

Outcomes of Lumbar Discectomy in Elite Athletes: The Need for High-level Evidence

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Published online: 8 July 2014

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Abstract

Background Although lumbar discectomy for treatment of lumbar disc herniation in the general population generally improves patients' pain, function, and validated outcomes scores, results of treatment in elite athletes may differ because of the unique performance demands required of competitive athletes.

Questions/purposes We performed a systematic review to answer the following questions: (1) What proportion of athletes return to play after lumbar discectomy, and what is the effect of sport? (2) What is the expected recovery time after lumbar discectomy in elite athletes? (3) What is the expected career length and performance of elite athletes after lumbar discectomy?

Methods We performed a systematic literature review of articles of lumbar discectomy in the elite athlete population through the MEDLINE and EMBASE databases from 1947 to 2013. Elite athletes were defined as professional, Olympic, or National Collegiate Athletic Association Division I collegiate level. A hand search of the references of all key articles was performed to ensure inclusion of all relevant studies. Information regarding study design, types

of athletes, level of sport, recovery time, return to sport, length of career after surgery, and career performance after surgery was extracted. Ten articles met the inclusion and exclusion criteria for this review. These articles consisted of levels III and IV data and were graded based on the Methodological Index for Non-Randomized Studies (MINORS) scale.

Results Overall, the studies included in this review found that 75% to 100% of athletes were able to return to elite competition after operative treatment. In general, a higher proportion of baseball players returned to elite competition compared with other athletes. The reported recovery period after lumbar discectomy ranged from 2.8 to 8.7 months. The average career length after lumbar discectomy ranged from 2.6 to 4.8 years. Elite athletes reached an average of 64.4% to 103.6% of baseline preoperative statistics after lumbar discectomy with variable performance based on sport.

Conclusions A high proportion of elite athletes undergoing lumbar discectomy return to play with variable performance scores on return. Future prospective studies are needed to compare the recovery time, career longevity, and performance for athletes undergoing lumbar discectomy versus nonoperative treatment for lumbar disc herniation.

Each author certifies that he or she, or a member of his or her immediate family, has no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research*® editors and board members are on file with the publication and can be viewed on request.

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Introduction

Lumbar discectomy for the treatment of lumbar disc herniation (LDH) has led to excellent pain relief, return-to-work rates, and patient satisfaction in the general population [4, 13, 14, 25–27]. The efficacy of lumbar discectomy has traditionally been quantified by validated outcome measures such as the Oswestry Disability Index (ODI),

visual analog scale (VAS), and SF-36 [7]. However, outcomes for elite athletes may be quite different than those in the general population because of the increased postoperative demands of elite athletic performance [9].

Elite athletes undergo intense training regimens at early ages, which may lead to an increased risk of lumbar disc degeneration and back pain compared with the general population [12]. Furthermore, athletes in certain sports such as American football are more prone to developing spine injuries as a result of high biomechanical forces on the spine during play [28]. Baseball pitchers also experience high torsional forces throughout their spine [21] that can produce annular tears and disc herniations [20].

In elite athletes, symptomatic LDH can threaten both career performance and longevity. Because the window for a professional player's career is typically short, optimal treatment, subsequent recovery period, and expected outcomes are critical in this population. Commonly used measures such as the ODI, VAS, and return-to-work rates for sedentary professions are not necessarily applicable to unique considerations in elite athletes. Consequently, a number of recent retrospective studies have reported more appropriate clinical outcome measures such as number of athletes who return to play, career length, and performance-based outcomes [2, 8–10, 15–17, 19, 23, 24, 28, 29].

We performed a systematic review with the following key questions in mind: (1) What proportion of athletes undergoing lumbar discectomy return to play, and what is the effect of sport? (2) What is the expected recovery time after lumbar discectomy in elite athletes? (3) What is the expected career length and performance of elite athletes after lumbar discectomy?

Search Strategy and Criteria

A systematic literature search using MEDLINE and EMBASE (1947–2013) was performed. We used the Boolean terms “lumbar” AND “discectomy” OR “discectomy” OR “disk” OR “disc” AND “athlete” OR “athletes” OR “sport” OR “sports”. A total of 810 articles were then independently reviewed (Fig. 1) by two authors (RN, CAK). Inclusion criteria were defined as English language articles reporting outcomes data after lumbar discectomies in elite athletes in active play at the professional, Olympic, and/or collegiate level. To fit inclusion criteria, articles had to report the percentage of athletes who successfully returned to sport. Other outcome data that were collected included recovery time, postoperative career length, and performance score, but these were not part of the inclusion criteria. The reported surgical procedures included conventional discectomy, microdiscectomy, and microendoscopic discectomy. Procedures such as percutaneous discectomy/nucleotomy were

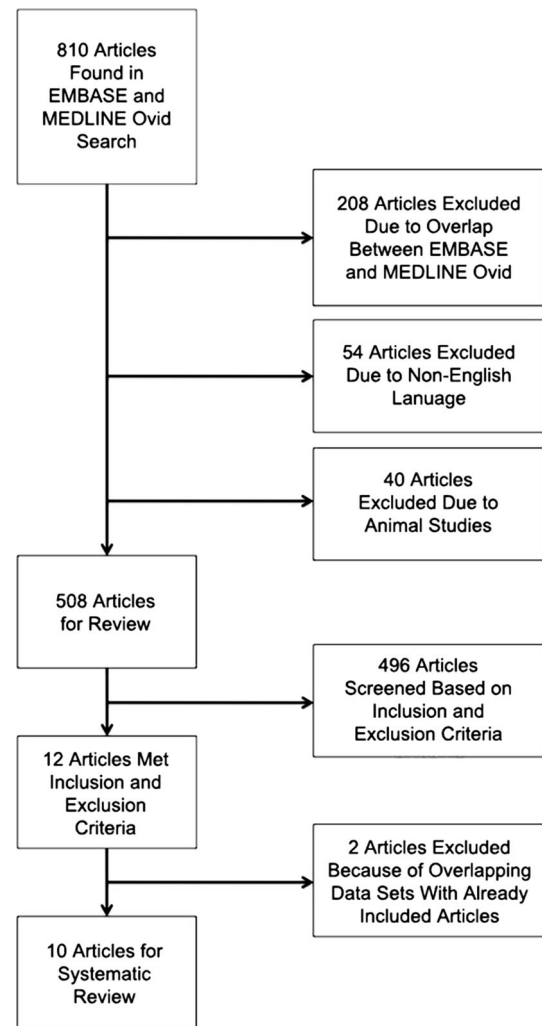


Fig. 1 The flowchart illustrates the methodology for identifying relevant articles.

excluded. Exclusion criteria included data for the general population (nonelite athletes) or military personnel, concomitant spinal fractures, and surgical procedures other than a conventional discectomy. It is worth noting that the minimum followup for these articles was 1 year (most articles mention minimum 2-year followup or mention no followup data). Finally, a hand search of the references of all key articles was performed to ensure inclusion of all relevant studies.

Study Quality

A total of 12 articles that met the inclusion and exclusion criteria were identified [2, 8–10, 15–17, 19, 23, 24, 28, 29] (Fig. 1). Two of these studies were excluded because of the reporting of overlapping player populations [15, 16]. All included articles comprised level III or IV data

Table 1. Summary of articles included in the review

Article	Year	Level of evidence	MINORS score	Number of patients undergoing lumbar discectomy	Mean age (years)	Sport	Number of patients with successful return to sport (%)	Mean recovery time (months)	Length of career postoperatively (number of games)	Length of career postoperatively (years)
Schroeder et al. [17]	2013	Level III retrospective cohort study	17/24	48	NR	NHL	38 (79%)	NR	129.6	2.6
Yoshimoto et al. [29]	2013	Level IV case series	9/16	7	20.9	Multiple	7 (100%)	2.75	NR	NR
Earhart et al. [8]	2012	Level III retrospective cohort study	15/24	40	32.4	MLB	39 (98%)	8.7	232.8	4.8
Watkins et al. [23]	2012	Level IV case series	8/16	85	28.1	Multiple	67 (89%)*	5.8	NR	NR
Hsu et al. [10]	2011	Level III retrospective cohort study	15/24	226	NR	Multiple	184 (81%)	NR	NR	3.3
Weistroffer et al. [28]	2011	Level IV case series	8/16	52	27.1	NFL	42 (81%)	NR	33	3
Anakwenze et al. [2]	2010	Level III retrospective case-control	13/24	24	27.8	NBA	18 (75%)	NR	20.1 fewer games in next season	NR
Hsu [9]	2010	Level III retrospective cohort study	16/24	96	27.5	NFL	75 (78%)	NR	36	3.1
Watkins et al. [24]	2003	Level IV case series	11/16	60	26.8	Multiple	53 (88%)	5.2	NR	NR
Wang et al. [19]	1999	Level IV case series	9/16	10	NR	Multiple	9 (90%)	NR	NR	NR

* Ten players in Watkins et al. [23] retired from sports as a result of reasons unrelated to lumbar disc herniation and were not included in return-to-play percentages; MINORS = Methodological Index for Non-Randomized Studies; NR = not reported; NHL = National Hockey League; MLB = Major League Baseball; NFL = National Football League; NBA = National Basketball Association.

Table 2. Stratification of athletes per sport

Sport	Number of athletes included
Professional American football	154
Professional baseball	82
Professional hockey	122
Professional basketball	67
Olympic swimming	1
Olympic skiing	1
Olympic water polo	2
Professional ballet	1
Professional martial arts	1
Professional sailing	2
Unknown sport	17
Total number of athletes included in analysis	450

(Table 1). We applied the Methodological Index for Non-Randomized Studies (MINORS) scale [18] to judge the quality of the study conclusions (ideal maximum score is 16 for noncomparative and 24 for comparative studies). The grading was performed by two authors independently (RN, CAK). In the cases of disagreement, the senior author graded the study.

Postsurgical outcomes were compiled including the percentage of athletes who were able to return to play at their previous level of competition (10 articles reporting) [2, 8–10, 17, 19, 23, 24, 28, 29], the recovery period after lumbar discectomy to return to play (four articles) [8, 23, 24, 29], the number of games played after surgery (three articles) [8, 9, 17], the number of years played after surgery (two articles) [10, 17], and performance outcomes based on statistical performance both before and after lumbar discectomy (three articles) [8, 10, 17]. Performance scores for two studies [9, 17] based on a previously published scoring system [5] using statistics unique to each sport and position were used as an outcome measure. For example, in the study by Hsu [9], performance scores for the quarterback position were based on a formula that included passing yards, rushing yards, touchdowns, and interceptions. There were variations in this formula based on position played. Schroeder et al. [17] described a similar formula for hockey players based on goals, assists, and shots on goal and was individualized based on position. In baseball athletes [8], the performance outcome measure was determined for hitters as the batting average and for pitchers the earned run average.

A total of 450 elite athletes in 10 studies underwent lumbar discectomy for LDH from 1967 to 2010. These athletes were primarily from the four major North American professional sports leagues: 154 of 450 (34.2%) from the National Football League (NFL), 67 of 450 (14.9%)

from the National Basketball Association (NBA), 122 of 450 (27.1%) from the National Hockey League (NHL), and 82 of 450 (18.2%) from Major League Baseball (MLB). In addition, there were four Olympians who participated in water polo, skiing, and swimming, two professional sailors, one professional ballerina, and one professional mixed martial arts fighter (Table 2). The average age reported in these studies for patients undergoing lumbar discectomy ranged from 19.4 to 31.1 years [2, 8, 9, 17, 23, 24, 28, 29]. The average body mass index (BMI) in studies that reported this statistic ranged from 21.9 to 35.5 kg/m² [2, 8, 10, 28, 29]. The wide range of average BMIs can be attributed to the variety of athletes, ranging from Olympic swimmers to NFL linemen.

Results

The proportion of athletes who successfully returned to play after lumbar discectomy ranged from 75% to 100% in the seven articles [2, 10, 17, 19, 23, 24, 29] that reported this outcome measure. Of note, the definition of “return to play” varied among the articles. Several articles [2, 19, 24, 29] defined this as return to active participation in the previous sport, but some had stricter definitions such as being on the active roster [10, 17] or logging 1 minute of play time in a regular season game [23].

The average reported recovery time for athletes undergoing lumbar discectomy to return to active play ranged from 2.8 to 8.7 months [8, 23, 24, 29]. The shortest reported recovery time was 2 months for a professional ballerina (n = 1) [24].

For those athletes who successfully returned to play after lumbar discectomy, the average reported career longevity ranged from 2.6 to 4.8 years [8–10, 17, 28]. For NHL players, Schroeder et al. [17] reported an average of 129.6 hockey games played postoperatively. For MLB players, the average career longevity postoperatively was 232.8 games, as reported by Earhart et al. [8]. For NFL players, the average postoperative career longevity was 36 games [9]. It is worth noting that the minimum followup for these articles was 1 year (most articles mention minimum 2-year followup or mention no followup data). In the three articles that [8, 9, 17] reported player performance data before and after lumbar discectomy, postoperative scores were compared with preoperative data. In these studies, players’ average statistics after surgery ranged from 64.4% to 103.6% of baseline preoperative statistics. There was some variability in postoperative performance scores depending on sport (hockey 64% of baseline [17], football > 100% of baseline [9]).

Of note, seven studies did not comment on complications in their athlete population [1, 8, 10, 17, 19, 23, 28].

Yoshimoto et al. [29] and Watkins et al. [24] reported no complications, and Hsu [9] reported an 8.3% LDH recurrence frequency, which is comparable to the general population [3, 4, 6].

Discussion

LDH can be a devastating injury for elite athletes with the potential to reduce an athlete's career longevity and athletic performance. Lumbar discectomy is a successful treatment for LDH in the general population in that it relieves pain and restores function in most patients who undergo the procedure [4, 26]. However, the impact on lumbar discectomy on elite athletes may vary compared with the general population because of the high postoperative demands required to reach elite athletic performance. This systematic review sought to define the expected outcomes after lumbar discectomy using performance-based measures.

There were several limitations to our systematic review. First, all included studies that met our inclusion criteria were limited to level III and IV evidence. Sample size in many of the included studies was also a limitation of this study. Among the level III case-control studies, only data from surgical cohorts were presented because of the specific question of outcomes of lumbar discectomy in elite athletes. Second, because of the retrospective nature of these studies, there are inherent biases, including both selection and transfer bias, which may inflate the apparent benefits of surgical treatment reported in these studies. Although level I and II studies eliminate these biases, these are impractical given the small patient population of elite athletes with LDH.

Additionally, inherent variations of reporting such as time of clinical presentation, performance-based outcomes, and complications may have affected the results for recovery time and effect of sport. Furthermore, each article differed in its definition of "return to play," preventing direct comparisons across these various studies. Other basic differences in terms of scientific reporting further limited analysis, for example, even the age at the time of surgery of the athletes analyzed, was inconsistently reported in the studies we evaluated. In this systematic review, the data from the 10 included articles could not be equally weighted or pooled together because of the differences in methodology across studies. Future studies that investigate these issues should standardize the reporting of these outcomes. These inherent limitations weakened the conclusions for each of our research questions.

The 10 included studies found that 75% to 100% of the elite athletes studied were able to return to their prior level of competition after lumbar discectomy, which is

comparable or better than that of the general population as described by Weinstein et al. (76.2% return-to-work rate 1 year after lumbar discectomy) [27]. Among the four major North American professional sports leagues, although our data could not be pooled, the proportion of athletes who returned to play was generally higher in MLB players and lower in NFL athletes, which may reflect the relative physical demands of each sport. As noted previously [10], the reasons for these findings can also be attributed to the nature of guaranteed versus nonguaranteed contracts, culture of the sport, and differences in medical clearance protocols. Larger sport-specific studies with clear definitions of return to play may help better quantify the proportion of athletes who are able to return to an elite level of competition after lumbar discectomy. Of note, among the papers included in this systematic review, four studies also addressed the proportion of players who returned to sport after nonoperative treatment of LDH. All four reported no significant difference in return to play between operative and nonoperative cohorts [8–10, 17].

The reported average recovery time of 2.8 to 8.7 months after lumbar discectomy in this patient population appeared to be greater than that seen in the general population. Earhart et al. [8] evaluated recovery time in MLB players with LDH who underwent operative versus nonoperative treatment and found a significantly longer recovery time in the operative cohort (8.7 months versus 3.6 months, respectively). No other studies directly compared recovery times in operative versus nonoperative cohorts. Studies in the general population [11] have recommended return to work anywhere from 1 to 4 weeks after lumbar discectomy [6], dependent on its physical demands. This discrepancy can be partly explained by the impact that time of presentation can have. For example, athletes who undergo lumbar discectomy late in the season or in situations where there is a capable backup player may be placed on the injured reserve list for the remainder of the year before returning the next season. Although they may have been medically cleared to play sooner, the recovery time would be delayed simply because of a typical off-season. Furthermore, professional athletes must often wait at least 6 weeks after surgery before performing any type of rigorous physical activity. Impact activities and speed training are often delayed even further with the fear of reinjury without proper core strengthening. These realities contribute to the differences in mean recovery time [13]. More rigorous studies with specifically defined endpoints are needed to better define the recovery time for elite athletes after lumbar discectomy.

We found that, in general, baseball players had the longest average career length after lumbar discectomy (4.8 years) [8], whereas NFL athletes played for 3.1 years [9], and NHL athletes played for 2.6 years on average after

lumbar discectomy [17]. Two studies compared the career length after operative versus nonoperative treatment for LDH. They both found no significant differences in career length after treatment [10, 17]. In terms of postoperative performance, elite athletes who underwent lumbar discectomy were able to perform at 64.4% to 103.6% of baseline of their baseline preoperative level based on statistical outcomes. The variability depended on the sport played with hockey players having the largest decline in postoperative performance and football players showing a slight improvement in performance after lumbar discectomy. In two studies that compared performance scores after treatment for LDH, there was no significant difference between operative and nonoperative treatment. However, Earhart et al. [8] reported a significant decrease in performance at 1 year after surgery in MLB players who underwent lumbar discectomy, whereas there was no decrease in performance after nonoperative treatment for LDH. As previously mentioned in included studies, this variability of performance can be dependent on a number of factors including age at surgery, team roster, and quality of the athlete before injury. Furthermore, statistical performance is not necessarily indicative of athletic capability because a player's skill such as arm strength can have a different impact on postoperative outcome depending on sport, position, and other compensable skills.

Although LDH has historically been viewed as a career-threatening injury in elite athletes, based on data in this review, football players who are able to complete the rigorous rehabilitation required to return to play after lumbar discectomy can expect to reach their preinjury performance level. However, as some authors have opined, because this patient population has high physical capabilities, they may be able to accommodate for strength deficiencies or pain better than the general population [22]. Future studies are needed to examine the variability in player performance based on specific sport after lumbar discectomy.

Randomized controlled studies of lumbar discectomy in the general population have shown that a high proportion of patients are satisfied with the intervention, have improvements in terms of activities of daily living, and return to employment [13, 26, 27]. However, for the elite athlete whose livelihood depends on athletic performance, managing postoperative expectations after lumbar discectomy can be more difficult given the paucity of literature specific to athletes. In a small group of studies, a high proportion of players undergoing lumbar discectomy successfully returned to play with variable performance scores on return. Although further prospective cohort studies would be useful to further define the best treatments for LDH in elite athletes, this review can serve as a general guideline for expectations after lumbar discectomy in this population.

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