

Review Article

Return to sport after lumbar spine surgery: a comprehensive review

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ABSTRACT

Spinal pathologies are a significant challenge for athletes, often affecting performance and threatening career longevity. This review summarizes current evidence on return-to-sport (RTS) outcomes following lumbar spine surgeries, focusing on procedures such as microdiscectomy, spinal fusion and stabilization. Lumbar microdiscectomy demonstrates high RTS rates, with recovery averaging 5-6 months, while lumbar fusion poses greater challenges, particularly in high-impact sports, with recovery often exceeding 8-12 months. Pediatric and adolescent athletes show promising RTS outcomes, with up to 96% resuming pre-surgical performance within a year. Key factors influencing successful RTS include the type of surgery, sport-specific demands and adherence to structured rehabilitation protocols emphasizing trunk stabilization and core strength.

Keywords: Athletes, Lumbar spine surgery, Rehabilitation, Return to sport, Spinal fusion

INTRODUCTION

Athletes frequently face significant challenges from spinal pathologies, with the lumbar spine particularly vulnerable to injuries from stress, trauma or degeneration. These conditions can impair performance or even jeopardize careers. Surgical interventions like microdiscectomy, spinal fusion and disc replacement effectively reduce pain and restore function, but the timing and safety of returning to sport remain critical concerns. This review examines evidence on return-to-sport outcomes following lumbar spine surgeries, emphasizing recovery factors, surgical techniques, rehabilitation protocols and their impact on athletic performance.

RETURN TO SPORT AFTER LUMBAR SPINE SURGERY

Lumbar microdiscectomy

Lumbar microdiscectomy is one of the most frequently performed procedures to address lumbar disc herniation, a common condition among athletes due to repetitive spinal stress and trauma. The surgery alleviates nerve

compression by removing part of the herniated disc, typically leading to immediate relief of leg pain and quicker recovery compared to more invasive procedures.^{1,2} Watkins et al conducted a landmark study involving 60 professional and Olympic athletes who underwent microdiscectomy for lumbar herniated nucleus pulposus between 1984 and 1998.³ Despite being an older study, it remains the largest and most diverse to date, including athletes from various sports such as ballet, baseball, basketball, football, hockey, skiing, swimming and water polo.

The study revealed that 88% of these athletes successfully returned to play, with an average recovery time of 5.2 months (range: 1–15 months). Factors influencing recovery included the severity of neurological symptoms, preoperative conditioning and adherence to postoperative rehabilitation programs. Notably, trunk stabilization exercises emerged as a key component of rehabilitation, emphasizing the importance of core strength in protecting the spine during high-level competition.⁴ Additional studies support these findings. Hsu et al studied 23 NFL athletes and reported a 74% return-to-play rate after lumbar microdiscectomy.⁵ Athletes maintained pre-injury

performance metrics, with an average career length of 4.1 years post-surgery, showcasing the procedure's efficacy in high-contact sports where spinal load is a constant concern. A recent study by Cordover et al evaluated RTS outcomes in high school and college-aged athletes following lumbar microdiscectomy.⁶ The study included 38 athletes with an average age of 19 years, predominantly male (82%), participating in various sports such as football, baseball and basketball. The findings revealed that 71% of these athletes successfully returned to their respective sports at an average of 4.5 months postoperatively. Notably, 82% of those who returned were able to compete at or above their pre-injury performance levels.

The risk of reherniation, a critical factor for long-term outcomes, was analyzed by Savage et al and Hsu et al.^{7,8} Among the same cohort of NFL players as the previous study, a reherniation rate of 8.7% (2 of 23) was observed, comparable to the recurrence rates reported in non-athletic young populations. This underscores the importance of tailored postoperative rehabilitation, including progressive trunk stabilization and sport-specific drills, to prevent reinjury and optimize long-term outcomes.

The difference in RTS rates between the landmark study by Watkins et al and more recent studies, such as Hsu et al raises interesting questions about the role of sport type and injury mechanisms in recovery outcomes.^{1,2} It is plausible that the lower RTS rate observed in the NFL cohort reflects the unique demands and high-contact nature of the sport, where greater axial and rotational spinal loads increase the risk of delayed recovery or reinjury.⁹ Additionally, the broader spectrum of sports in Watkins et al's study ranging from ballet to water polo likely involved lower-contact activities, which could account for the higher RTS rates.^{6,10}

Lumbar fusion

For athletes with severe conditions such as degenerative disc disease, lumbar instability or high-grade spondylolisthesis, lumbar fusion is often recommended. This procedure eliminates painful motion at the affected level by fusing adjacent vertebrae, providing stability but reducing spinal flexibility. Fusion approaches include anterior, posterior and transpos techniques. An example of anterior lumbar interbody stabilization is illustrated in Figure 1. Recovery and return to sport after fusion can be more challenging, particularly in sports requiring significant trunk rotation, such as golf, tennis and gymnastics.

Shifflett et al examined return-to-sport outcomes in golfers following lumbar fusion.¹¹ Among 34 patients (average age 57 years old), 65% resumed practice within a year and 52% returned to course play. Remarkably, 80% maintained or improved their preoperative handicap, suggesting that, with appropriate rehabilitation, lumbar fusion can be compatible with sports demanding flexibility, although recovery times are often extended

compared to microdiscectomy. In contrast, outcomes in contact sports are less predictable. Eck et al and Rubery et al reported that RTS following stabilization was not recommended in collision and contact sports.^{12,13} A clear correlation with a worsening postoperative result is still not proved. Other studies analyze return to contact sport after 1 year.¹⁴ For these sports, these particular athletes may be reduced from highly competitive to recreational-semi competitive participants.

However, other studies have demonstrated more optimistic results, with some athletes returning to contact sports after one year. Herman et al noted that nearly 50% of surgeons permitted non-contact sports postoperatively after 6 months and one-third allow collision sports after 1 year, although poor outcomes were associated with higher-grade spondylolisthesis in up to 6% of cases.¹⁵ Athletes with stable fusion and full rehabilitation typically return to sports within 1 year. Single-level fusions minimally affect function, but multilevel fusions may limit mobility. Decisions should be individualized based on severity, surgery and sport demands.

Recreational athletes tend to fare better following lumbar fusion. Jain et al analyzed RTS in 32 recreational athletes and reported 100% return rates in golfers (8.6±3.6 months), swimmers (5.3±2.1 months) and cyclists (3.3±1.2 months), with significant reductions in pain and maintenance of functional levels.¹⁶ For athletes in high-demand sports, lumbar fusion may present significant challenges. Reduced spinal flexibility can limit performance, especially in sports requiring dynamic movements. While single-level fusions minimally impact mobility, multilevel fusions often restrict flexibility and may signal the end of competitive careers in certain sports.

Rubery and Bradford's survey of SRS members found that 51%–56% of surgeons allowed a return to contact sports like basketball or soccer at one year postoperatively, while only 27%–36% permitted return to collision sports like hockey and football.¹³ These findings underscore the need for case-by-case decision-making, considering the specific demands of the athlete's sport and the extent of fusion.

Specific case of ice hockey

Ice hockey presents unique biomechanical challenges to the lumbar spine, including axial compression and torsional stress during skating, shooting and passing. Unlike jumping and running loads common in sports like basketball, hockey involves frequent collisions and rotational forces, making lumbar injuries a major concern. In a study of 87 NHL players, 31 underwent nonoperative care, 48 underwent a discectomy and 8 underwent a single-level fusion.¹⁷ Post-injury, players averaged 136 games over 2.7 seasons, but performance generally declined compared to pre-injury levels. Unlike in other sports where lumbar discectomy typically preserves performance (e.g., NFL), hockey players experienced consistent declines, likely due to the sport's physical demands and

predisposition to lumbar degeneration. Lumbar injuries are the fourth most common reason for missed games in hockey, highlighting the critical need for tailored treatment and rehabilitation strategies to maximize recovery and minimize performance loss.



Figure 1 (a, b): Anterior lumbar interbody stabilization L5-S1.

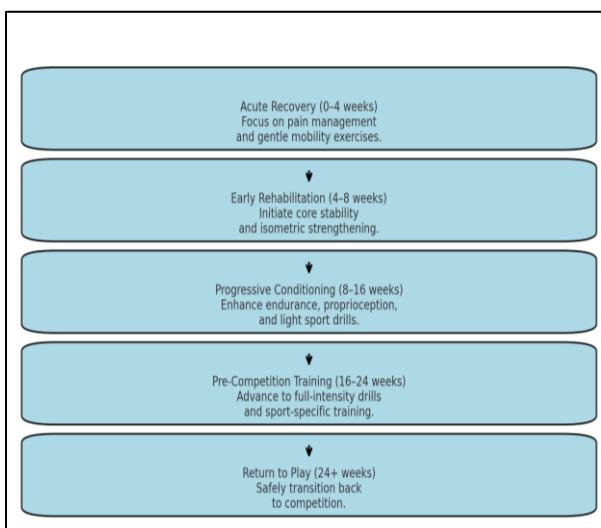


Figure 2: Rehabilitation and RTS framework.

RETURN TO PLAY CRITERIA AFTER LUMBAR SURGERY

The return to play criteria for lumbar surgery are not universally standardized, but common elements include the resolution of neurological symptoms, the restoration of spinal flexibility and strength and evidence of stable fusion or successful decompression on radiographic imaging. According to Li et al and Hresko et al, athletes can typically return to non-contact sports within 6 to 8 weeks after lumbar microdiscectomy and 4 to 6 months after lumbar fusion. Contact sports, where greater stress is placed on the spine, generally require more extended recovery times, often exceeding 12 months.^{18,19} Haddas et al also made recommendations for the older golf athlete undergoing fusion for RTP in golf at 6 months while those requiring decompression alone without fusion may return to golf at 3 months.²⁰ Many authors suggest that, before considering a return to play, an athlete should have radiographic evidence of a solid fusion, resolution of preoperative pain and restoration of strength, flexibility and endurance.²¹

A structured rehabilitation program is essential for achieving successful RTS. Watkins et al emphasized that rehabilitation should focus on trunk stabilization, proprioceptive training and sport-specific exercises tailored to the athlete's demands.¹ The progression of rehabilitation exercises should be gradual, starting with basic core stabilization, followed by resistance training and finally dynamic, sport-specific movements that replicate the physical demands of the athlete's sport. The return to play should be assessed not by the time elapsed post-surgery but by the athlete's ability to complete their rehabilitation program without pain or functional limitations.

PEDIATRIC AND ADOLESCENT RETURN TO SPORT: RECOVERY AND LONG-TERM PROSPECTS

Spine surgery in pediatric and adolescent athletes, particularly for conditions such as scoliosis, has received an increasing focus in sports medicine. Adolescent athletes face unique recovery challenges due to ongoing growth and development, which can significantly influence post-surgical outcomes and the timeframe for return to sport.

OUTCOMES AND RECOVERY TIMELINE

Tetreault et al and Garg et al observed that most adolescent athletes returned to competitive sports within 6 to 12 months after surgery.²² By three months, 25%–52.6% of patients had returned to their pre-surgical level of play. At six months, this increased to 55%–75% and by one year, 90%–96% had resumed their pre-surgical performance levels. Non-contact sports such as swimming, running and cycling demonstrated the highest success rates. In contrast, sports requiring significant spinal flexibility, like gymnastics and dance, often required extended recovery

periods, particularly for athletes undergoing multi-level fusions.²³ After posterior spinal fusion for scoliosis, surgeons generally allow return to non-contact sports by 3 months and contact sports between 6 months and 1 year.²⁴ However, the return to collision sports remains controversial. A more distal fusion level has been identified as a potential negative predictor for successful RTS following posterior spinal fusion for adolescent idiopathic scoliosis (AIS).²⁵

SURGEON RECOMMENDATIONS AND CRITERIA

Rubery and Bradford conducted a survey among Scoliosis Research Society (SRS) members regarding RTS criteria after spinal fusion for scoliosis.¹³ Their findings indicated that 43% of surgeons recommended resuming low-impact, non-contact sports at 6 months postoperatively and 61% allowed contact sports at 1 year. Collision sports, including wrestling, football, hockey and gymnastics, were approved by only 32% of surgeons at 1 year post-surgery.²⁶ Notably, 60% of surgeons advised against or prohibited a return to collision sports after scoliosis fusion. The level of distal fusion did not significantly influence most surgeons' decisions about RTS for collision sports. Similarly, Lehman et al surveyed the spinal deformity study group to

explore recommendations for RTS after AIS surgery.²⁷ Their study emphasized the use of pedicle screw constructs, which many surgeons believe enable an earlier RTS timeline. Non-contact activities like swimming and running were commonly allowed by 3 months, with most patients resuming contact sports by 6 months and collision sports by 12 months. Despite these trends, approximately 20% of surgeons prohibited collision sports regardless of construct type. A more distal fusion level further reduced the likelihood of approval for collision sports.

FACTORS INFLUENCING RETURN TO SPORT

Several factors have been proposed as predictors of difficulty with RTS, including the lowest instrumented vertebra (LIV), Lenke classification, curve magnitude, age and SRS-22 scores.²⁸ However, there is no clear consensus on which factors are most predictive. External factors, such as patient motivation, fear of re-injury and post-surgical deconditioning, may play an equally significant role. Common barriers reported by athletes include back pain, loss of flexibility and psychological apprehension. These challenges can sometimes lead athletes to transition away from collision or high-impact sports, with rates of such shifts reaching 37% in some studies.²⁹

Table 1: Return-to-sport rates and average recovery times for athletes undergoing lumbar spine surgeries.

Surgical technique	Return to sport rate (%)	Average recovery time
Lumbar microdiscectomy	74-88%	5-6 months
Lumbar fusion	65% (golf), 52% (others)	8-12 months
Pediatric patients	90-96%	6-12 months

Table 2: Key factors influencing return to sport.

Factor	Description	Impact on recovery
Sport type	High-contact sports (e.g., hockey, football) and rotational sports (e.g., golf, tennis) impose greater spinal stress.	Slower recovery, increased risk of complications and lower RTS rates compared to non-contact sports.
Pre-operative condition	Severity of symptoms, neurological deficits and physical conditioning before surgery.	Athletes with minimal symptoms and better conditioning experience faster recovery and better outcomes.
Surgical complexity	Single-level procedures vs. multi-level procedures, type of stabilization or decompression.	Single-level surgeries generally result in shorter recovery times and higher RTS rates than multi-level fusions.
Rehabilitation program	Sport-specific rehab focusing on trunk/core stabilization, spinal flexibility and gradual progression.	Adherence improves strength, mobility and RTS success while reducing the risk of reinjury.
Psychological readiness	Confidence, fear of re-injury and mental preparedness post-surgery.	Athletes who address psychological barriers are more likely to return to competitive levels.

CONCLUSION

Athletes undergoing lumbar spine stabilization surgeries can generally expect favorable outcomes regarding return to sport. However, the success rates and recovery timelines vary significantly depending on the type of surgery, the athlete's preoperative condition, the sport's demands and

adherence to rehabilitation protocols. While lumbar microdiscectomy is highly effective in facilitating a rapid return to sport, athletes undergoing more complex procedures, such as multi-level fusions, face greater challenges and longer recovery period.³⁰ Rehabilitation plays a pivotal role in recovery and a structured, individualized approach is essential for achieving optimal

outcomes. Ongoing research and refinement of RTS criteria will help optimize the recovery process and ensure that athletes can safely return to competitive sports without compromising their long-term spinal health.

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