

## Intervertebral Disc Herniation in Adolescents

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- Background:** The purpose of this study was to review surgery-proven lumbar disc herniation in adolescents with an emphasis on the distinguishing features.
- Methods:** Twenty-eight adolescents between 14 and 18 years old had lumbar discectomy after conservative treatment for 9 months. Indications for surgery were intractable pain and failure of conservative treatment for more than 6 weeks. Lumbar spine apophyseal ring fracture was found in 10 of the 24 patients (42%) who had computed tomography studies. Seven patients had piecemeal excision of the fractured apophysis together with the discectomy.
- Results:** All but three patients could raise their leg more than 70 degrees after the operation. The latest follow-up was conducted an average of 6.1 years after surgery. Good or excellent results were noted in 93% of the patients. Two patients had follow-up operations for recurrent disc herniation and wound infection.
- Conclusion:** Apophyseal ring fracture was a feature in adolescent disc herniation that requires surgical intervention. Early computed tomography study is proposed to detect apophyseal ring lesion, which may lead to failure of conservative treatment. Excision of the fractured ring apophysis is suggested in addition to discectomy when the canal space is occupied.  
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**Key words:** disc herniation, adolescent, apophyseal ring fracture.

Lumbar intervertebral disc herniation rarely occurs in adolescents. The clinical presentations of adolescent disc herniation differ from those of the adults.<sup>(1-6)</sup> Back pain is not all marked in adolescent patients. Persistent postural disturbances and lack of history of injury are the prevalent presentations.<sup>(4)</sup>

Most of the patients with herniated discs can be successfully managed using conservative treatment. Since many of the adolescents with back and leg pain, have negative lumbar radiographs, the diagnosis of disc herniation is only considered as a possibility. No real incidence of disc herniation in the ado-

lescent population has been quoted in the literature. Of the total number of discectomies performed for disc herniation in patients of all ages, only 0.5-6.8% were performed on adolescents.<sup>(1,7,8)</sup> Causes for the rarity of discectomy in adolescents are not clear, and the features of the few adolescent patients who required surgery have seldom been discussed.

In this study, we reviewed the adolescent patients who had surgery-proven disc herniation to clarify the distinguishing features from those in the adults and the risk factors that show the need for surgical intervention.

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## METHODS

Twenty-eight patients between 14 and 18 years old had surgery for lumbar disc herniation in the authors' hospital from 1991 to 1998. There were 27 male patients and one female patient. Nine patients (32%) had history of sports injuries, traumas, or lifting heavy objects before the onset of symptoms. All patients had received at least one of the following conservative treatments: bed rest, traction, physiotherapy, medication, and chiropractic treatments.

The indications for surgical intervention include 1) intractable pain and failure of conservative treatment for more than 6 weeks, 2) radiographic diagnosis of intervertebral disc herniation by computed tomography (CT), magnetic resonance imaging (MRI) or myelograph, and 3) nerve tension sign. A single-level unilateral foraminotomy or partial laminectomy was performed to remove the herniated disc and decompress the affected nerve root. The associated apophyseal separation was removed piece by piece using a down-biting curette to decompress the spinal canal, as described by Epstein.<sup>(9)</sup> Spinal fusion was not performed routinely in addition to the discectomy.

Follow-up data was obtained from medical records, image studies, and questionnaires. The results were graded as excellent when there was no pain and no limitation of activity. Results were graded as good when back pain or leg pain upon heavy activity was occasionally reported. Results were graded as fair when the symptoms improved after operation but recurrent or residual pain led to restriction of activities. Poor results were graded when the symptoms did not improve or worsened after the operation.<sup>(1)</sup>

## RESULTS

The average duration of symptoms before surgical intervention was  $9.0 \pm 7.1$  months (range, 1 to 24 months) before the surgery was advised. The symptoms had been noted since the mean age of 16 years 7 months. At the time of operation, the mean age of the patients was 17 years and 4 months.

### Physical findings

Back pain was noted in all but two patients. Forward flexion of the spine was limited in all

patients. All patients had sciatica and three patients had sciatica involving both legs. Paresthesia was present in 15 patients (54%) in whom the L5 dermatome was involved in 12 patients and the S1 dermatome was involved in three patients. Muscle weakness was noted in 11 patients (39%) in whom extensor hallucis longus (L5) was involved in 10 patients and flexor hallucis longus (S1) was involved in one patient. Deep tendon reflex was decreased in eight patients, and all occurred during the ankle jerk. Seven patients had tight hamstring muscles. At the time of operation, the straight leg raising test was positive in all 28 patients. Pain was initiated when the leg was raised to a mean of 33 degrees (range, 20 to 50 degrees). Crossed leg raising test was positive in 15 patients (54%).

### Radiographic findings

Standard antero-posterior and lateral lumbar radiographs exhibited scoliosis in six patients and loss of lumbar lordosis in 11 patients. The level of disc herniation was L4-L5 in 23 patients and L5-S1 in five patients. Twenty-four patients underwent CT studies; disc herniation was located laterally in 19 patients and five patients had central disc herniation. In almost all patients the disc herniation was protruded; only one case was diagnosed as sequestered.

Apophyseal ring fracture was found in 10 of the 24 patients who underwent CT study (42%). The apophyseal ring fracture and disc herniation were at the same level, indicating the fracture and disc herniation came from an acquired injury and both were responsible for the symptoms (Fig. 1). The upper end plate of L5 was the most common site (4 cases). A large, centrally located protruding apophyseal ridge was noted in five cases. The apophysis was located laterally in another four cases. The other one case had a centrally located and small lesion.

### Operations

A single-level unilateral foraminotomy was performed to remove the herniated disc and decompress the affected nerve root in 23 patients. The other five patients received bilateral foraminotomy or laminectomy for a central herniated disc or fractured apophysis. In the 10 patients who had apophyseal ring fractures, seven patients received piecemeal excision of the fractured apophysis in addition to discectomy to decompress the spinal canal. Four of the seven

patients had lateral lesions that directly compressed the nerve root (Fig. 1). The other three patients had piecemeal excision of a centrally located ring apophysis that was prominent and caused acute indentation on the thecal sac (Fig. 2). Three patients did not have concomitant excision of the fractured ring apophysis during discectomy. Two of the three patients had laminectomy for a large but smooth, centrally located apophysis (Fig. 3). One patient had a small, centrally located lesion and only discectomy was performed.

Back pain and sciatica were resolved after the surgery. All but three patients could raise their legs more than 70 degrees. The three patients demonstrating residual nerve tension sign had no more pain or postural deformity postoperatively. All 10 patients that underwent apophyseal ring separation had good or excellent results after discectomy with concomitant excision of the fractured apophyseal fragments or laminectomy.

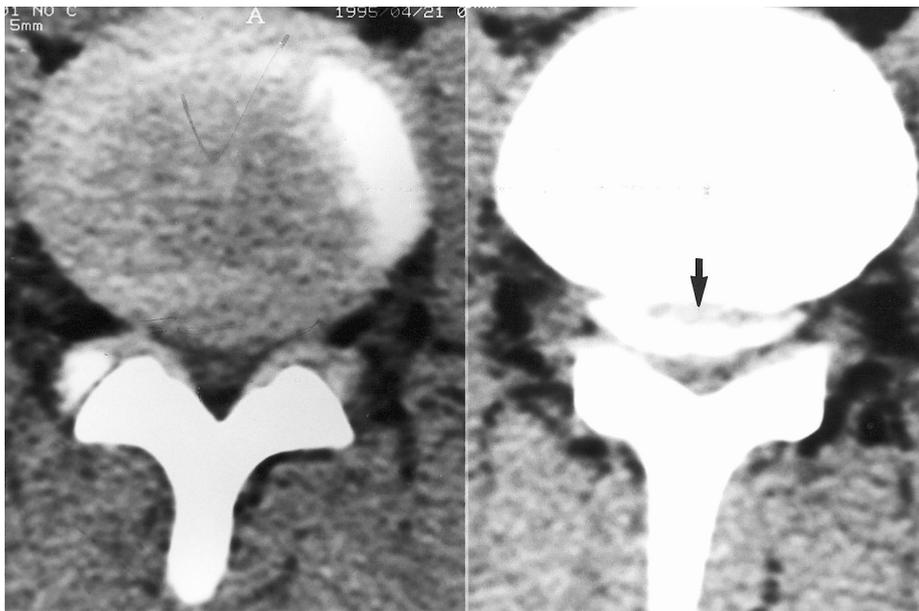
Two patients had subsequent operations. One had a good result initially. Recurrent disc herniation



**Fig. 1** An 18-year-old male had L45 disc herniation and L5 upper ring apophysis separation. Excision of the laterally located fractured apophysis (arrow) and discectomy were performed to relieve back and leg pain that persisted for 12 months.



**Fig. 2** A 13-year-old male had L45 disc herniation and L5 upper ring apophysis separation. Excision of the prominent, centrally located apophysis (arrow) was performed in addition to discectomy and laminectomy.



**Fig. 3** A 15-year-old male had L4/5 disc herniation and L4 lower ring apophysis separation. He had discectomy and laminectomy to decompress the spinal canal. The large and smooth fractured apophysis (arrow) was left alone. Results were excellent 7 years after the operation.

with incapacitating pain led to a second operation 3 months after the first discectomy. An excellent result was achieved after the second operation. The other patient had deep wound infection and debridement was performed 1 week after the discectomy. The infection was controlled and the final result was graded as good.

The latest follow-up was conducted at an average of 6.1 years after surgery (mean age, 23.8 years). Seventeen of the 28 patients (59%) had excellent results, in which no pain or limitation of exercise was reported. Nine patients (32%) demonstrated good results, in which occasional mild pain was reported. Two patients had fair results (7%) because of recurrent back pain without sciatica. The radiographic studies showed equivocal findings and the patients did not want further surgical intervention. The occurrence of apophyseal ring fracture was not associated with the fair results or recurrent disc herniation.

## DISCUSSION

The goal of treatment of adolescent lumbar disc herniation is to relieve symptoms and allow early

return to school. A trial of conservative treatment is the established standard;<sup>(6)</sup> however, it does not justify a prolonged period of medication and activity restriction. Kurihara and Kataoka reviewed 70 adolescents with disc herniation.<sup>(8)</sup> Only 40% of the patients responded to conservative treatment and recurrence of symptoms was common after they returned to normal activity. In our series, the 28 adolescents suffered from pain and postural deformity for an average of 9 months. The delay of definite diagnosis and surgery might have been the result of insidious onset of back pain in adolescents and because doctors are used to treat adolescents conservatively.

The results after surgical discectomy were generally excellent.<sup>(1,7,8,10-14)</sup> Borgesen and Vang reviewed 158 adolescent patients reported in the literature and in their series.<sup>(7)</sup> The rate of good and excellent results after surgery was 93.7%. Our series also demonstrated good and excellent results in 93% of patients. DeLuca et al. compared the results of non-operative treatment to that of discectomy and found the rate of a good and excellent results was only 25% in the non-operative group versus 91% in the operative group.<sup>(14)</sup>

Since damaged disc material never regains its natural property with or without surgical intervention, a less favorable outcome is expected with longer observation of this condition. DeOrio and Bianco found good results in only 73.5% of the patients at a mean of 19 years follow-up, although the rate of good results was 90% the first year after surgery.<sup>(1)</sup> During a follow-up study after 27.8 years, Papagelopoulos et al. reported the probability that a patient would not need additional surgery was 80% at 10 years and 74% at 20 years after the initial operation.<sup>(15)</sup> In this series, one patient had definite recurrence of disc herniation and another two patients demonstrated recurrent back pain without evidence of disc herniation. Discectomy is not the final solution for all patients with disc herniation; however, for prompt relief of symptoms and early return to normal school activities, we propose early discectomy when conservative treatment fails.

Apophyseal ring separation or fracture is uncommon and has been described mainly in adolescent males.<sup>(9,16-21)</sup> Yang et al. reviewed disc herniation on lumbar CT and found apophyseal ring separation in 5.7% of 352 patients of all ages.<sup>(21)</sup> In this study, a high incidence of apophyseal ring separation (42%) was noted in the 24 adolescents who underwent CT imaging. The previous studies focusing on adolescents seldom described apophyseal ring separation<sup>(1,3-8,14,15)</sup> because the lesion could not be detected on plain radiography or myelography.<sup>(20)</sup>

Epstein and Epstein proposed a classification for limbus fracture.<sup>(9)</sup> A space-occupying bony lesion is an aggravating factor together with a herniated disc in the nerve root impingement. Although we performed piecemeal excision of the separated apophysis in seven cases in our series, we cannot define the criteria for concomitant apophysis excision when discectomy is indicated. Nevertheless, we suggest that the apophysis located laterally can be excised together with the disc. For the lesion that is located centrally and markedly occupies the canal space, decompression can be performed using piecemeal excision or laminectomy. Additional fusion may be necessary to prevent instability when discectomy and laminectomy are performed together.

A review of surgically treated cases does not avoid the potential of sampling bias. The incidence of adolescent disc herniation, as well as its symptoms and radiographic findings, is not the issue of

this study. The ring apophysis separation may be responsible for the unique features of adolescent disc herniation in which a lack of history of injury, less intensity of back pain, and more neurologic deficits are observed. Ten of the 28 patients, who had suffered from symptoms for 9 months and finally required surgery, demonstrated fractured lumbar ring apophysis on CT. The existence of apophyseal lesions may be a poor prognostic factor, and early surgical intervention is justified. For relief of symptoms and early return to school, discectomy is the choice of treatment when conservative treatment fails. We propose early CT or MRI study for adolescents who have back or leg pain persisting for 4 to 6 weeks to aid the diagnosis of disc herniation as well as to detect apophyseal lesions that may lead to failure of conservative treatment. Excision of the fractured ring apophysis is suggested in addition to discectomy when the canal space is occupied.

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## 青少年的椎間盤突出

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**背景：** 對青少年椎間盤突出的外科病例進行研究，並著重於與成人椎間盤突出的異同。

**方法：** 28位年紀介於14至18歲的椎間盤突出病人於保守療法達9個月後進行手術，腰椎電腦斷層顯示10位病人(42%)有椎體環韌帶斷裂。7位病人接受椎間盤及環韌帶切除術，其中4位斷裂的環韌帶位於外側，壓在神經根上，3位斷裂的環韌帶位於中央，明顯造成硬脊膜的壓跡。

**結果：** 術前病人的坐骨神經炎症狀於術後獲得緩解，除3位病人外皆可直腿抬高超過70度，術後平均6.1年的追蹤顯示，93%的病人有良好預後。2位病人因復發性椎間盤突出及傷口感染而再次手術。

**結論：** 外科手術是解除症狀及早日讓青少年返回正常學校生活的首選療法。早期電腦斷層檢查可及早發現腰椎環韌帶斷裂此一導致保守療法無效的因子，若斷裂的環韌帶造成神經壓迫，可於椎間盤手術時一併切除。  
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**關鍵字：** 椎間盤突出，青少年，腰椎環韌帶斷裂。

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