

[Orthopaedic Surgery]

Pediatric Return to Sports After Spinal Surgery

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Context: Pediatric patients who undergo spinal surgery are frequently involved in sporting activities. Return to play is often an important postoperative concern for the patient and family.

Evidence Acquisition: A PubMed search was conducted for articles in the English language on return to play after treatment of pediatric acute disc herniation, degenerative disc disease, spondylolysis, spondylolisthesis, and scoliosis from 1980 to 2015. Reference lists were reviewed for additional pertinent articles. We included articles that focused on return to sports after surgical treatment of these conditions in this review.

Study Design: Clinical review.

Level of Evidence: Level 4.

Results: There are no published guidelines, and most of the literature in this area has focused on return to play after spinal injury rather than after spinal surgery. Most children and adolescents have excellent outcomes with minimal pain at 1 year after lumbar discectomy. The majority of surgeons allow return to full activity once pain-free range of motion and strength are regained, typically at 8 to 12 weeks postoperatively. Pediatric patients with spondylolysis have good outcomes after direct pars repair. Satisfactory outcomes have been demonstrated after fusion for low- and high-grade spondylolisthesis. Most surgeons allow return to noncontact sports by 6 months after surgical treatment of spondylolysis and spondylolisthesis. Return to contact and collision sports is controversial. After posterior spinal fusion for scoliosis, most surgeons allow return to noncontact sports by 3 months and return to contact sports between 6 months and 1 year. Return to collision sports is controversial.

Conclusion: There is little evidence to guide practitioners on return to sports after pediatric spinal surgery. Ultimately, the decision to allow any young athlete to resume sports participation after spinal injury or surgery must be individualized.

Keywords: pediatric return to play; discectomy; spondylolysis; spondylolisthesis; pars repair; scoliosis; spinal fusion

Athletic activity and participation in sports is an important aspect of society and has a significant impact on the psychosocial well-being of the developing child and adolescent patient.^{36,39} In 2008, an estimated 44 million preadolescents and adolescents participated in organized sports in the United States.²⁶ With the emphasis on youth sports in today's society, there is increased intensity and competition within a wide range of athletics in the pediatric population. Young patients who undergo spinal surgery are frequently heavily involved in sporting activities. Return to play (RTP) is often an important postoperative concern for the patient and family.³³ Pediatric spine surgeons must be prepared to discuss

this topic and provide opinions regarding RTP after surgery.²⁰ Unfortunately, there are no published guidelines, and most of the literature in this area has focused on RTP after spinal injury rather than after spinal surgery. Consequently, there is little evidence to guide practitioners.³

ACUTE DISC HERNIATION AND DEGENERATIVE DISC DISEASE

In contrast to adults, children and adolescents are less likely to have a herniated disc or degenerative changes as the etiology of low back pain (LBP). Adults have a 4- to 5-fold greater rate of

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disc herniation compared with children. Micheli and Wood²² reported that 48% of adults with back pain are diagnosed with a discogenic etiology, whereas only 11% of adolescent athletes have disc herniation or degeneration as the source of LBP. Only 5% of lumbar disc disease occurs in patients younger than 18 years.²² Furthermore, pediatric disc herniation is more likely to result from acute injury rather than from a chronic degenerative condition.³⁴ Papagelopoulos et al²⁹ reported that pediatric patients represented only 0.4% of their lumbar discectomy population, with 50% of the disc herniations sustained during athletic activity. Children who participate in collision sports and weight lifting are at increased risk for lumbar disc herniation because of increased axial forces exerted on the spine during activities that require hyperflexion and hyperextension. Although trauma is often cited as the cause of disc herniation in adolescents,¹¹ evidence suggests that disc herniation occurs most often in combination with preexisting spinal abnormality.^{5,12} A total of 30% to 70% of adolescents with acute disc herniation also have vertebral anomalies, such as scoliosis, transitional defects (lumbarization and sacralization), schisis, and canal narrowing.¹²

Certain sports increase the risk of degenerative disc disease in the pediatric population. Daniels et al⁶ found increased degenerative changes in the cervical and thoracic spine of children and adolescents who participate in motocross compared with age-matched controls. Similarly, there is an increased incidence of degenerative disc disease in high school football players, specifically those playing a lineman position and those with Schmorl nodes and disc herniation. Continuing to play American football through 2 years of high school was a risk factor for the onset of LBP.²⁵

There are differences in treatment approaches to disc pathology in children compared with adults. Pediatric patients respond less to conservative treatment and are more likely to require an operation.³⁴ Surgery is reserved for those athletes with disc herniation who fail to improve with conservative treatment, or those showing bowel or bladder symptoms, evidence of cauda equina syndrome, debilitating pain, or progressive neurologic deficit.^{34,38} DeOrio and Bianco⁷ reported an overall good or excellent result in 73.5% of patients 16 years and younger who had undergone lumbar discectomy. Ebersold et al⁸ reported the results of 74 pediatric patients who had undergone lumbar discectomy, noting that at 9 months postoperatively, 95% had good or excellent results. Slotkin et al³⁴ reported that pediatric patients who had undergone lumbar discectomy usually had excellent outcomes, with more than 90% reporting a good or excellent result, as defined by minimal or no pain 1 year after surgery.

Parents often worry about whether their child should RTP after lumbar discectomy. Although very little long-term outcome data exist, Eck and Riley,⁹ Burnett and Sonntag,³ and Cahill et al⁴ have suggested that neither single-level nor multilevel discectomy appears to be a contraindication to return to contact sports. In fact, the majority of surgeons allow full return to activity after laminectomy or discectomy if full, pain-free range

of motion and strength are regained.²¹ Cahill et al⁴ reviewed 87 pediatric patients who had undergone lumbar microdiscectomy; 64% of the patients were athletes. The athletes were released to full sports participation at 8 to 12 weeks postoperatively.⁴

Although spinal stability is typically not compromised after lumbar discectomy, the potential risk of reinjury or further degenerative changes should be discussed with patients and their parents before RTP is permitted. After nonsurgical or surgical treatment of a lumbar disc herniation, athletes should undergo progressive rehabilitation before returning to sports. Therapy should be directed at core strengthening, sport-specific training, and lumbar stretching. Athletes are generally expected to return to activity 3 to 6 months after nonsurgical treatment and 6 to 12 months after surgery.¹⁴

SPONDYLOLYSIS AND SPONDYLOLISTHESIS

Spondylolysis and spondylolisthesis are implicated in up to 47% of complaints of LBP in adolescent athletes.²² This bony defect, which is often described as a stress fracture, occurs in the pars interarticularis and is thought to result from repetitive flexion, hyperextension, and rotation of the spine. Adolescents who participate in sports that require these motions (eg, gymnastics, football, dance, weight lifting) are at greater risk of developing spondylolysis.¹⁷

Most patients with symptomatic spondylolysis or spondylolisthesis can be successfully managed nonoperatively.¹ Patients who stop sports for at least 3 months are 16.39 times more likely to have an excellent result compared with those who continue sporting activities.¹⁰ Kim and Green¹⁷ suggest a course of physical therapy prior to the return to competitive sports to ensure proper muscle balance and core strength to prevent future injuries. Return to competitive sports is permitted when the athlete has painless spinal mobility without hamstring spasm and has advanced to unrestricted activities without pain.¹⁶ Most young athletes treated conservatively for early spondylolysis can expect to maintain a good functional outcome for up to at least 11 years.²³ Adolescent athletes who are skeletally immature should be followed to skeletal maturity at intervals of every 6 months to 1 year with physical examinations and imaging as indicated to monitor for progression of spondylolisthesis.

Surgical treatment is reserved for those athletes with persistent symptomatic spondylolysis or spondylolisthesis who have failed a comprehensive nonoperative treatment course of at least 6 months. Surgical intervention is also recommended for immature athletes with high-grade (Meyerding III or IV) slips, since they are at significant risk for further slippage as shown in retrospective and observational studies.³⁷

Treatment of spondylolysis with posterolateral fusion has demonstrated success rates close to 90%.^{16,17} Long-term clinical and radiographic outcomes after posterolateral fusion for low-grade spondylolisthesis are satisfactory.¹⁵ Helenius et al¹⁵ reported satisfactory long-term outcomes, as measured by the

Oswestry Disability Index (ODI) and Scoliosis Research Society (SRS) questionnaire, in 108 young patients who were treated with in situ fusion for low-grade spondylolisthesis with a mean follow-up of 20.8 years. Lamberg et al¹⁹ reported good ODI scores at 17.2 years postoperatively in 69 young patients with high-grade spondylolisthesis who had undergone posterolateral, anterior, or circumferential in situ fusion. The circumferential fusion group demonstrated slightly better outcomes. However, loss of motion at the fused segment can potentially increase loading at adjacent spinal levels. This can lead to symptomatic degeneration and can require additional surgery for the adjacent segments in up to 36% of patients. As such, direct pars repair rather than fusion may be a better treatment option for patients with spondylolysis because spinal motion is preserved.³⁵

Several techniques for direct pars repair have been described, including the Buck screw,² Morscher hook screw,²⁴ and Scott wiring technique.²⁷ A biomechanical study demonstrated that the Buck screw provided the stiffest and strongest repair, whereas wiring was the least stable construct.¹⁸ Buck's technique of direct pars repair should be considered in adolescent athletes with persistent significant symptoms after a trial of conservative therapy as it appears to improve their quality of life and decrease their time to RTP.³⁵ Reitman and Esses³² reported on 4 young athletes who began returning to sport within 6 months after Buck repair for spondylolysis, and by 1 year, all athletes had returned to their preinjury level of performance. Nozawa et al²⁸ described better outcomes with the wiring technique in 20 competitive athletes with spondylolysis or grade I spondylolisthesis. The authors categorized various sports into different levels of intensity by modifying a classification devised by the American Academy of Pediatrics. Ninety percent of the athletes returned to sports at the same intensity level, but not all athletes returned to their preinjury sport.²⁸

Radcliff et al³¹ published their rehabilitation protocol after direct pars repair, which begins with core strengthening and nonimpact aerobic activity at 2 weeks postoperatively. All exercises are performed with a neutral spine during the first 3 months. Higher impact activity may start at 3 months, and sport-specific training can be introduced at 4 to 6 months. Athletes may RTP when they demonstrate normal strength, normal range of motion, and no pain with sport-specific activity. This typically occurs between 6 and 12 months after surgery. Although solid radiographic fusion is preferred, the authors believe this to be the least important determinant for RTP.³¹

There are no evidence-based guidelines on RTP criteria after direct pars repair. Published recommendations for return to noncontact sports after fusion for spondylolisthesis are controversial. Rubery and Bradford³³ conducted a survey of 261 members of the SRS who commonly treated spondylolisthesis. They found that 62% to 66% of surgeons allowed return to low-impact, noncontact sports by 6 months postoperatively for both low- and high-grade slips.³³ Eck and Riley⁹ suggest delaying return to noncontact sports for 1 year. RTP criteria for contact sports are even more controversial. Eck and Riley⁹ do

not recommend returning to full-contact sports. Burnett and Sonntag³ allow return to contact sports but do not specify a timeframe. Rubery and Bradford's³³ survey of the SRS demonstrated that 51% to 56% of surgeons permitted return to contact sports, such as basketball and soccer, at 1 year after surgery regardless of slip grade. The most important factors that influenced decision making on RTP were radiographic appearance and time from surgery. Football and hockey were placed into a separate category of collision sports. Only 27% to 36% of surgeons allowed return to collision sports at 1 year postoperatively. Forty-nine percent and 58% of surgeons recommended against collision sports for low- and high-grade slips, respectively. The most common sports that surgeons discouraged patients to resume after spondylolisthesis fusion were gymnastics, football, rugby, wrestling, weight lifting, skydiving, and bungee jumping.³³ Herman et al¹⁶ allow unrestricted RTP for athletes who are asymptomatic, have achieved stable fusion, and are fully rehabilitated to their previous playing capacity. This typically occurs within 1 year after surgery.¹⁶

Although some authors do not restrict return to contact sports after fusion for spondylolisthesis, they advise that athletes participating in activities that require extreme spinal mobility or involve heavy loads may be limited after surgery. Radcliff et al³¹ caution that fusion may be a career-ending surgery for activities that require extreme lumbar hyperextension, such as gymnastics and dance. They also state that athletes participating in sports that involve heavy loads may be reduced from highly competitive to recreational.³¹ Herman et al¹⁶ believe that a single-level lumbosacral fusion has minimal impact on spine function, whereas a multilevel fusion may impair mobility and performance.

SCOLIOSIS

Scoliosis develops in approximately 3% of children younger than 16 years. Only 0.3% to 0.5% of these children have progressive curves requiring treatment. Curves that measure greater than 45° to 50° may require surgical intervention. Fabricant et al¹³ recently performed an analysis of independent predictors of RTP in 42 athletes who had undergone posterior spinal fusion for adolescent idiopathic scoliosis (AIS). Patients were allowed to return to full activity at a minimum of 4 months postoperatively if they had resolution of pain and radiographs did not demonstrate any change in curve correction or implant position. Mean time to RTP was 7.4 months. At a mean follow-up of 5.5 years, 59.5% of patients returned to athletics at an equal or higher level of participation. The most common reasons for a decline in activity level were loss of flexibility, back pain, and deconditioning. Distal fusion level was a significant predictor of successful RTP. A stepwise decline in activity level was seen with more distal fusion levels, with 73% of patients with a T12 distal fusion level returning to their previous level of activity compared with 20% of patients with an L4 distal fusion level. The authors emphasized that these

findings should not be used as a guideline for releasing patients back to sport but should be used when counseling patients and families about the likelihood of RTP after posterior spinal fusion for AIS.¹³

Rubery and Bradford's³³ survey of the SRS regarding RTP criteria after fusion for scoliosis demonstrated that 43% of surgeons recommended low-impact, noncontact sports at 6 months and 61% allowed contact sports at 1 year postoperatively. The factors that most influenced RTP were time from surgery, use of instrumentation, and chosen sport. Collision sports including wrestling, football, hockey, and gymnastics were permitted by only 32% of respondents at 1 year postoperatively. Sixty percent of surgeons recommended against or forbade return to collision sports after scoliosis fusion. Distal fusion level did not influence decision making on RTP for the majority of surgeons.³³

Lehman et al²⁰ surveyed members of the Spinal Deformity Study Group to identify current recommendations regarding return to various noncontact (gym class, swimming, recreational sports, running, sprinting, cheerleading without stunts), contact (soccer, basketball, volleyball, cheerleading with stunts), and collision sports (American football, hockey, rugby, martial arts, wrestling) after AIS surgery. Surgeons permitted earlier return to noncontact and contact sports when pedicle screw instrumentation was used, with most patients allowed to return to running by 3 months, noncontact and contact sports by 6 months, and collision sports by 12 months postoperatively. All surgeons permitted eventual return to noncontact and contact sports regardless of construct type (hooks, pedicle screws, or hybrid). Approximately 20% of surgeons forbade return to collision sports after AIS surgery for all construct types. Surgeons were less likely to allow return to collision sports with a more distal fusion level. The majority of surgeons who were surveyed did not recommend formal physical therapy after surgery.²⁰

A long-term study by Parsch et al³⁰ found that patients with idiopathic scoliosis who had undergone nonoperative or operative treatment had a lower sport score than age-matched controls, suggesting that reduced spinal function correlated with reduced sport activity. After a mean follow-up of 22 years, patients with idiopathic scoliosis suffered limitation of their sports activities, with the main limiting factors being functional impairment and back pain. Among the patients with scoliosis, operative treatment did not result in more activity restriction than nonoperative treatment. Fusion levels did not appear to influence activity level.³⁰

SUMMARY

Pediatric athletes who undergo surgical treatment of certain spine conditions can have excellent outcomes and successfully RTP. Most children and adolescents have excellent outcomes with minimal pain at 1 year after lumbar discectomy. The majority of surgeons allow return to full activity once pain-free range of motion and strength are regained, typically at 8 to 12 weeks postoperatively. Pediatric patients with spondylolysis

have good outcomes after direct pars repair. Satisfactory outcomes have been demonstrated after fusion for low- and high-grade spondylolisthesis. Most surgeons allow return to noncontact sports by 6 months after surgical treatment of spondylolysis and spondylolisthesis. Return to contact and collision sports is controversial. After posterior spinal fusion for scoliosis, most surgeons allow return to noncontact sports by 3 months and return to contact sports between 6 months and 1 year. Return to collision sports is controversial. Distal fusion level may be an independent negative predictor of successful RTP after posterior spinal fusion for AIS. Ultimately, the decision to allow any young athlete to resume sports participation after spinal injury or surgery must be individualized.

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