

Case Report

Cauda equina syndrome a rare early surgical complication in a pediatric patient with dysplastic high-grade lumbosacral spondylolisthesis: A case report

Abdulmajeed A. Alzakri, MD.

Department of Orthopedics, College of Medicine, King Saud University, Riyadh, Saudi Arabia.

*Corresponding author:

Abdulmajeed A. Alzakri,
Department of Orthopedics,
College of Medicine, King
Saud University, Riyadh, Saudi
Arabia.

aalzakri@ksu.edu.sa

Received: 14 May 2022
Accepted: 02 August 2022
Epub Ahead of Print: 20 August 2022
Published: 18 November 2022

DOI
10.25259/JMSR_77_2022

Quick Response Code:



ABSTRACT

Recent literature supports the surgical reduction of high-grade spondylolisthesis, particularly with an unbalanced pelvis and spine. Drop foot is the most common neurological complication reported in the literature. Scoliosis Research Society database reported only one patient (child) with cauda equina syndrome after surgery for dysplastic high-grade lumbosacral spondylolisthesis. The lack of longitudinal clinical follow-up of that patient limited their result. There is another report of 12 cauda equina syndrome cases after *in situ* arthrodesis for lumbosacral spondylolisthesis. The current report is the first case in the literature of cauda equina syndrome after partial reduction of dysplastic high-grade lumbosacral spondylolisthesis in a child. The aim was to raise awareness of the possibility of this post-operative complication happening in children and the possibility of avoiding it. A child who developed a cauda equina syndrome as an early neurological complication after surgery, which recovered completely 6 weeks after revision surgery, is reported. During the revision surgery, an L5-S1 transforaminal interbody fusion was performed by insertion of polyetheretherketone cage. Bilateral anal compound muscle action potential is seen after implant removal and sacral dome resection. Using somatosensory, motor evoked potential and continuous electromyogram for both rectal and external bladder sphincters in children with high-grade lumbosacral dysplastic spondylolisthesis undergoing surgical reduction are important to prevent a devastating neurological complication. Sacral dome resection and appropriate L5-S1 discectomy prevent stretching of the cauda equina over the posterosuperior border of the sacrum postoperatively.

Keywords: Cauda equina syndrome, Dysplastic spondylolisthesis, High-grade, L5-S1, Neurophysiology, Pediatric

INTRODUCTION

Cauda equina syndrome is an unusual complication after spinal surgeries. There have been limited published reports in the literature about this complication. The exact pathophysiology remains unclear. The damage to the nerve roots composing the cauda equina could be because of direct mechanical compression and venous congestion or ischemia.^[1] Scoliosis Research Society (SRS) has reported 5% of neurological surgical complications in pediatric patients, with dysplastic and isthmic spondylolisthesis, with only one case having cauda equina syndrome.^[2]

The current report is a case of high-grade lumbosacral dysplastic spondylolisthesis who developed immediate cauda equina syndrome postoperatively, which is an unusual post-

How to cite this article: Alzakri AA. Cauda equina syndrome a rare early surgical complication in pediatric patient with dysplastic high-grade lumbosacral spondylolisthesis: Case report. J Musculoskelet Surg Res 2022;6:283-7.

operative complication after such surgery. The current report aimed to raise the awareness of the possibility of this post-operative complication happening in children and how to avoid it.

CASE REPORT

A 13-year-old female not known to have any illness presented in our clinic with back pain. Physical examination showed normal gait and bilateral hamstring tightness. She had normal upper and lower extremities neurological examination. She showed no improvement in the back pain after an extensive physical therapy program of 6-month duration.

Radiological evaluation, including radiographs, computed tomography (CT scan), and magnetic resonance imaging (MRI), showed high-grade lumbosacral spondylolisthesis with a retroverted pelvis and balanced spine (Type V according to the Spinal Deformity Study Group classification) [Figures 1 and 2] and Grade V according to Meyerding classification.^[3,4]

She underwent a posterior approach, L5 laminectomy, and L5-S1 instrumentation with posterolateral fusion. Only, a

partial L5-S1 discectomy was performed and using a delivery funnel, a putty bone graft was inserted under fluoroscopy control. No neuromonitoring was used for that surgery. Reduction to grade two was achieved without perioperative complications. The slip percentage and lumbosacral angle improved from 81.4% and 48.9° preoperatively to 41.08% and 77.7° postoperatively. Nothing in the operation was reported suggested that the cauda equina had been directly injured during the procedure. Immediately postoperatively, the patient developed urine and bowel incontinence, saddle paresthesia, L5 and S1 dermatomes numbness bilaterally, and decreased L5 and S1 myotome muscle power bilaterally.

Emergency radiographs and CT scan were performed, showing a good position of the screws. MRI showed severe spinal stenosis at the level of L5-S1 with anterior compression [Figure 3]. Then, it was decided to take the patient to the operating room again. The neurophysiology monitor was prepared for the revision surgery.

Before starting the incision, the baseline neuromonitoring showed no anal muscle response bilaterally, and while removing the implants a sudden return of the anal muscle response in the neuromonitoring was observed. Resection of the sacral dome and complete removal of intervertebral disc were performed. Polyetheretherketone intervertebral cage was inserted after the preparation of the S1 endplate.

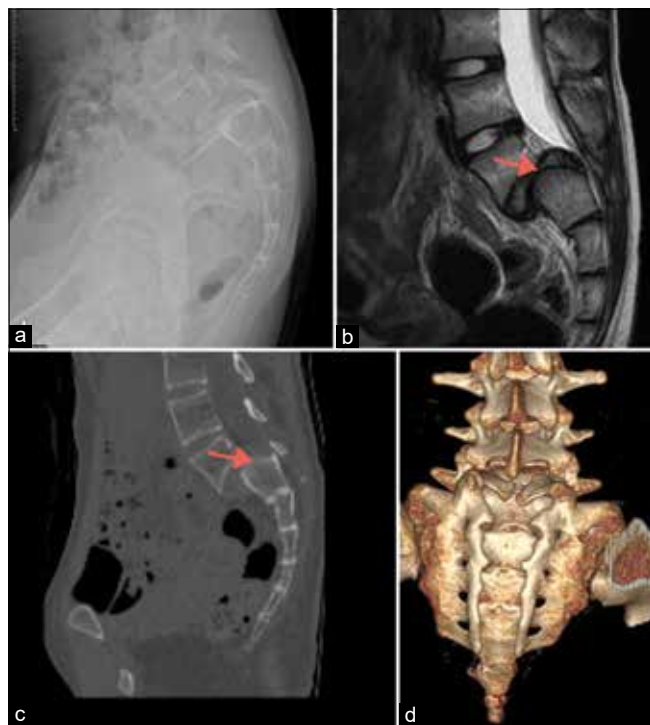


Figure 1: Pre-operative images of the lumbar spine. (a) Lateral radiograph view shows dysplastic type of L5-S1 spondylolisthesis with unbalanced pelvis. (b) Sagittal view magnetic resonance imaging shows a large L5-S1 intervertebral disc (arrow). (c) Sagittal view computed tomography scan shows the sacral dome (arrow). (d) 3D reconstruction of lumbosacral junction shows a complete agenesis of dorsal wall of sacral canal.



Figure 2: (a) Pre-operative full spine radiograph shows coronal malalignment. (b) Pre-operative full spine radiograph with retroverted pelvis.



Figure 3: Immediate post-operative images. (a and b) Anteroposterior and lateral views radiograph show L5-S1 instrumentation with posterolateral bone graft. (c) Sagittal view computed tomography scan shows partially resected sacral dome (arrow). (d) Sagittal view magnetic resonance imaging shows partially resected L5-S1 intervertebral disc (arrow).

The pedicular screws in L5 and S1 were changed with larger diameter screws. New L4 pedicular and iliac screws were added bilaterally and almost 25% reduction was achieved with normal neuromonitoring till the end of surgery [Figures 4 and 5].

No peri or post-operative complications were reported after the revision surgery. Postoperatively, the patient was referred to physical and occupational therapy. After 6 weeks, the sphincters' function returned to normal, sensation, and muscle power of the lower limbs returned to normal. The revision surgery was done 24 h after the index procedure. Both index and revision procedures were performed by the same surgeon.

DISCUSSION

We are reporting on a patient who developed cauda equina syndrome after partial reduction of high-grade lumbosacral spondylolisthesis and recovered completely after sacral dome resection and L5-S1 transforaminal interbody fusion (TLIF). Recent literature suggests that quality of life improvement in pediatric patients with high-grade lumbosacral spondylolisthesis undergoing surgical reduction, specifically when they have an unbalanced pelvis and spine.^[5] The



Figure 4: Post-operative computed tomography-scan of the lumbar spine shows the resected sacral dome and inter-vertebral cage.

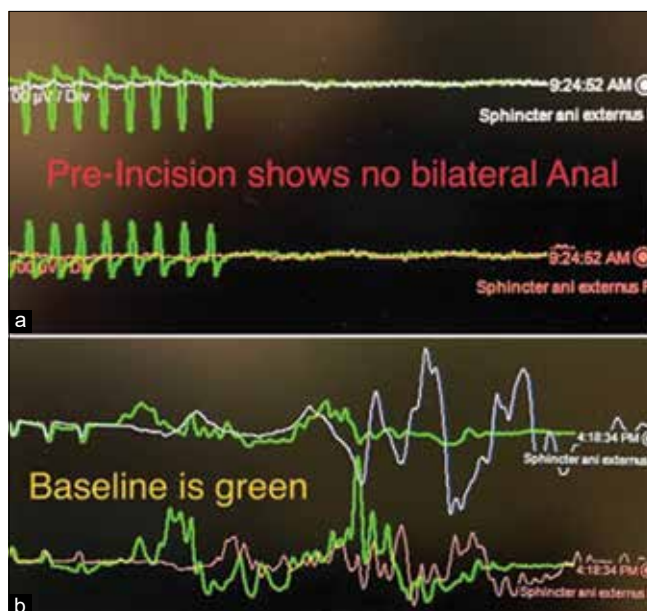


Figure 5: (a) Neuromonitoring shows a baseline with no anal sphincter's muscles response. (b) Bilateral anal muscle compound muscle action potential is seen after implants removal.

neurological deficits have been reported more in the series of patients who underwent surgical reduction.^[6,7] According to the SRS database, the neurological deficits were higher in patients who had a surgical reduction of the high-grade lumbosacral spondylolisthesis.^[2] Among 605 patients treated surgically for pediatric isthmic/dysplastic spondylolisthesis, the neurological complications were reported in 10% among the reduction group and 2.1% among the non-reduction group. They reported 31 patients who had a new neurologic deficit postoperatively, one was a cauda equina syndrome, and 30 were nerve root injuries. The majority of them had recovered from these deficits, with either complete or partial recoveries.

The lack of follow-up information regarding the patient who developed cauda equina postoperatively limited their study.^[2]

The most of the neurological complications reported in the literature are L5 nerve root transient injury and only few studies reported cauda equina as a complication after surgery of high-grade spondylolisthesis in pediatric patients.^[8] Schoenecker *et al.* reported 12 pediatric patients who underwent *in situ* arthrodesis for Grade III, or IV lumbosacral spondylolisthesis complicated by cauda equina syndrome, none of them was after surgical reduction like the current case. Half of them eventually recovered completely, and the remaining patients had a permanent residual neurological deficit, manifested either by complete or partial inability to control the bowel and bladder.^[9]

Petraco *et al.* suggested in their anatomic study that the L5 nerve root could be stretched during the reduction of high-grade spondylolisthesis. This might explain the high incidence of foot drop following the reduction of high-grade spondylolisthesis. The damage to the nerve roots composing the cauda equina could also be damaged because of direct mechanical compression and venous congestion or ischemia.^[10]

Different techniques in the literature are used to monitor surgical procedures involving the spinal cord or parts of the cauda equina nerves. Multimodality neurological monitoring packages are needed because the patient with high-grade spondylolisthesis needs maximal security concerning the risk of intraoperative and iatrogenic neurological deficits. James *et al.* have used a continuous recording of electromyographic (EMG) activity in sphincter muscles by placing the electrode on each side of the midline in the external rectal sphincter in a series of patients who underwent a radical removal of lipomas at the conus or cauda equina region.^[11] Pang *et al.* measured rectal sphincter tone in patients undergoing surgeries in the lumbosacral junction.^[12] Shinomiya *et al.* assessed the detrusor muscle function during surgery by measuring the visceral pressure in tethered cord patients.^[13] Nakamae *et al.* reported two cases with high-grade dysplastic spondylolisthesis using intraoperative electrophysiological monitoring.^[14]

Shortening the lumbosacral junction by resecting the sacral dome leads to relaxing the tension on nerve roots and correcting the deformity. Min *et al.* consecutively studied that 15 patients with high-grade dysplastic lumbosacral spondylolisthesis were surgically treated by posterior-only approach with resection of the sacral dome. Postoperatively, four patients had a temporary neurological deficit of the L5 nerve root, which resolved completely within 3 months. No cauda equina or permanent neurological deficits were reported in their series.^[15] The pre-existing lumbosacral kyphosis vertically oriented the sacrum and dome of sacrum in patients with high-grade lumbosacral spondylolisthesis make the cauda equina nerves more vulnerable. We think that a relative stretching of the sacral nerves over the posterosuperior

border of the sacrum could be the cause of developing cauda equina syndrome postoperatively. Correcting the lumbosacral kyphosis, complete resection of the sacral dome, and doing TLIF might prevent such complication from happening after surgical reduction or *in situ* fusion of patients with high-grade lumbosacral spondylolisthesis.

CONCLUSION

Dysplastic high-grade lumbosacral spondylolisthesis is associated with a high incidence of neurological deficits and surgery should only be practiced under the guidance of multimodal neuromonitoring with continuous recording of EMG activity in sphincter muscles. Correcting the lumbosacral angular deformity and resecting the sacral dome might be the reason for decreasing the cauda equina tension over the post-superior border of the sacrum. It is important to take all precautions to prevent devastating and may be irreversible neurological deficits postoperatively.

AUTHOR'S CONTRIBUTIONS

The author AA has conceived and designed the analysis, collected the data, performed the analysis and wrote the paper. The author has critically reviewed and approved the final draft and is responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

Approved by institutional review board, College of Medicine, King Saud University (June 2022; E22 6891).

DECLARATION OF PATIENT CONSENT

The author certifies that he has obtained all appropriate patient consent forms. In the form, the patient's parent has given his consent to report the patient's images and other clinical information in the journal. The patient's parent understands that the patient's name and initials will not be published, and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

FINANCIAL SUPPORT AND SPONSORSHIP

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

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