Modified Bohlman`s Procedure - Transsacral Interbody Fusion Technique for Spondyloptosis

DK Thomas[1], N Mohammed[2], A Akii Bua[2], D Toby[1], V Arlet[3], C Quan Soon[4]

ABSTRACT

The following report describes the unique procedure currently emerging to treat spondyloptosis.

Here we describe the case of K.P. 17 year old female who had been diagnosed with spondylolisthesis. Her chief complaint was lower mechanical back pain, for which she underwent a lumbar-sacral fusion procedure in Port of Spain General Hospital in 2011. Upon follow up in clinic, she presented with severe axial / mechanical back pain which was affecting her lifestyle. This progressively became worse.

On further evaluation a spondyloptosis of L5/S1 was diagnosed and despite previous fusion, a Modified Bohlman`s procedure with non-vascularized fibula autograft after decompression of L5 /S1 motion segment, was performed. This procedure has never been reported in the Caribbean region. The occurrence, pathomechanics, operative technique and outcomes are discussed in detail.

Keywords: Autograft, fibula graft, modified Bohlman`s procedure, spondyloptosis

---

From: [1]Princess Elizabeth Centre, [2]Department of Surgery, Orthopaedics and Trauma, General Hospital, Port of Spain, [3]Department of Orthopaedic Spine Surgery, Hospital of the University of Pennsylvania, United States of America and [4]Department of Clinical Surgical Sciences, University of the West Indies, St. Augustine, Trinidad and Tobago.

Correspondence: Dr D Thomas, Princess Elizabeth Centre, Port of Spain, Trinidad.
Email: dylankthomas@hotmail.com

INTRODUCTION

Spondyloptosis is defined as 100% or greater subluxation of a cranial vertebral body on the adjacent caudal one (1). It results in one spinal segment being lodged in the anterior or posterior space of the adjacent segment. Traditionally multistage procedures have been used to correct this deformity. However, we employed a one stage procedure - a posterior approach for transsacral interbody fusion technique for spondyloptosis.

CASE REPORT

For the past 6 years K.P, a 17 year old female of African ethnicity, has been a patient at Princess Elizabeth Hospital which is a complex orthopedic spine institute. She was first referred in 2010 with a history of lower back pain, aggravated by flexion and extension, and with physical activities accompanied by weakness in lower limbs. This pain gradually became worse, thus affecting her lifestyle. Her past surgical history includes an umbilical repair at age 5, with no other medical condition, and a query family history of Marfan's Syndrome (maternal). She had a normal musculoskeletal examination in 2010. On X-ray (figure 1) in 2010 an L5/S1 grade 3 spondylolisthesis (isthmic) was diagnosed and the patient was sent for MRI lumbar spine and nerve conduction test (NCT).

On MRI severe stenosis was noted at S1 level and on NCT; no cauda equina involvement or lumbar nerve root impingement was found. She was schedule for surgery and underwent fusion of lumbosacral spine at Port of Spain General Hospital. Postoperatively, initially her symptoms were relieved and her spondylolisthesis appeared to have improved (figure 2). In early 2016 she returned complaining once again of severe mechanical back pain, which was not

radiating to lower limbs and without any radiculopathy symptoms. X-ray revealed a spondyloptosis at L5/S1 with rods and pedicle screw from her previous spine surgery (figure 3). Physiotherapy and pain killers were inadequate and the decision of Modified Bohlman's procedure was made. With the patient in prone position with intraoperative neuromonitoring the lumbar area was surgically exposed and previous hardware (pedicle screws and rods) were removed. 4cm of left fibula autograph was harvested and a L5/S1 discectomy and foraminotomy was performed with mobilization of thecal sac. A tunnel was prepared through the sacrum into L5 vertebral body where the fibula graft was impacted and augmented by 7mm cannulated screws from S1 to L5 vertebral bodies (Figs 4 and 5). Post operatively the patient was discharged at day five and returned to normal activities of daily living and school in three weeks. She was seen in clinic routinely post procedure where her symptoms subsided with no deficit.

DISCUSSION

Spondylolisthesis can be defined as forward displacement of one vertebral body to the one adjacent to it. Spondyloptosis is the final result of this progression of the spondylolisthesis. The Meyerding grading of subluxation is shown in Table 1. It is based on the degree of listhesis observed on radiological viewpoint and it is well used in clinical practice for diagnosis purposes (1). In 1976 Wiltse et al classified spondylisthesis based on etiology Table 2. (2) Isthmic spondylolisthesis (spondylolysis) rarely produce central canal stenosis since only the anterior part of spinal canal is shifted forward (3). Roche and Rowe studied 4200 cadaveric spines and found only 1.1% African American females compared with 2.3% for Caucasian females and 4.2% overall incidence (4). Jackson et al concluded that the incidence is higher in young athlete population than in general population (5).

Our patient of Afro Caribbean descent didn't engage in sporting related activities. Fredrickson et al provided insight on progression of spondylolisthesis in 500 first grade students with plain radiographs. The incidence of spondylolysis was 4.4 % at age 6, increasing to 5.2% at age 12 and 6 % by adulthood. No cases of spondylolysis reported in newborn (6). Frennerd et al followed 47 patients below 16 years for 7 years initially with low grade spondylolisthesis. Initial degree of slip was 9- 14 % with only 4 % did the degree of slip progress more than 20% (7). Danielson et al reported 3 % of 311 patients' progress to slip of more than 20% (8). Our patient's spondylolisthesis started at age 12 and progressed to spondyloptosis at age 17 despite posterior instrumentation. Most cases of isthmic spondylolisthesis is due to mechanical stress to that portion of neural arch of the pars interarticularis (9). Wilste et al suggest most cases of isthmic spondylolisthesis is result of fatigue fractures caused by repetitive stress rather than single traumatic event (10). Farfan et al suggest a single event leading to micro fracture in pars with progression proceed with repetitive stress (11). Cyron and Hutton performed a study on 74 cadavers by cyclic loading on the inferior articulate process causing a shear force resulting in pars fracture of 55 of 74 spines. The study also brings in notice the strength neural arch increases up to 4 or 5 decade (12). The primary etiology of our patient was spondylolysis (isthmic) that progressed to spondyloptosis. The rarity of this phenomenon in our patient is noteworthy despite the absence of regional epidemiological studies on spondylolisthesis.

Our operative technique which involved "back to front" L5 to S1 interbody fusion using non vascularized fibula autograft with cannulated screw augmentation was similar to that found in the literature (13). This is first documented application of this technique in Trinidad and Tobago. There are other studies that showed modified Bohlman's procedure augmented with

posterior instrumentation (14). The patient had quick return to function and nil neurological deficit or pain emphasizing the effectiveness of this procedure.

In conclusion the “Back to Front” Modified Bohlman’s technique is a safe and effective single stage procedure used to treat spondyloptosis and allows quick return to activities of daily living/functionality.

REFERENCES

1. Meyerding HW. Spondyloptosis. Surg Gynaecol Obstet 1932; **54**:371–377.
2. Wiltse LL, Winter RB: Terminology and measurement of spondylolisthesis. J Bone Joint Surg [Am] 1983; **65:** 768–72.
3. Greenberg, M. (2001). Handbook of Neurosurgery 7th Edition. New York, NY: Thieme Medical Publishers.
4. Roche MA, Rowe GG. The incidence of separate neural arch and coincident bone variations: a survey of 4,200 skeletons. Anat Rec 1951; **109:** 233–52.
5. Jackson DW, Wiltse LL, Cirincione RJ. Spondylolysis in the female gymnast. Clin Orthop 1976; **117:** 658–73.
6. Fredrickson BE, Baker D, McHolick WJ, et al. The natural history of spondylolysis and spondylolisthesis. J Bone Joint Surg [Am] 1984; **66:** 699–707
7. Frennered AK, Danielson BI, Nachemson AL. Natural history of symptomatic isthmic low-grade spondylolisthesis in children and adolescents: a seven year follow-up study. J Pediatr Orthop 1991; **11:** 209–13.
8. Danielson BI, Frennered AK, Irstam LK. Radiologic progression of isthmic lumbar spondylolisthesis in young patients. Spine 1991; **16:** 422–5.
9. Standaert CJ, Herring SA .Spondylolysis: a critical review *British Journal of Sports* Med 2000; **34:** 415–22.
10. Wiltse LL, Widell, Jackson DW. Fatigue fracture: the basic lesion in isthmic spondylolisthesis. J Bone Joint Surg 1975; **57:** 17–22.
11. Farfan HF, Osteris V, Lamy C. The mechanical etiology of spondylolysis and spondylolisthesis. Clin Orthop 1976; **17:** 40–55.

12. Cyron BM, Hutton WC. The fatigue strength of the lumbar neural arch in spondylolysis. J Bone Joint Surg 1978; **60:** 234–8.

13. Hart RA, Domes CM, Goodwin B, et al. High-grade spondylolisthesis treated using a modified Bohlman technique: results among multiple surgeons. J Neurosurg Spine 2014; **20:** 523–30.

14. Bohlman HH, Cook SS: One-stage decompression and posterolateral and interbody fusion for lumbosacral spondyloptosis through a posterior approach. Report of two cases. J Bone Joint Surg Am 1982; **64:** 415–18.

Table 1: The Meyerding Grading Classification

Grade	**Percentage Subluxation (of the AP diameter of the vertebral body)**
1	< 25%
2	25-50 %
3	50-75%
4	75-complete
Spondyloptosis	>100%

Table 2: Wiltse et al 1976 spondylisthesis classification based on etiology

Type	**Etiology**
Type 1. Dysplastic	Congenital abnormality of L5 and 94 % are associated with spinal bifida.
Type 2. Isthmic	A lesion in the pars interarticularis occurs, also known as spondylolysis. Is seen in 5-20 % of spine X-rays and appears the neck of "scotty dog" on oblique lumbar spine X-ray and it subdivided in 3 divisions. Type 2 A Elongated but intact pars Possibly due to repetitive fracture and healing. Type 2 B Lytic Representing a fatigue fracture of the pars. Type 2 C Acute Fracture of pars.
Type 3. Degenerative	Due to long standing intersegment instability, but no break in pars found in 5.8% of men and 9% of women (majority asymptomatic)
Type 4. Traumatic	Due to fractures usually in areas other than pars.
Type 5. Pathologic	Generalized or local bone disease e.g. osteogenesis imperfecta.

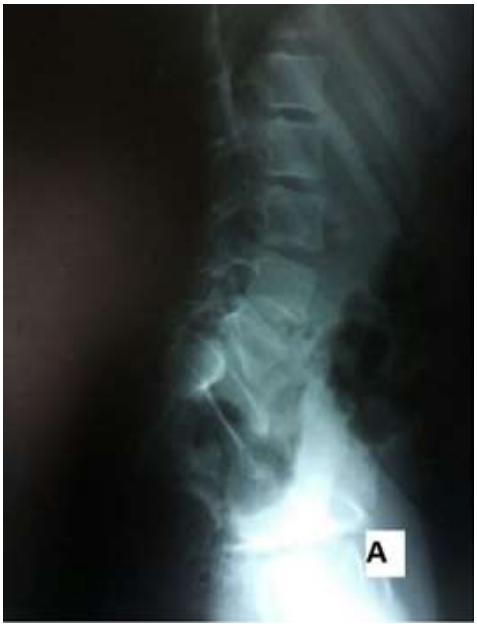

Fig. 1 : Pre operative Xray lateral view L/S spine 2010.

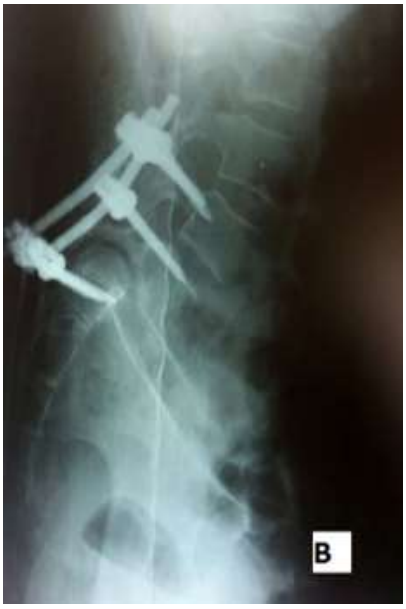

Fig. 2 : Post operative Xray lateral view L/S spine (Posterior instrumentation – pedicle screws and rods).

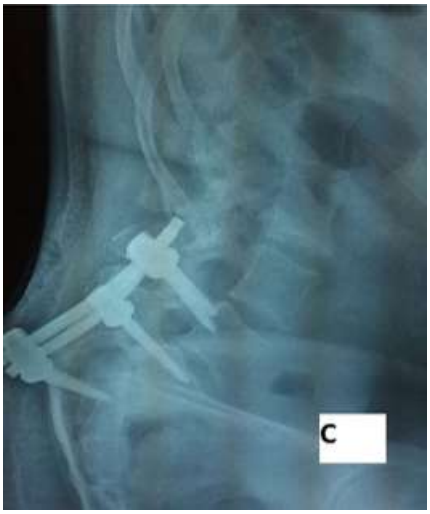

Fig. 3 : Lateral Xray showing spondyloptosis 2015.

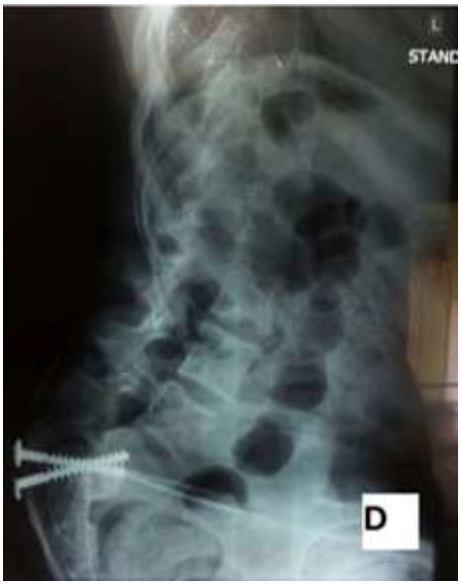

Fig. 4 : Post operative lateral Xray- Modified Bohlman's procedure 2016.

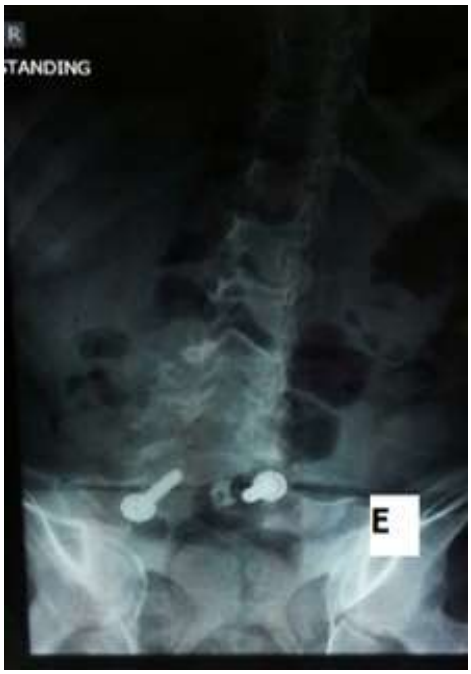

Fig. 5: Post operative AP Xray – modified Bohlman's procedure 2016.