Massively Slipped Vertebral Apophyseal Ring with Intervertebral Disc Herniation in an Overweight Girl: A case report

Akom Prommahachai, MD

Devision of Orthopaedic Surgery, Udon Thani Hospital, Udon Thani, Thailand

Purpose: *To present a rare spine condition in a very young teenage diagnosed combined slipped vertebral apophyseal ring with lumbar disc herniation of L4-5.*
Methods: *The author demonstrates a case by describing the patient's history, physical examination, imaging, surgical treatment and postoperative outcomes. Literature reviews and discussion were included.*
Results: *An 11-year-old overweight female patient presented with chronic bilateral lumbar radicular pain and neurogenic claudication for 4 months. CT scan of lumbar spine demonstrated a large apophyseal fracture of the inferior end-plate of the L4 vertebral body and MRI showed a massively herniated nucleus pulposus at L4-L5 level. Extensive L4 laminectomy combined with avulsed fragment removal and discectomy was performed to decompress the spinal canal and neural structures. The patient showed a complete absence of the clinical symptoms of radicular pain and claudication within 1 month and regained complete neurological recovery in 3 months. The patient was able to return to full activities of daily living and sport in 6 months after the surgery.*
Conclusion: *Combined slipped vertebral apophyseal ring with lumbar herniated nucleus pulposus in a very young overweight girl is a very rare condition. High degree of suspicion is important to properly investigate these conditions. Adequately surgical decompression is the key to obtain an excellent clinical result.*

Keywords: *Slipped vertebral apophyseal ring, lumbar disc herniation, teenage*

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Introduction

Slipped vertebral apophyseal ring is a rare condition which occurs mostly in a skeletal immature spine. The overall prevalence is only 0.07% of all patients of all ages undergoing disc surgery. Male patients are predominance with 85% of cases occurring in boys[1]. In contrast, the prevalence of lumbar disc herniation in children or adolescents is slightly more frequent but still very uncommon. In published literature, children generally constitute only 0.5-3% of all patients surgically treated for lumbar disc herniation[2]. When it comes to a combined conditions in the young, herniated nucleus pulposus associated with apophyseal ring fracture, is even an exceptionally rare condition.

The purpose of this study was to present an unusual spine condition in a very young teenage with massively slipped vertebral apophyseal ring combined with large herniated nucleus pulposus, which included clinical presentation, investigation, surgical intervention provided and postoperative outcomes. The study was approved by the Udon Thani Hospital Ethics Committee (registration number: I013/2563).

Correspondence to: Devision of Orthopaedic Surgery, Udon Thani Hospital, Udon Thani, Thailand
E-mail: prommahachai@gmail.com

Case presentation

An 11-year-old female patient, BMI 30.59 kg/m^2, presented with chronic left leg pain for 4 months. Four months prior to admission, she fell on the ground on her left buttock with a low-energy mechanism. She had suddenly severe left buttock, ipsilateral hip and leg pain and was unable to walk. The patient went to a local hospital and was given oral pain controlled medications, and rested at home for one month. Since then, she had left leg pain and numbness along left L5 dermatome area. Numeric Rating scale of the leg pain was 7 from 10 preoperatively. Her right leg was not painful but had severe numbness along lateral side of the leg. The symptoms of both legs subsided while lying position and worsened while prolonged sitting, walking or standing. The patient was able to stand or walk only 30 minutes and needed to sit down or lie on bed to relieve her both legs discomfort. After many conservative modalities by the local hospital for 4 months consecutively without any improvement, she was transferred to Udon Thani Hospital for further treatment. On physical examination, she had Trendelenburg gait on both sides. Her trunk shifted to the right. Her lumbar spine was hypo-lordotic. The lumbar spine motion showed limited both flexion and extension but there was no spine tenderness. Positive Trendelenburg test was demonstrated on both sides. Both extensor halluces longus were graded III and pinprick sensation of L5

dermatome decreased on both sides. Deep tendon reflex of patellar tendon was +2 and 1+ of Achilles tendon reflex on both sides. There were strong positive nerve root tension signs (straight leg raising test, nerve root sitting test and cross leg raising test) detected on both sides.

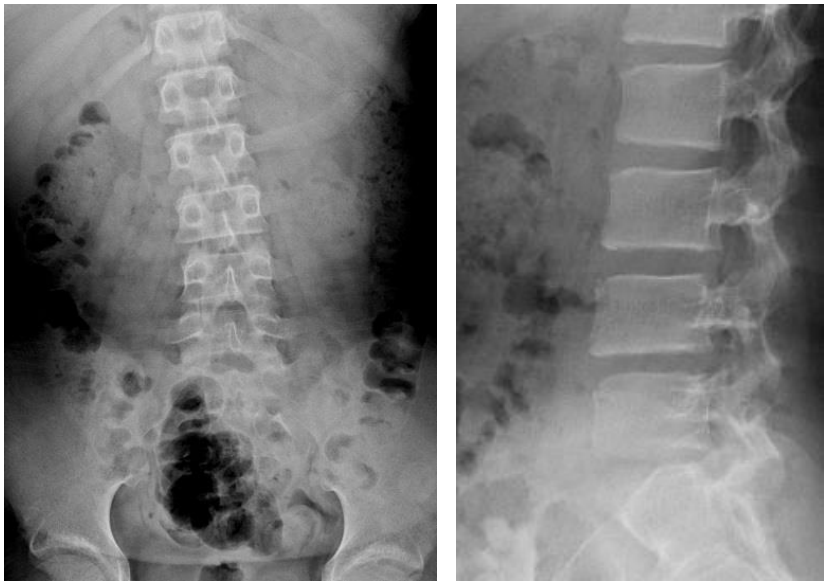

Fig. 1 Plain radiographs of lumbar spine revealed slightly right lumbar deviation on anterior-posterior view (left). There was a slightly narrowing of intervertebral disc height of L4-5 on lateral view (right) but no significant endplate abnormality nor abnormal bony fragment was demonstrated.

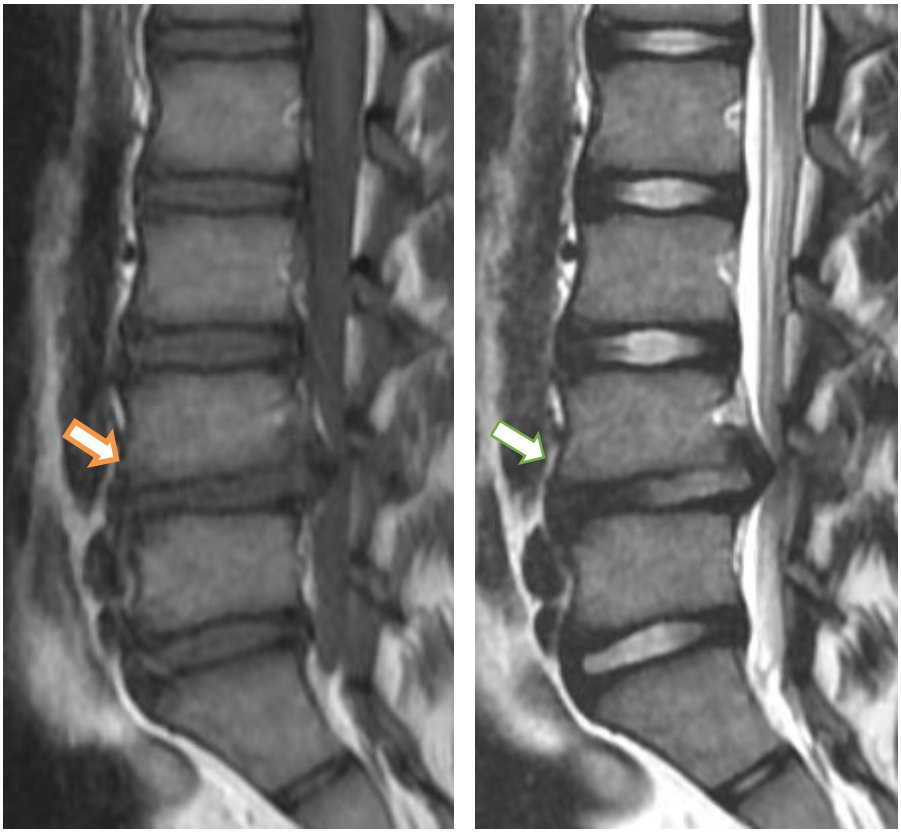

Fig. 2 T1 weighted (left) magnetic resonance image of the lumbar spine in sagittal plain showed a massive, posterior migration of nucleus pulposus at L4-L5 level (arrow). T2 weighted axial image (right) showed the disc extrusion produces a significant mass effect on the thecal sac and nerve roots at this level.

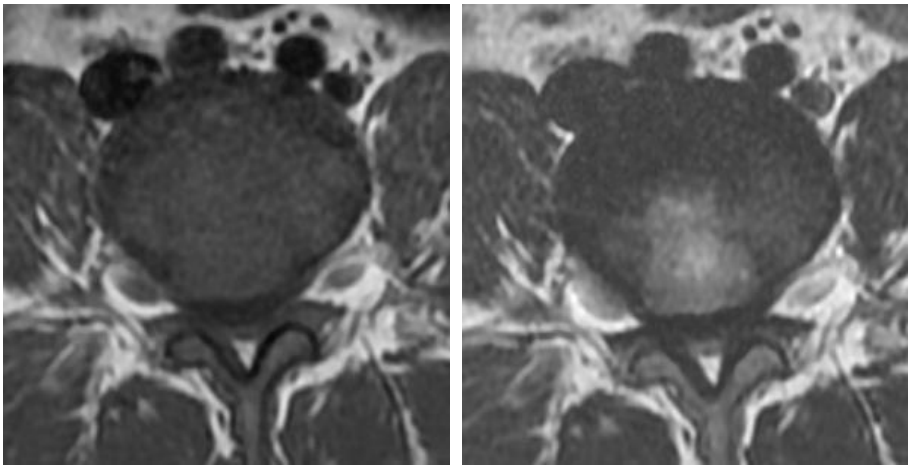

Fig. 3 T1 weighted (left) and T2 weight (right) magnetic resonance image of the L4-5 intervertebral disc level in axial plain showed a large, broad-based, centrally located disc extrusion. The spinal canal was nearly totally compromised by the disc herniation.

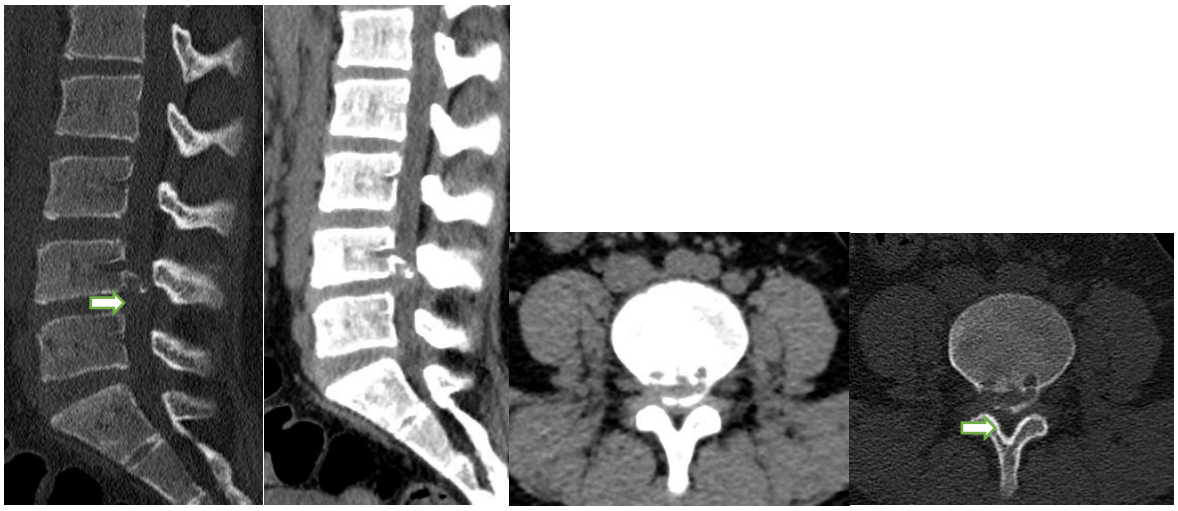

Fig. 4 CT scan of lumbar spine clearly demonstrated a large apophyseal fracture in the midline of the inferior end plate of the L4 vertebral body (arrow). The lesion occupied almost entirely spinal canal behind L4 vertebral body.

Regarding the failure of conservative treatment and the severity of the patient's symptoms, an operative treatment was performed. The patient was placed in the prone position under general anesthesia. Extensive bilateral L4 laminectomy was done to provide a good exposure and obtain adequate working space for decompressive procedure at the level of L4-5. Operative finding showed that the spinal canal was occupied anteriorly by a large, broad-based with sharp spike, a posterior slipped apophyseal osteocartilaginous fragment from inferior vertebral end- plate of L4. Additionally, below the apophyseal ring portion, associated large extruded nucleus pulposus was seen. Dura and bilateral L5 spinal nerve roots were severely adhered to the slipped disc and bony fragment portion by severely epidural fibrosis. Lysis of epidural adhesion was done carefully followed by a removal of the retropulsed apohyseal ring fragment. L4- 5 discectomy was performed to achieve an adequate spinal canal decompression. There was no dural tear or any intraoperative complications. The patient completely recovered from bilateral leg pain and discomfort (Numeric Rating Scale: 0 from 10) within 1 month postoperatively, and regained fully neurological recovery of weakness and sensation within 3 months.

6 months after the surgery, the patient had normal gait appearance with no neurogenic claudication. Numeric Rating Pain scale at 6 months was 0 from 10 of her back and both legs. Her spine had full lumbar motion and no deformity. All neurological examination was still normal. She returned to school and was able to participate school or sport activities normally without pain on her back or legs. Follow-up MRI imaging at postoperative 6 months demonstrated widening spinal canal at the level of L4-5 after surgical decompression (Fig.5)

Fig. 5 Six months postoperative MRI lumbar spine demonstrated considerably widening spinal canal of L4-5 level (arrow) without bony or disc compression at the anterior thecal sac after surgical decompression.

Discussion

Slipped vertebral apophyseal ring have been given many names, such as limbus fracture; fracture of vertebral rim; posterior marginal node; vertebral end plate dislocation; avulsed apophyseal ring; and apohyseal ring fracture[3]. The etiology and risk factors of the condition are still inconclusive. Avulsed apophyseal ring fracture caused by chronic stress and repetitive trauma has been a well-known theory of slipped apophyseal ring. The posterior apophyseal ring is highly and repetitively stressed during lumbar extension and this repeated mechanism causes weakness of the ring. Consequently, the weakened posterior ring will be vulnerably avulsed following traction stress in lumbar flexion[4]. However, some authors believed that separation of the ring apophysis was caused by direct trauma of the ring lesion, because it commonly occurred in the active athletes or strenuous activities[1,5]. Traumatic events, which were found in slipped vertebral apophyseal fracture over 60%, could be ranged from simple falls to vigorous activities[6]. The presented case had overweight condition, BMI 30.59 kg/m^2, and this body figure may be a contributing factor of aggravating minor trauma to be a great impact on the spine and may be a cause of apophyseal ring separation. Nevertheless, this issue has only few small studies mentioning that an overweight condition could possibly been associated with posterior apophyseal ring separation[7]. In contrast, overweight is associated with lumbar disc herniation and predicted lumbar discectomy in female adolescents. This evidence is supported by a large scale clinical study by Mattila and colleague in 2008[8]. The possible association is partly related to early biological maturation.

Generally, lumbar disc herniation and slipped apophyseal ring share similar clinical presentations which are unilateral or bilateral radiculopathy depending on site and size of the lesion. Neurogenic claudication can be presented if the lesion significantly occupies the spinal canal, especially in a long-standing duration. The patient with a combined lesion, slipped or avulsion of apophyseal ring with disc herniation may exhibit more severe symptoms than the patient with pure disc herniation[3]. Our present case report had obvious clinical neurogenic claudication. This could be explained by chronicity with severe spinal canal narrowing. The great magnitude of compression by the combined lesion possibly contributed to persistent bilateral nerve root tension signs over 4 months of clinical course.

The best investigation to diagnose slipped or avulsed vertebral apophyseal ring fracture is computerized tomography of lumbar spine. It demonstrates size, shape and location of the fracture clearly and also helps differentiate the calcified or non-calcified fracture from disc herniation[3,5]. Although MRI has low accuracy to distinguish the bone fragment from the low signal intensity of the

disc or the posterior longitudinal ligament, it is still the best imaging for intervertebral disc herniation. In case of combined lesions, MRI is necessary for evaluating disc pathology and also planning of disc surgery[3]. The choices of investigation depend on each patient's characteristics. While MRI is the gold standard of a patient with neurological abnormality, CT scan is also indispensable for an immature spine which avulsed apophyseal ring can be one of differential diagnosis. An inadequate imaging could lead to inappropriate surgical intervention such as a difficulty of exposure or decompression including potential neural damage. The present case report, CT and MRI were conducted and they demonstrated a combination of slipped posterior apophyseal ring fracture and large intervertebral disc herniation.

There are several operative procedures that have been used to decompress slipped vertebral apophyseal ring and disc herniation. Microscopic or endoscopic lumbar spinal decompression can provide an adequate decompression and provide a minimal invasiveness to soft tissue and spinal integrity, particularly in acute slipped or very recent injury and a unilateral side or lateral site of lesion[9-11]. Hemi- or full laminotomy and/or discectomy may be an alternative option to obtain an adequate spinal decompression with a lesser degree soft tissue invasiveness than a standard laminectomy. This option might be suitable for subacute or chronic symptoms with a small magnitude or unilateral side of compression[1,12,13]. However, the author chose a standard bilateral extensive laminectomy for several reasons. First, this procedure provides a clear and direct visualization of spinal canal and involved spinal nerve roots bilaterally. Second, severely epidural fibrosis around thecal sac and spinal nerve roots would have to be expected from chronic symptoms. Therefore, an extensive lysis adhesion with an adequate exposure needed to be accomplished through a standard decompressive laminectomy. Third, considerably massive pathology requires an adequate working space to avoid dura or neural tissue damage. Fourth, an extensive laminectomy necessitated to access the apophyseal fragment which located posterior to L4 vertebral body. The standard bilateral decompressive approach is also more effective than the unilateral approach (either microscopic, endoscopic decompression or hemi-laminotomy) in central disc or avulsed ring fracture location[5,6,9,11,13-15]. Finally, this procedure has provided an excellent and reliable results for avulsed apophyseal ring fracture and intervertebral disc herniation in the adolescent[13,16-18].

Summary of previous clinical articles related to surgical interventions of slipped vertebral apophyseal ring and lumbar disc herniation was provided in table 1. Ten studies (200 patients) were included and all of them were retrospective case series or case reports.

Table 1 Summary of clinical studies related to surgical treatment of slipped apophyseal ring and lumbar disc herniation.

Study (Year)	No. of patients (Gender, M:F)	Mean age (range, years)	Surgical intervention	Outcome	Follow-up (years)	Complication
Our study (2020)	1 (0:1)	11	Extensive laminectomy + avulsed fragment + disc removal	Completely relief and full neurological recovery	0.25	none
Farrokhi et al. (2009)[13]	2 (2:0)	13.5 (13-14)	Extensive laminectomy + avulsed fragment + disc removal	Completely relief	N/A	none
Matsumoto et al. (2007)[10]	18 (15:3)	28.9 (11-69)	Microscopic discectomy + avulsed bony fragment removal	JOA score for low back pain improve from 14.1 to 26.3 (maximum:29)	1.76	1 disc recurrence
Shirado et al. (2005)[17]	32 (22:10)	25.4 (16-39)	Laminectomy + avulsed fragment + disc removal	75% Excellent 22% good 3% fair	4.7	none
Mendez et al. (2002)[6]	23 (17:6)	35 (22-58)	Hemi or full laminectomy + avulsed fragment removal + discectomy	75% excellent, 16% good	N/A	none

Study (Year)	No. of patients (Gender, M:F)	Mean age (range, years)	Surgical intervention	Outcome	Follow-up (years)	Complication
Martinez-Lage et al. (1998)[1]	1 (1:0)	15	Laminotomy + avulsed fragment removal + discectomy	Excellent	9	none
Talha et al. (1997)[14]	1 (1:0)	18	Wide laminectomy + avulsed fragment removal + discectomy+ Fusion	radicular pain relief in 3 months, back pain relief in 9 months	0.75	none
Baba et al. (1996)[11]	29 (19:10)	16.5 (9-24)	26 patients: slightly extended laminotomy avulsed fragment removal + discectomy 3 patients: slightly extended laminotomy+ avulsed fragment removal + discectomy + posterolateral fusion	21 excellent 8 good	5.8	3 temporarily painful paresthesia
Scarfo et al. (1996)[12]	26 (17:9)	34.3 (20-53)	Microsurgical discectomy avulsed fragment removal + discectomy	Good	1	none
Epstein et al. (1992)[5]	59 (38:21)	33 (7; <20 11;20-30 22;30-40 17;40-50 2; >50)	32 cases: Extended laminotomy 18 cases: hemilaminectomy 6 cases: laminectomy + avulsed fragment removal + discectomy (3 cases: no surgery)	42 excellent 9 good 4 fair 1 poor	1.7	none
Savini et al. (1991)[15]	9 (7:2)	27 (15-40)	6 cases: unilateral laminotomy with partial facetectomy 2 cases: bilateral laminectomy 1 case: hemicorpectomy +anterior fusion	All: complete regression of pain and total recovery of neurologic problems.	2	1 cauda equina syndrome; regressed completely in 6 months.

JOA = Japanese Orthopedic Association

The age of patients in the included studies (table 1) ranged from 9 to 69 years[11,10]. The mean age of patient ranged from 13.5 to 35 years[6,13]. Six included articles reported the lesion occur mainly in the third and fourth decade of life[5,6,10,12,15,17] while only 4 small-scaled articles reported the lesion occurred in the mid-period of second decade of life[1,11,13,14]. The slipped apophyseal ring mostly occurred in male, and the male (139): female (61) ratio is 2.27:1. These demographic findings are significantly different from the presented study that the lesion occurred in an 11-years-old female patient. In terms of surgical treatment, the majority of included studies (6 from 10) reported decompressive laminectomy (slightly extended, extended, wide, extensive laminectomy) with avulsed bony fracture and disc removal was performed and provided completely pain relief, neurological recovery and overall excellent results[5,6,11,13,14,17]. Minimal invasive or microsurgical decompression was reported in 2 studies[10,12] with good result, improved JOA score but one recurrence disc herniation after surgery. This summarized review may indicate that standard decompressive measure is suitable for such a combined lesion and able to accomplish an adequately neural decompression also obtain an excellent clinical outcomes.

Conclusion

Combined slipped vertebral apophyseal ring with lumbar herniated nucleus pulposus in a very young overweight girl is an exceptionally rare existing condition. High index of suspicion is critically important to properly and thoroughly investigate these combinations. MRI lumbar spine together with CT scan are necessary to diagnose the combined lesion correctly. Adequate surgical decompression by extensive laminectomy simultaneous with avulsed fragment removal and discectomy is the key to obtain excellent clinical results.

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กรณีศึกษาการเกิดภาวะแผ่นหน่อกระดูกสันหลังแตกเลื่อน และหมอนรองกระดูกสันหลังส่วนเอวเคลื่อนทับเส้นประสาทในผู้ป่วยเด็กหญิงน้ำหนักเกิน

อาคม พรมมหาไชย, พบ

วัตถุประสงค์: *เพื่อนำเสนอกรณีศึกษาการเกิดภาวะแผ่นหน่อกระดูกสันหลังเลื่อนร่วมกับหมอนรองกระดูกสันหลังส่วนเอวเคลื่อนทับเส้นประสาทในผู้ป่วยเด็กวัยรุ่นซึ่งพบได้น้อยมาก*

ผลการศึกษา: *กรณีศึกษาผู้ป่วยเด็กหญิงอายุ 11 ปี น้ำหนักเกิน มีอาการปวดเอวร้าวลงขาสองข้างร่วมกับอาการ neurogenic claudication มา 4 เดือน ผลการตรวจ CT scan พบแผ่นหน่อกระดูกสันหลังส่วนเอวบริเวณ inferior end-plate ปล้อง L4 แตกเป็นชิ้นขนาดใหญ่เคลื่อนตัวไปด้านหลังกดทับโพรงประสาทและ MRI พบหมอนรองกระดูกสันหลังส่วนเอวเคลื่อนในระดับเดียวกัน ผู้ป่วยได้รับการรักษาโดยการผ่าตัด L4 bilateral extensive laminectomy และตัดแผ่นหน่อกระดูก inferior end-plate ปล่อง L4 ที่กดเบียดโพรงประสาทและหมอนรองกระดูกสันหลังส่วนเอวในระดับเดียวกันที่ทับรากประสาทออก ภายหลังผ่าตัดอาการปวดสะโพกร้าวลงขาและ claudication หายเป็นปกติใน 1 เดือน ความผิดปกติของระบบประสาทกลับมาเป็นปรกติใน 3 เดือน และผู้ป่วยสามารถกลับไปใช้ชีวิตรวมถึงการเล่นกีฬาได้เป็นปรกติใน 6 เดือนภายหลังผ่าตัด*

สรุป: *การเกิดภาวะแผ่นหน่อกระดูกสันหลังเลื่อนและหมอนรองกระดูกสันหลังส่วนเอวเคลื่อนทับเส้นประสาทร่วมกันในผู้ป่วยเด็กหญิงอายุน้อยและน้ำหนักเกินพบได้น้อยมาก การตระหนักถึงภาวะทั้งสองมีความสำคัญในการส่งตรวจรังสี และการผ่าตัดระบายความดันโพรงประสาทและเส้นประสาทที่เพียงพอให้ผลการรักษาหลังผ่าตัดที่ดีมาก*