



Adolescent Lumbar Intervertebral Disc Herniation: Conservative versus Surgical Treatment

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Abstract

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BACKGROUND: Lumbar disc herniation (LDH) in adolescents is relatively a rare condition among those cases presented with low back pain. Trauma and genetics are the most common predisposing factors. Furthermore, the clinical presentations differ from those of the adults. Back pain is not all marked in adolescent patients.

AIM: This study was subjected to discuss the etiology, diagnosis and treatment modalities, and the variable outcomes for both medical and surgical treatment of LDH in adolescents.

PATIENTS AND METHODS: This prospective study was conducted on 20 patients (12 males, eight females) age range 10–19 years presenting with LDH, managed and treated conservatively and/or surgically in Neurosurgery Department at Kasr Al Ainy School of medicine, Cairo University in the period from October 2015 to September 2016 with 12-month follow-up period.

RESULTS: In our study, 12 patients (60%) gave a positive family history, also nine cases (45%) had a history of back trauma before affection with LDH. All the cases (100%) were presented with sciatic pain while only half of them had low back pain, also two cases with motor deficit. After performing magnetic resonance imaging of lumbosacral spine, L5-S1 disc level was the most common level affected. All the patients were subjected to medical treatment which was effective in 40% of the cases and surgical treatment was the only curative method in 12 cases (60%). In this study, the outcome was excellent in 90% of cases where significant to complete relief of pain and significant improvement in the neurological deficits was achieved.

CONCLUSION: Conservative treatment is less effective for adolescent LDH patients as compared with adults, even though it remains the first-line treatment for adolescent LDH.

Introduction

Lumbar disc herniation (LDH) is a common disorder among adults with degenerated lumbar intervertebral discs. However, its occurrence in adolescence is much less frequent mostly because adolescents tend to have a healthier lumbar spine as compared with adults [1]. Although almost all attention was given to adult LDH, adolescent LDH remaining partially understood. Over years, the number of studies in this regard was on a rise, which led to an ever increasing understanding of this entity [2].

Trauma (mostly sport-related or self-reported injury) is commonly considered as the most likely cause. As many as, 30–60% of children and adolescents with symptomatic LDH have a history of trauma before the onset of pain [3], [4], [5], [6], [7], [8]. This is in contrast to adult patients who usually do not have any traumatic experiences before the symptoms occur. However, more recent studies suggest that instead of being a primary contributory factor, trauma is likely to be an inciting event in the exacerbation of the pre-existing lesion in the discs, for example, micro-damage, degenerative changes, etc. [7], [9], [10]. The second generally recognized cause

is genetic factor. Studies have shown that between 13% and 57% of adolescents with LDH have a first-degree relative with the same disorder [11], [12], [13].

LDH in adolescence is usually manifested by symptoms that are generally similar to those observed in adults [7], [10]. Back pain is not all marked in adolescent patients. One distinctive feature is that up to 90% of patients have a positive straight-leg raising test [5], [14]. However, adolescents are less often seen with neurological symptoms such as numbness and weakness [12], [15], [16].

Although conservative treatment is generally recommended as the first-line treatment for LDH in adolescents without neurological deficits [11], [16], [17], [18], [19], it has been widely agreed by most authors that conservative treatment is not as effective for pediatric LDH as it is for adults [6], [9], [16], [20], [21] and its successful rate varies from 25% to 50% [11], [13], [22]. Furthermore, it was found that <1% of those patients had surgery for herniated lumbar disc [23]. Causes for the rarity of discectomy in adolescents are not clear, and the features of the few adolescent patients who required surgery have seldom be discussed.

Like adults, modalities of surgical treatment for adolescence LDH consist of percutaneous endoscopic discectomy (also known as microendoscopic discectomy) and open discectomy including microsurgical discectomy or microdiscectomy (MD), discectomy with laminotomy or laminectomy, and spinal fusion.

Patients and Methods

This prospective study was conducted on 20 patients between (12 males and eight females), age range 10–19 years presenting with LDH, managed and treated in the Neurosurgery Department at Kasr Al Ainy School of medicine, Cairo University in the period from October 2015 to September 2016 with 12-month follow-up period.

Inclusion criteria include people aging 10–19 years with significant back and/or sciatic pain as well radiological diagnosis of disc herniation by magnetic resonance imaging (MRI).

Exclusion criteria include patients who had previous disc surgery or those with spinal deformities.

Methodology

Patient evaluation

History

Proper history taking was done including full personal history, the presenting complaint with special concern for the present history with evaluation and analysis of the patient's symptomatology regarding the onset, course and duration, possible cause, in addition to analysis of other neurological symptoms in focus which include symptoms of low back pain, and/or leg pain, motor, sensory, or sphincteric affection. Furthermore, past history was included in addition to the family history (similar conditions in the family).

Examination

Complete general examination including the patient's vital signs, head, neck, chest, and abdomen was performed for all patients and a fully detailed and thorough neurological examination of the motor and sensory functions and reflexes. In addition, tests to detect nerve root tension signs were performed for all patients.

Investigations

Routine laboratory investigations including CBC, blood sugar, liver, and kidney functions, PT, PTT, and INR were performed.

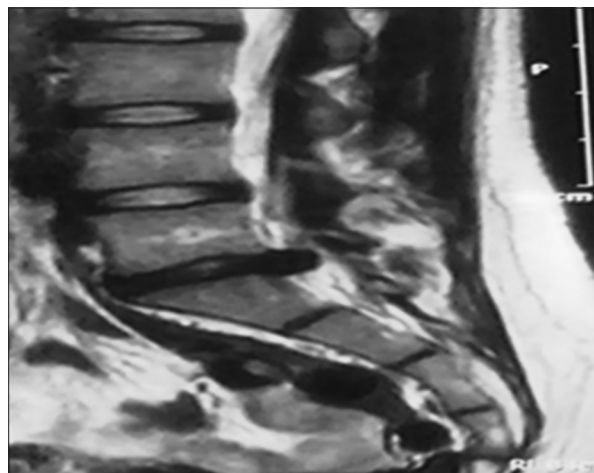


Figure 1: Pre-operative magnetic resonance imaging lumbosacral spine (sagittal T2W images of 19-years-old adolescent with L5-S1 disc herniation)

Radiological investigations included pre-operative plain X-ray for lumbosacral spine with dynamic views to exclude congenital anomalies and instability. Furthermore, MRI (T1WI and T2WI) was done for all patients (Figures 1 and 2). Herniated discs were evaluated for site, size, direction of migration (if present), and degree of degeneration.

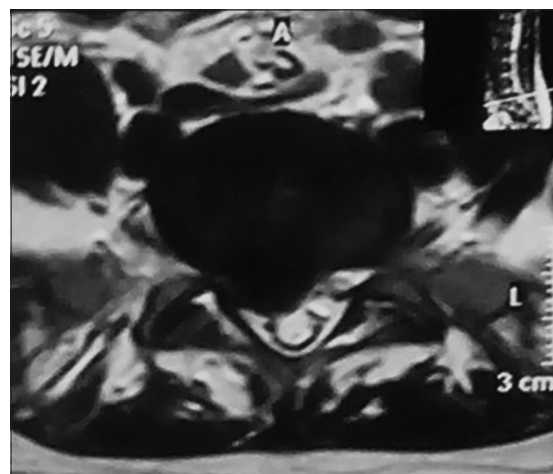


Figure 2: Pre-operative magnetic resonance imaging lumbosacral spine (axial T2W images with L5-S1 right disc herniation)

The modified Pfirrmann grading system [24] was used for lumbar disc degeneration detection in this study as degenerative disc disease is thought to have a role in the occurrence of LDH in adolescents [25].

Management

Conservative treatment was the mainstay of management of these cases for 3–6 weeks including bed rest and medications in the form of analgesics, muscle relaxants, neurotonics, and steroids also physiotherapy. Surgical treatment was indicated for patients with intractable pain and failure of conservative treatment for more than 6 weeks with nerve tension sign and after an informed consent including parental permission for all

cases, a single-level discectomy through fenestration, partial, or complete laminectomy was performed to remove the herniated disc and decompress the affected nerve root either microscopically or conventionally. Spinal fusion was not indicated in addition to the discectomy.

The clinical symptoms were assessed at 3, 6, and 12 months following the start of management. The outcome was classified using visual analog scale (VAS); calculating the score for leg pain and low back pain done at the start of management and throughout the period of follow-up where the patients mark on the line the point that they feel represents their perception of their current state. Figure 3 (The VAS for measuring the pain intensity consists of a 10 cm line, with 2 endpoints, 0 point represents no pain and 10 point represents the worst pain. The patient is asked to rate his/her current level of pain by placing a mark on the line).

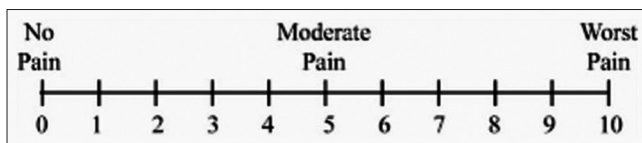


Figure 3: Visual analog scale

The grade of pain relief in the follow-up period was taken as complete if the pain score was 0, 1–2 was taken as significant relief of pain and 3–4 as moderate relief of pain. Furthermore, assessment of motor and sensory functions was done regularly in the follow-up period.

Results

The data collected from the 20 cases during the study were analyzed, compared, and evaluated.

Age and sex distribution

Regarding the age distribution among 20 patients in our study, the peak incidence was between 17 and 19-years-old. The mean age was 17.6 years. Most of patients in our study were males (12 patients, 60%), while 8 patients (40%) were females with M: F ratio (1.5: 1) and this may be due to early exposure to heavy work among males in the society and higher susceptibility to trauma as shown in Table 1.

Table 1: Age and sex distribution among the studied group

Age group	Male No.	Female No.
13–15	0	2
15–17	2	0
17–19	10	6
Total	12	8

Family history and the presence of a possible etiology

Among the 20 cases of this study, there were 12 cases (60%) gave a positive family history of LDH. Furthermore, 9 cases (45%) of the studied group had a history of back trauma either sports related (two cases), lifting heavy objects (two cases), or a road traffic accidents (five cases) Table 2.

Table 2: Incidence of cases with positive family history and possible causes among adolescents with lumbar disc herniation

Possible etiology	No.	%
Positive family history	12	60
Trauma	9	45

Clinical presentation and signs in adolescents with LDH

All the cases of this study were presented with features of LDH for at least 2 months with acute onset in 14 cases (70%), while it was insidious in 6 cases (30%) and the most common presenting feature was sciatic pain representing 100% of the cases. It was unilateral in 17 cases (85%) and bilateral in 3 cases (15%); low back pain was the second common presentation in 10 patients representing 50% of the cases, sensory deficit was detected in 3 cases (15%), while partial unilateral foot drop was observed in only 2 cases (10%), none of the patients had sphincteric troubles. Straight leg raising test was positive (<60°) in 16 cases representing 80% of them Table 3.

Table 3: Clinical presentation and signs in adolescents with lumbar disc herniation

Clinical presentation	No.	%
Type of onset		
Acute	14	70
Insidious	6	30
Sciatic pain	20	100
Unilateral sciatic pain	17	85
Bilateral sciatic pain	3	15
Persistent low back pain	10	50
Sensory deficit	3	15
Motor deficit	2	10
Positive S.L.R. test	16	80

Levels of LDH in the study

According to MRI of lumbosacral spine, all the cases had a single level affection and the most common level affected was at L5-S1 (ten patients, 50% of cases), followed by L4-L5 level with 8 cases affection (40%) as shown in Table 4.

Table 4: Levels of lumbar disc herniation according to MRI

Disc level	No.	%
L5-S1	10	50
L4-L5	8	40
L3-4	2	10

MRI: Magnetic resonance imaging.

Locality of the herniated disc

According to MRI, 18 patients (90%) were presented with laterally located disc herniation (LDH),

only two of them (10% of the cases) were bilaterally located and the other 16 (80%) were unilaterally located disc herniation. Centrally located disc herniation was in two cases of the studied group (10%) Table 5.

Table 5: Locality of the herniated disc

Laterally located LDH		Centrally located LDH	
Unilateral LDH	Bilateral LDH		
16 Cases	80%	2 Cases	10%
		2 Cases	10%

LDH: Lumbar disc herniation.

Management of LDH in adolescents

Regarding different modalities of management in those cases; conservative treatment was effective and sufficient in 8 cases (40%), four males and four females, while surgical treatment after the recommended period of medical treatment (6 weeks) was the only curative method in 12 patients (eight males and four females) representing 60% of the cases Tables 6 and 7.

Table 6: Distribution of the modalities of treatment

The management modality effectiveness	No.	%
Conservative treatment	8	40
Surgical treatment	12	60

Detection of lumbar disc degeneration in the studied group

The modified Pfirrmann grading system was used to detect lumbar disc degeneration among cases through Sagittal T2-weighted images of MRI.

Table 7: Distribution of the modalities of treatment among males and females

Percentage	Male		Female	
	Conservative	Surgical	Conservative	Surgical
No.	4	8	4	4
%	20	40	20	20
Total	12		8	

Six (30%) levels of discs were Grade 1, 12 (60%) levels of discs were graded 3, 2 (10%) levels of discs were graded 5 Table 8.

Table 8: Modified Pfirrmann classification for lumbar disc degeneration detection

Grade	No. of levels	%
1	6	30
3	12	60
5	2	10

Surgical procedures

The applied surgical procedures in our study were: 1 – conventional open laminectomy and discectomy in 6 cases (30% of the whole cases). 2 – microdiscectomy in 6 cases (30%) Table 9.

Table 9: Applied surgical procedure in the study

Surgical procedure	No.	%
Conventional laminectomy and discectomy	6	30
Microdiscectomy	6	30
Total	12	60

Operative findings

Types of disc herniation found intraoperatively: Disc bulge with intact annulus in 8 cases (40%), extruded disc in 3 cases (15%), and subligamentous (sequestered) disc prolapse in 1 case (5%). While characteristics of the removed disc: It was soft, rubbery, and hydrated in 10 cases (50%) but it was hard and dehydrated in 2 cases (10%). The ligamentum flavum was hypertrophied in 6 cases (30%) among the 12 operated cases Table 10.

Table 10: The intraoperative findings

Operative finding	No	%
Type of disc herniation		
Intact annulus	8	40
Extruded	3	15
Sub ligamentous	1	5
Characteristics of the disc		
Soft, hydrated	10	50
Hard, dehydrated	2	10
The ligamentum flavum		
Hypertrophied	6	30
Normal	6	30
Total No. of operated cases	12	60

Post-operative complications

There was no intraoperative complication such as dural tear, root injury. None of the patients had postoperative wound infection or underwent any further surgery for recurrence of symptoms.

The outcome of the cases

Pain relief

The grade of pain at the start of the management and immediately postoperatively (for those who underwent surgical intervention) and through the 12-month follow-up period was obtained from the patients using the VAS. The mean score of leg pain for the patients in the start of management was 8. Post-operative pain relief was taken as complete if the pain score was 0. 1–2 was taken as significant relief of pain and 3–4 as moderate relief of pain. At the end of follow-up period, 14 patients had complete relief of leg pain, four patients had significant relief, and two patients had moderate relief. While the mean score for back pain at the start of management was 4.6 and by the end of follow-up period, 16 patients had complete relief of back pain, while two patients had significant relief of pain, and another two patients had moderate relief of back pain Tables 11 and 12.

Table 11: Visual analog score of patients at starting the management

VAS for leg pain	No.	%	VAS for back pain	No.	%
7	5	25	1	2	10
8	7	35	2	3	15
9	6	30	3	5	25
10	2	10	5	1	5
			6	1	5
			7	6	30
			8	2	10
Total	20			20	

Table 12: Visual analogue score of patients at the end of follow-up period

V.A.S for leg pain	No.	%	V.A.S for back pain	No.	%
0	14	70	0	16	80
1	3	15	1	2	10
2	1	5	2		
3	2	10	3	1	5
4			4	1	5
Total	20			20	

Motor and sensory deficits

The two cases who had presented with motor deficit they reported improvement in motor power. Regarding the sensory disturbance, two out of the three patients had improvement. All patients in the study regained their normal daily activities by the end of the follow-up period Table 13.

Table 13: Motor and sensory assessment at the end of follow-up period

Improvement of the neurological disorders	No.	%
Cases with motor deficit	2	10
Improvement in motor power	2	10
Cases with sensory disturbance	3	15
Improvement of sensation	2	10

Outcome of the surgically treated cases

Out of the 12 operated cases, eight patients had complete relief of leg pain, two cases had significant relief, and two cases had moderate relief of leg pain. While back pain was relieved completely in ten patients and the other two cases had moderate relief Table 14.

Table 14: The outcome of pain relief among surgically treated cases

Post-operative VAS for leg pain	No.	%	Post-operative VAS for back pain	No.	%
0	8	66	0	10	83
1	2	17	1		
2			2		
3	2	17	3	1	8.5
4			4	1	8.5
Total	12		Total	12	

All the cases with neurological deficits were operated on.

Discussion

LDH is a common disorder among adults, with reported lifetime occurrence as high as 40% [26]. Although the true frequency of this condition in children and adolescents is not precisely defined. In adolescent patients presenting with back pain, <10% is attributed to disc herniation [27].

As degeneration of the intervertebral discs has a role in their herniation, adults are at greater risk for LDH than adolescents and this degeneration has an important impact on the natural history, course, and management of LDH in adolescents.

Trauma is commonly considered as the most likely cause as many as 30–60% of children and adolescents with symptomatic LDH have a history of trauma before the onset of the disease [3], [4], [5], [6], [7], [8].

The second generally recognized cause is genetic factor. Studies have shown that between 13% and 57% of adolescents with LDH have a first-degree relative with the same disorder [11], [12], [13]. In the present study, trauma in young age and early contact to heavy work in our locality and genetic factor was supposed to have a role.

In this study, the mean duration of symptoms was 3.1 months. While in Karademir *et al.* study, the mean duration of symptoms was 7.21 months [25].

In our study, regarding neurological deficits; 25% of the studied group were presented with neurological deficit (10% with motor and 15% with sensory deficit). Furthermore, straight leg raising test was positive in 80% of the cases while low back pain was reported in 50% of cases and leg pain in 100% of the cases. In a previous study, it was reported that low back pain associated with leg pain was the main clinical symptom in 82%, back pain in 13%, and leg pain in 5% and signs of neurological deficit were often absent [10]. Moreover, in another study, it was found that up to 90% of patients have a positive straight leg raising test [5], [14]. Furthermore, children and adolescents are less often seen with neurological symptoms such as numbness and weakness [3], [16], [28]. Although in a recent study, gross motor weakness was met in 57.1% of the studies group [10].

In the previous studies, it was found that the most common involved level is L4–5 followed by L5–S1 [25]. While in our study, it was different where the most common level of disc herniation was L5–S1 in 10 patients (50%), 8 (40%) at L4–L5, and only 2 cases (10%) at L3–L4. Although single level involvement was reported in all cases but these patients should be followed for probability of involvement of other level in the future as shown by studies with longer follow-up [9].

All patients had MRI to confirm diagnosis where disc herniation was located laterally in eighteen patients (90%) with two of them were bilaterally. Two patients in the study (10%) had central disc herniation.

A search of the literature indicates that the short to long-term success rate of conservative treatment for adolescence LDH without neurological deficits varied from 25% to 50% [11], [13], [22]. Which is similar to our study where conservative treatment was effective in 8 cases (40%). However, it has been widely agreed by most authors that conservative treatment is not as effective for pediatric and adolescents LDH as it is for adults [6], [9], [16], [20], [21]. Moreover, this may be explained by herniated lumbar disc in adolescents

that are less degenerated, more hydrated and viscous so it does not dry or resorb as compared with adults [6], [9]. Furthermore, the epiphyseal cartilage of the vertebral body in children and adolescents is not fully fused; hence, severe trauma could rupture the epiphyseal ring forming a large inelastic mass along with the herniated disc [3]. Beside that adolescents are active and less likely to comply with strict bed rest. Nevertheless, conservative treatment is still generally recommended as the first-line treatment for LDH in children and adolescents without neurological deficits [11], [16], [17], [18], [19].

Two forms of surgical modalities were used in this study; lumbar MD in 50% of the operated cases and conventional open laminectomy and discectomy was performed for the other 50%.

MD has been used for the treatment of adolescent LDH in many studies [28] with good results. In our study, both techniques (MD and conventional open laminectomy and discectomy) were associated with good to excellent success in 83% of the operated cases.

Early post-operative complications found in children and adolescents patients include wound hematoma (1–4%) and delayed wound healing (3%) [3], [7] While post-operative infection is rare in children and adolescents with only few cases being reported in the literature [10], [28] While in this study, there was no intraoperative complication such as dural tear or root injury. None of the patients had post-operative wound infection or underwent any further surgery for recurrence of symptoms.

The results of our study were generally satisfactory as our series demonstrated excellent results in 90% of cases as they had significant to complete relief of pain and significant improvement in the neurological deficits was achieved and patients returned to their daily activities by the end of the follow-up period. While 10% of cases had moderate relief of pain and continued on some medical treatment. It is worth noting that surgical treatment for young patients with LDH is associated with excellent short-term outcome regardless the chosen modality and it does not appear to have a negative impact on overall health and well-being except in patients with significant deficits before surgery [28].

Conclusion

Conservative treatment is less effective for adolescent patients as compared with adults, even though it remains the first-line treatment for adolescent LDH.

Limitations and future studies

- The number of cases shall be larger
- Follow-up period shall be longer
- Multi-centricity shall be taken into consideration for more concrete evidence and results.

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