%	5%	9%	12%	21%	13.5%

circumferential *in situ* fusion (either two-staged or single staged posterior approach).^[3,4] Here, we successfully utilized transpedicular fusion from L3 or L4 to L5-S1 in six patients with HGS. Safe penetration of the anterior sacral cortex with longer sacral screws for deeper penetration of the bone mass, increased their pull-out strength. Further, no patients developed further slippage following the procedures over an average follow-up period of 32 months.

We, therefore, concluded that the transpedicular instrumentation technique was more effective than the typical *in situ*/noninstrumented L5-S1 HGS fusion for HGS.^[5]

CONCLUSION

Transpedicular lumbosacral L3 or L4 to L5-S1 instrumented fusions for grade IV spondylolisthesis/HGS without reduction was successfully performed in six adolescent/young adults. This resulted in favorable outcomes and was a useful alternative to *in situ*/noninstrumented HGS lumbosacral fusions.

Declaration of patient consent

Patient’s consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Boachie-Adjei O, Do T, Rawlins BA. Partial lumbosacral kyphosis reduction, decompression, and posterior lumbosacral transfixation in high-grade isthmic spondylolisthesis: Clinical and radiographic results in six patients. *Spine (Phila Pa 1976)* 2002;27:E161-8.
- Greenberg MS, editor. *Spine and spinal cord In: Handbook of Neurosurgery*. 8th ed. New York: Thieme Publishers; 2016. p.

- 1024-151.
3. Hart RA, Domes CM, Goodwin B, D'Amato CR, Yoo JU, Turker RJ, *et al.* High-grade spondylolisthesis treated using a modified Bohlman technique: Results among multiple surgeons. *J Neurosurg Spine* 2014;20:523-30.
 4. Kotil K, Tunckaya T, Bilge T. Reduction of high-grade spondylolisthesis using a transvertebral surgical approach in a child. A case report and review of the literature. *Turk Neurosurg* 2006;6:4197-201.
 5. Lehmer SM, Steffee AD, Gained RW Jr. Treatment of L5-S1 spondyloptosis by staged L5 resection with reduction and fusion of L4 onto S1 (Gaines procedure). *Spine (Phila Pa 1976)* 1994;19:1916-25.
 6. Meyerding HW. Spondyloptosis. *Surg Gynecol Obstet* 1932;54:371-7.
 7. Pizzutillo PD, Hummer CD. Nonoperative treatment for painful adolescent spondylolysis or spondylolisthesis. *J Pediatr Orthop* 1989;9:538-40.

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