Lumbar microdiscectomy in pediatric patients: a large single-institution series

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Clinical article

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Object. Lumbar disc herniation is a rare but significant cause of pain and disability in the pediatric population. Lumbar microdiscectomy, although routinely performed in adults, has not been described in the pediatric population. The objective of this study was to determine the surgical results of lumbar microdiscectomy in the pediatric population by analyzing the experiences at Children’s Hospital Boston over the past decade.

Methods. A series of 87 consecutive cases of lumbar microdiscectomy performed by the senior author (M.R.P.) from 1999 to 2008 were reviewed. Presenting symptoms, physical examination findings, and preoperative MR imaging findings were obtained from medical records. Immediate operative results were assessed including operative duration, blood loss, length of stay, and complications, along with long-term outcome and need for repeat surgery.

Results. This series represents the first surgical series of pediatric microdiscectomies. The mean patient age was 16.6 years (range 12–18 years) and 60% were female. The preoperative physical examination results were notable for motor deficits in 26% of patients, sensory changes in 41%, loss of deep tendon reflex in 22%, and a positive straight leg raise in 95%. Conservative management was the first line of treatment in all patients and the mean duration of symptoms until surgical treatment was 12.2 months. The mean operative time was 110 minutes and the mean postoperative length of stay was 1.3 days. Complications were rare: postoperative infection occurred in 1%, postoperative CSF leak in 1%, and new postoperative neurological deficits in 1%. Only 6% of patients needed repeat lumbar surgery and 1 patient ultimately required lumbar fusion.

Conclusions. The treatment of pediatric lumbar disc herniation with microdiscectomy is a safe procedure with low operative complications. Nuances of the presentation, treatment options, and surgery in the pediatric population are discussed. (DOI: 10.3171/2009.9.SPINE09756)

Key Words • disc herniation • microdiscectomy • lumbar spine • complication

Disc herniation is traditionally a disease of middle-aged adults and is assumed to be a multifactorial process that represents the accumulation of environmental, occupational, and genetic influences.1 Disc herniation also occurs in the pediatric population with a much lower incidence than in adults. Estimates are that cases requiring surgical treatment occur in 5.5 per 100,000 person years in the < 25-year-old population, compared with 128 cases per 100,000 person years in the 40–45-year-old age group.3 The clinical presentation of pediatric lumbar disc herniation is similar to that observed in adults and commonly includes lumbar and radicular pain, while neurological deficits including motor and sensory loss have been reported in as many as 50% of patients.5,8,9,13,15,16

Due to the different structural properties of the pediatric disc as well as the different environmental and limited occupational exposures in the pediatric patient, it is not clear that findings in adult disc herniation can be generalized to the pediatric patient.18 There have been reports of case series of traditional open discectomy in pediatric patients.5,13–16 These studies detail procedures performed in the 1970s to 1990s and used surgical techniques that are substantially different than those used in modern microdiscectomy. The surgical treatment of lumbar disc herniation has evolved into a well-established, safe, and less-invasive operation. In the current era, the operation is often a microsurgical procedure, in contrast to traditional open methods of the past that involved larger skin incisions, more extensive muscle dissections, and larger laminectomies. The microdiscectomy procedure consists of a 2- to 3-cm lumbar incision and minimal bone removal and is extensively performed in adults with low complication rates.12 Although the microdiscectomy
Perioperative Outcomes

Preoperative Evaluation

Patient Identification

This study is a retrospective case series of patients 18 years of age and younger who underwent lumbar disc excision at Children’s Hospital Boston from 1999 to 2008. There were 87 patients eligible for inclusion who were identified in the medical records. All of the surgical procedures were performed by the senior author (M.R.P.). The Institutional Review Board at Children’s Hospital Boston approved the study.

Preoperative Evaluation

The medical records of the patients were reviewed to determine presenting symptoms and physical examination findings as documented by the treating neurosurgeon. Variables recorded included the presence of motor or sensory deficits, the loss of a deep tendon reflex, bowel or bladder dysfunction, results of the straight leg–raising test, and the presence of spinal deformity or reactive scoliosis on examination. The overall time to surgery from onset of symptoms was calculated. The use of nonsurgical treatments such as physical therapy and epidural steroid injections or selective nerve blocks was also determined. All patients underwent preoperative MR imaging evaluation of the lumbar spine. Findings on MR imaging as documented by the treating surgeon and radiologist were reviewed. Level of disc herniation and any adjacent levels of disc disease were also recorded.

Operative Technique

Microdiscectomy was performed via a posterior approach while the patient was in the prone position using the Wilson laminectomy frame. Level of surgery was confirmed by intraoperative radiographic guidance, using either plain radiographs or fluoroscopy. Through a midline incision (ranging from 2 to 4 cm depending on patient size), subperiosteal dissection was performed to expose the interlaminar space. The vast majority of procedures were unilateral. A small keyhole laminotomy (<1 cm of bone removal on average) was performed, as needed, using Kerrison rongeurs or the high-speed drill. The operative microscope was then used for removal of the ligamentum flavum, identification of the exiting nerve root, foraminotomy, and disc excision.

Perioperative Outcomes

The operative records were reviewed to determine the operative time, blood loss, and occurrence of any intraoperative complication such as durotomy. Length of postoperative hospitalization was also determined. Postoperative complications were defined as any adverse outcome that occurred within the first 30 days after surgery and included new neurological deficit or the need for repeat surgery (1 patient who presented with a CSF leak 2 months after surgery was also included in those with postoperative complications).

Long-Term Outcomes

The primary long-term outcome was the need for repeat lumbar microdiscectomy or additional lumbar surgery. Repeat interventions were classified at the same level as the discectomy or at a different level. These outcome measures were determined through medical record review. The date of last follow-up was defined as the date of the last clinic appointment with the Department of Neurosurgery, Orthopedics, or Pain Management.

Statistical Analysis

Means were calculated for continuous preoperative and radiographic findings, and for categorical variables the percentage per group was determined. The outcome variable of postoperative complications was dichotomized into absence or presence of any postoperative complication. The primary long-term outcome variable of the need for repeat operation/intervention was dichotomized into interventions at the same level and interventions at a different spinal level. All calculations were performed using SAS statistical software (version 9.2, SAS Institute).

Results

Patient Characteristics

A total of 87 patients 18 years of age or younger with lumbar disc herniation underwent microdiscectomy between 1999 and 2008. The patient demographics and presenting clinical symptoms are detailed in Table 1. The age range was 12–18 years with a mean age of 16.6 years. There were 52 female patients (60%) in the series and 64% described themselves as competitive athletes. On presentation for surgical evaluation, 85% of patients complained of back pain and 95% complained of pain radiating down the leg. Bowel and bladder disturbances were uncommon complaints and were noted by only 2 patients.

The preoperative neurological examination was notable for lower-extremity motor weakness in 26%, decreased sensation in 41%, and loss of deep tendon reflex in 22%. A nonfixed reactive scoliosis was noted in 18% of patients upon physical examination as a result of the patient leaning away from the side of disc extrusion to decompress the exiting nerve root. The results of the straight leg–raising test were available for 85 patients with a positive test in 95% of patients.

The mean time to surgical intervention after the development of pain was 12.2 months with a range of 2 weeks to 36 months. The long interval between symptoms and surgery was due to both a delay in diagnosis and attempts at conservative therapy after the diagnosis was established. The primary indication for surgery was persistent pain and the inability to return to usual daily.
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activities and sports as the majority of neurological deficits were subtle. Prior to operative intervention, a trial of conservative treatment measures was used. Conservative measures consisted of interdisciplinary management with the Orthopedic Spine/Sports Medicine Departments, as well as the Anesthesia Pain service. Almost all patients had a period of physical therapy and were not considered for surgery until attempts at conservative therapy were unsuccessful. Epidural steroid injections were used in 32% of patients with a mean of 2.1 injections in those patients prior to surgery (range 1–4 injections). The injections often served as a bridge to allow physical therapy in those patients with too much pain to perform therapy otherwise. It should be noted that many patients not included in this surgical series were successfully treated with conservative therapy and never progressed to surgical therapy.

All patients underwent MR imaging of the lumbar spine. Magnetic resonance imaging was the primary imaging modality used and almost no patients required CT. Myelography was never used, reflecting the practice pattern in the modern era. Typical findings of a single-level disc herniation are displayed in Fig. 1. Plain radiographs and nuclear medicine imaging were used as adjuvant modalities if there was concern for other pathologies such as spondylolysis, a common cause of back pain in the adolescent patient.11 Disc degeneration was noted on MR imaging at a single level in 41%, with degenerative changes or smaller disc herniations at other levels in 54% of patients. A Grade I spondylolisthesis was present in 3% of patients and 1 patient (1%) had a sacral meningocele.

Operative Results

The distribution of the level of lumbar microdiscectomies performed is shown in Table 1. The most common level of surgery was L4–5, accounting for 45% of surgeries, followed by L5–S1 (36%) and L3–4 (17%). Two-level discectomies were performed in 10% of patients. The average estimated blood loss was 32.7 ml (range 0–400 ml). There were 2 intraoperative CSF leaks noted (Table 2), with 1 leak found at the site of an epidural steroid injection and which was not believed to be related to the surgical procedure. The mean operative time was 110 minutes and the mean postoperative length of stay was 1.3 days, although if we eliminated a single outlier, the average becomes approximately 24 hours (range 0–9 days). One patient was discharged on the same day of surgery, even though we believed that this adolescent patient would have had better management of the postoperative discomfort with a hospital stay, and would have not followed the trend of outpatient lumbar discectomy in adults. Primarily as a result of insurance considerations, many patients are now considered to be on “observation” status and are allowed to remain in the hospital for up to 24 hours postoperatively.

Postoperative complications were rare (Table 2). There was 1 patient (1%) with an intraoperative CSF leak who presented with a postoperative CSF leak and required reoperation for primary dural repair. There was also 1 patient (1%) who presented 2 months postoperatively with a CSF leak; no intraoperative CSF leak occurred in this case. This patient was treated with an unsuccessful lumbar drain trial and then open dural repair. There was 1 patient (1%) with a postoperative infection that resulted in a CSF leak and meningitis. This patient, a 15-year-old female insulin-dependent diabetic, was initially treated with a wound washout and an open primary repair on postoperative Day 12. She later required an additional open procedure for repeat dural repair and required treatment with prolonged intravenous antibiotics and bedrest to allow the dural leak to seal.

There was 1 case of reoperation for residual herniated disc. This patient had persistent radicular symptoms postoperatively. Repeat MR imaging revealed residual herniated disc material and a CT scan demonstrated that the herniated disc was highly calcified. This patient underwent a second disc excision on postoperative Day 6 with resolution of symptoms. The calcified nature of the disc herniation in this patient is presented in Fig. 2.

There was 1 unexplained postoperative neurological deficit. This deficit occurred in a 16-year-old female patient who underwent a 2-level microdiscectomy (L3–4 and L4–5) for significant radicular pain. Postoperatively, she was noted to be unable to move her left foot while in the recovery room. She underwent emergency MR imag-
ing that was unrevealing, and due to persistent symptoms was emergently taken back to the operating room for wound exploration. No hematoma or abnormal findings was emergently taken back to the operating room for wound exploration. No hematoma or abnormal findings were noted on MR imaging or during the reexploration. Her weakness later completely resolved and electromyographic and nerve conduction studies were normal at delayed follow-up. The cause of the temporary weakness was never discovered and it is quite possible that nerve root manipulation or compromise was not to blame given that there were possible secondary gain issues.

Long-term need for repeat intervention was determined by medical record review. The average duration of postoperative follow-up was 12.5 months. There were 4 patients (5%) who required repeat lumbar surgery at the same level and 1 patient (1%) who required a discectomy at an adjacent level. The average time to repeat discectomy was 14.1 months. One of the 4 patients who underwent repeat discectomy at the same level experienced another unsuccessful surgery and had a significant component of back pain in addition to leg pain. He eventually required an L-3 to sacral fusion, to which he had an excellent response. He was likely a poor candidate for the initial discectomy as his pathology was more complex. Therefore, this repeated intervention was more likely a failure in patient selection than in surgical technique.

**Discussion**

This retrospective case series details our experience with the surgical treatment of pediatric lumbar disc herniation at Children’s Hospital Boston over the past decade. This study represents the largest modern pediatric series of lumbar disc excisions and documents the successful use of the microdiscectomy technique in the pediatric population.

This patient series confirms prior reports of the typical clinical presentations of pediatric lumbar disc herniation. Clearly the main indication for surgery in this study was intractable leg pain. In the current series, the most common physical examination finding was a positive straight leg raise in 95% followed by sensory changes in 42% of patients. The finding of bowel or bladder changes was extremely rare and is consistent with data from prior reports. Motor weakness on presentation was found in 26% of patients, and most often this was a subtle finding and not the imperative for surgery. This rate is less than that in prior reports of leg weakness that were in the range of 50–55% of patients. Additionally, this series confirms the adult experience that preoperative evaluation using MR imaging is now the standard of care, and all patients underwent MR imaging prior to surgery.

The time from symptom onset to surgical treatment was substantial (approximately 1 year on average). This duration is due to both delay in diagnosis and the time needed to institute conservative treatment, which should be the first line of therapy. A large number of children were initially misdiagnosed as having hip, knee, or foot disorders before it was realized, often by a physical therapist, that nerve root impingement was the cause of the pain. This initial misdiagnosis likely reflects the fact that lumbar disc herniation is rare in the pediatric population and often a pediatrician might not consider radiculopathy in the initial differential diagnosis of leg pain.

It is our strong belief that many pediatric patients with radiculopathy due to herniated lumbar discs will respond well to conservative treatments. Although there is limited literature on comparative outcomes of conservative treatments in children, we believe it should be attempted in all patients who do not have a neurological imperative for surgery. In those children with substantial pain, we will use epidural injections as a bridge to allow for physical therapy. In our series, 32% of patients underwent epidural steroid injections and this is a common component of conservative management. We believe our results with conservative treatment will reflect a much higher success rate than that previously published. Likewise, although recent reports in adult patients have indicated similar long-term outcomes in surgically and conservatively treated patients with lumbar disc herniation, this finding has not been evaluated in children. In fact, it is our belief that pediatric patients may not respond as well to conservative treatment as adults, but that they do respond in a significant proportion of patients and it should be attempted before any consideration of surgery unless there is a neurological imperative to operate. Even though...
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this is a large series of pediatric discectomies, this case volume mainly reflects referral patterns that centralize the overwhelming majority of cases in a large geographical region to a single surgeon and does not represent a low threshold for surgery. Within the institution, almost all patients with a disc herniation in need of surgery, whether initially seen by the Neurosurgery, Orthopedics, or Sports Medicine departments, are then triaged to the senior author. Based on a review of the office records of the senior author (M.R.P.) for a 1-year period (2007–2008), there were 44 new patient consultations for evaluation of lumbar disc herniation; during that period, only 13 of these patients underwent surgical treatment for these herniations. This indicates that more than 70% of patients referred for surgical evaluation were treated nonsurgically. Therefore, this series of surgically treated patients represents the minority of patients with disc herniations seen over the same time period and are those who have experienced unsuccessful conservative treatments.

Two interesting findings in this study were the high proportion of patients who were females and the high proportion who were athletes. The high percentage of females (approximately 60%) differs from most other series in which the percentage of female patients has ranged from 21 to 52%. There does not appear to be an obvious explanation for this finding. It does not appear to be reflective of any referral pattern because all patients in need of discectomy were triaged to the senior author. It is possible to speculate that this finding may be related to the high proportion of athletes in this series (64%). This finding could parallel other sex-based injury patterns noted in female athletes, such as the recent trend toward concussions observed in this population. Because this is the first large pediatric disc series in many years, the female predominance may reflect the more avid participation of females in activities such as soccer, basketball, hockey, and other sports that had previously been dominated by males. There appear to be clear female injury patterns in the knee that have recently emerged and we may be seeing a new trend toward a female predisposition to disc disease.

Importantly, this case series indicates that microdiscectomy is a safe procedure in the pediatric patient. The average blood loss was minimal and the majority of patients were discharged home on postoperative Day 1. The duration of hospitalization in this series was significantly shorter than that in other published case series. This difference is likely a direct benefit of the microdiscectomy technique. The lumbar incision is often < 2–4 cm in length and minimal bone removal is performed. The patients are often mobile several hours after surgery and activity restriction is minimized. For athletes, we have been able to allow them back to full athletic participation in 8–12 weeks on average. Although postoperative complications have not been detailed in prior patient series, the occurrence of postoperative complications was minimal in our series and consistent with a prior series of pediatric discectomy. Interestingly, the rate of CSF leak occurrence has also not been reported in the pediatric literature. There were 2 intraoperative CSF leaks and 1 delayed leak. This rate appears consistent with data from the adult literature and does not suggest an increased rate with the microdiscectomy technique. Additionally, a conventional microdiscectomy technique was exclusively used in this patient series. Recent interest has focused on the comparison of outcomes for tubular and conventional techniques.

The need for repeat intervention for disc herniation at the same level was 5% in our series and is lower than the 24% reported by Durham et al. However, the series of 40 pediatric patients treated at Children’s Hospital of Philadelphia. Other groups have reported reoperation rates ranging from 6 to 21%. The variability in the rate of reoperation could be due to many factors, but perhaps the biggest factor is related to the nature of the pediatric disc. Structurally, the pediatric disc has generally not undergone the same degenerative changes as in adults and it is quite rare in the authors’ experience to get a large free fragment of disc at surgery despite what appears to be significant compression on imaging. That is, it is rare that the disc has failed in such a way as to extrude a large fragment. We estimate that < 5% of our patients had a significant free fragment, and even in those patients there was additional compressive disc material requiring more intervention than simple removal of free fragment. More frequently, at surgery the disc handles as a very structurally tough tissue and comes out in multiple small fragments. It is not uncommon to pass the pituitary rongeur 50–70 times and to have to physically disrupt the extruded portion of disc with a back-angled curette to adequately decompress the disc space and free the nerve. Additionally, a few of the patients appeared to have heavily calcified discs and required a chisel to break up the shell of the disc (Fig. 2).

Fig. 2. Axial CT scan demonstrating a highly calcified lumbar herniated disc in a 14-year-old boy.
This appeared to be more common in the younger children and may reflect the younger child’s increased ability to generate new bone quickly. We believe that there is a learning curve in transitioning from adult to pediatric microdiscectomy and the surgeon should not be satisfied with the removal of a single fragment without careful inspection for residual compression. The early surgical failure requiring reoperation on postoperative Day 6 in this series was clearly secondary to a lack of diligence at surgery, satisfaction after a large fragment was extracted, and failure to remove the heavily calcified area. Follow-up MR imaging revealed a significant medial component of residual disc that required a second operation. This case served as an excellent learning tool to illustrate the need for much more exquisite attention to the thoroughness of disc removal. An understanding of the physical toughness of the disc and patience during the surgery are important to successful outcomes.

A limitation of this analysis relates to the design of a retrospective case series without functional outcomes. We are in the process of obtaining formal functional outcome measures to determine postoperative quality of life and level of disability in a retrospective and prospective manner. The senior author, in general, has had close patient follow-up and the majority of the patients quickly return to regular activities and athletic pursuits. Previous work from other institutions, such as the Children’s Hospital of Philadelphia, does support the premise that pediatric disc issues do not necessarily carry over into lifelong back pain–related disability issues.6

Conclusions

In this report, we discuss the results of surgical treatment for medically refractory lumbar disc herniation in pediatric patients at Children’s Hospital Boston over a 10-year period. This study represents the first case series that describes the use of the modern microdiscectomy procedure in pediatric patients. This series is the largest to date in this patient population and highlights the low complication rate and effectiveness of the procedure. The vast majority of children returned to their baseline level of function without prolonged recovery or residual deficits related to back or leg pain or neurological injury. We are hopeful that more formal outcome measures and prolonged follow-up will support these results.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References


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