

Baranowski Jakub, Terebecka Agata, Kuźminko-Bojarczuk Anna, Sagan Leszek. Return to sport after lumbar fusion among patients with degenerative spinal disease. *Journal of Education, Health and Sport*. 2022;12(7):269-276. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2022.12.07.026> <https://apcz.umk.pl/JEHS/article/view/JEHS.2022.12.07.026> <https://zenodo.org/record/6791240>

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. 32343. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences).

Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 21 grudnia 2021 r. Lp. 32343. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przepisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 20.06.2022. Revised: 20.06.2022. Accepted: 02.07.2022.

Return to sport after lumbar fusion among patients with degenerative spinal disease

Jakub Baranowski, Agata Terebecka, Anna Kuźminko-Bojarczuk, Leszek Sagan

Jakub Baranowski ¹, 0000-0001-5040-0676, jakub.baranowski@pum.edu.pl

Agata Terebecka ², 0000-0002-9892-0395, agata.terebecka@gmail.com

Anna Kuźminko-Bojarczuk ², 0000-0002-0763-2890, ania.kuzminko@gmail.com

Leszek Sagan ¹, 0000-0001-5366-1070, leszek.sagan@pum.edu.pl

¹ Department of Neurosurgery, Pomeranian Medical University Clinic Hospital No. 1, Unii Lubelskiej 1, 71-252 Szczecin, Poland

² Department of Radiology, Pomeranian Medical University Clinic Hospital No. 2, Powstańców Wielkopolskich 72, 70-111 Szczecin, Poland

Abstract

Introduction and purpose

Low-back pain (LBP) is one the most common causes of medical visits. Although specific diagnosis cannot always be made, degenerative spinal disease may be one. Non-surgical approach is the treatment of choice in most cases and provides satisfactory results. However, some patients require surgery when conservative treatment fails. Among different interventions, lumbar fusion is one of the most important. Common question arising from patients qualified for this type of surgery is the possibility of returning to sport (RTS).

Description of the state of knowledge

Successful RTS may be achieved with proper rehabilitation without surgery. However, invasive intervention, including lumbar fusion, is indicated when a non-surgical approach fails. Return to recreational sport is highly plausible among patients operated for spinal structures degeneration. The timing of RTS varies on the type of sport, nonetheless one may expect to rejoin sporting activities within a year. The return to golf has been well documented in the literature in comparison to other sport types. Golfers may expect successful recovery as 79-100% of them re-engage in golfing activities. Positive RTS is feasible for professional athletes and some of them are able to compete at elite level after surgery. The need for a well-structured rehabilitation protocol is underlined.

Summary

Successful RTS can be achieved in the vast majority of cases after lumbar fusion procedures. The suggested timeframes has been set as 6-12 months depending on the sport type. There are no strict recommendations, but general criterias include: 1) complete/nearly complete pain reduction; 2) adequate flexibility, strength and range of motion; 3) radiographic evidence of successful fusion.

Keywords: return to sport; spinal fusion; spondylosis; intervertebral disc degeneration

Introduction

Low-back pain (LBP) stands as the second most common cause of medical visits [1]. It is estimated that 60-90% of the population experience at least one acute LBP episode in their lifetime [2]. The general prognosis is exceptionally good as almost 90% of cases are resolved within a month with little or no medical intervention. Low-back pain is usually diffused and may radiate along the spine or to lower extremities. Chronic LBP is characterized by the duration of symptoms and the cut-off between acute and chronic episodes is set at >3 months [3].

LBP may be sometimes accompanied by leg pain, called sciatica or radiculopathy. This term relates to the sensation of pain or sensory changes (i. e. numbness) in the distribution of a given nerve root dermatome and is caused by a nerve root compression. Muscle weakness and reflex changes may also be presented in some cases. The most severe condition of multiple lumbar and sacral nerve roots compression forms cauda equina syndrome (CES). This is due to the compression of the cauda equina, which is a bundle of nerve roots below the conus medullaris. Clinically CES consists of sphincter dysfunction, including either urinary retention or incontinence; saddle anesthesia (sensory disturbance in the region around anus, genitals, thighs); significant lower extremities' muscles weakness; LBP with or without sciatica. Although not very common, CES is an urgent indication for decompressive surgery [4].

Degenerative spinal disease (DSD) or other conditions that lead to spinal canal narrowing, called spinal stenosis, often presents with neurogenic claudication along with LBP and/or radiculopathy. Classical neurogenic claudication is characterized by pain and numbness radiating down the leg occuring while standing or walking and is relieved after sitting/lying. However, many cases of DSD (including spinal stenosis and spondylolisthesis) are asymptomatic [5].

In the majority of LBP cases a specific single diagnosis cannot be made, as a number of pathologies are involved [3]. Those states include prolapsed discs (discs herniation), disc degeneration, osteoarthritis of the joints, fractures of vertebrae or spondylolisthesis to name a few [6]. Further division by etiologies may be made, such as congenital, degenerative, deformity, traumatic, etc. The following review focuses on degenerative causes of chronic LBP.

Degenerative spinal disease, also referred to as spondylosis, is a broad term covering progressive deterioration of different spinal structures, such as disc abnormalities (decreased height, bulging, herniation), facet joint disorders, osteophytes, ligaments hypertrophy. As a result the diameter of the spinal canal may be decreased, a condition known as spinal stenosis, which clinical presentation is mentioned above, and which arises from neural structures compression. Depending on the site of maximum degeneration, it can be further divided into central canal, lateral recess and foraminal stenosis [5]. Deterioration of spinal structures may lead to spinal instability which presents as a uni- or multisegmental form. Spondylolisthesis refers to the situation of anterior subluxation of one vertebral body (VB) on another; usually the superior VB is the anterior one. Degenerative spondylolisthesis, the unisegmental form, is Type 3 spondylolisthesis and usually occurs at L4–L5 level. It is caused by long-standing intersegmental instability without fracture of the pars [7]. Degenerative adult spinal deformity (ASD) results from cumulative multisegmental spinal deterioration in the intervertebral discs and facet joints. Those changes occur asymmetrically and produce deformity characterized by disturbances in the sagittal and/or coronal plane. Clinically, ASD presents with axial pain with or without radiculopathy and disability [8].

Only a fracture of the total number of LBP cases requires surgery as conservative treatment usually provides satisfactory results. Surgical intervention is indicated when conservative treatment fails to succeed and symptoms become severe or neurological deficits are present. The aim of surgery is to manage pain and halt neurological deterioration. The spectrum of surgical interventions is broad and includes less invasive procedures (such as simple decompression) to significantly more complex instrumentation with intervertebral (interbody) fusion and transpedicle screws and rod fixation [9, 10]. The main part of surgical treatment focuses on direct or indirect decompression of the nerve roots. In certain situations additional fusion should be considered and those include: 1) spondylolisthesis; 2) degenerative scoliosis and sagittal imbalance; 3) decompression itself will destabilize the spine; 4) recurrent herniated disc [11]. A surgeon has a variety of different fusion techniques to choose from and is able to personalize the procedure for a specific patient. Detailed description of fusion surgeries is beyond this review and may be found in references [12].

The possibility and timing of return to sport is a common question among patients qualified for lumbar fusion surgery. Thus, the following review addresses the topic of return to sport (RTS, also referred to as return to play, RTP) after spinal fusion.

Low-back pain is exceptionally prevalent among general populations; it is estimated that even 90% of adults experience at least one LBP episode during their lifetime [2]. It remains unclear whether athletes, professional or recreational, are at higher risk for LBP. Several factors must be taken in consideration when assessing this risk, especially sport type, intensity and frequency of training.

Sports correlated with the highest rate of severe LBP are wrestling and rhythmic gymnastics, while the risk remains lower for football, tennis, volleyball and heavyweight lifting [13]. It has been noted that radiological evidence of degenerative spinal disease is more common among the athletes than the control group, but it does not correlate with higher frequency of low-back pain [14].

Non-invasive treatment is the preferable first line management of LBP. Several protocols of rehabilitation and return to sport were published, however none high-evidence clinical trials were performed [13]. Cooke et al. presented a five-stage rehabilitation algorithm for LBP arising from degenerative diseases. From the first stage that focuses on pain control and consists of rest, application of painkillers (especially nonsteroidal anti-inflammatory drugs), epidural steroid injections, patients move to more complex routines in the latter stages. The protocol passes to exercises influencing dynamic spinal stabilization (mostly isometric exercises) and then to lumbar muscles strengthening. In stage IV active return to sport is achieved. Criteria for eligible RTP are described as follows: 1) a painless range of motion, 2) a return of muscle strength, and 3) a neutral position of the spine during sport is achievable. Stage V is to maintain rehabilitation outcomes by regular exercises [15].

Given the conservative treatment fails, invasive options are taken into consideration. Recently, the surgical management of chronic LBP on degenerative disc disease basis comprises interbody fusion with or without screw-rod fixation. It is suggested that interbody fusion techniques result in significantly high fusion rates [10, 16]. Many athletes, both professional and recreational, suffer from degenerative spinal disease and may face the decision to undergo lumbar fusion surgery. The timing and possibility of RTS are important aspects for some individuals.

Description of the state of knowledge

To address the above question, electronic research using online databases (Embase, PubMed/Medline and Web of Science) was performed independently in June 2022 by three researchers (JB - neurosurgery resident and AT, AKB - radiology residents). The search terms included were “lumbar fusion” and “return to sport” with their corresponding synonyms. Studies were eligible for inclusion if: 1) they include patients who underwent lumbar fusion; 2) indications for surgery were related to degenerative diseases; 3) RTS was described. Exclusion criteria were set as: 1) patients with non-degenerative diseases; 2) no return-to-sport described; 3) spinal surgery without fusion; 4) non-lumbar spine fusion.

The total of 105 non-duplicated hits were identified and directed to the screening process. Twenty-four full-text articles were assessed for eligibility after screening. The number of seven articles were included in the following systematic review. When disagreement among researchers as to the final inclusion of a given article was present, the decision was made by a majority of researchers' votes. The process was supervised by the senior researcher (LS).

In the study performed by Jain et al. a number of 117 patients, who underwent lumbar fusion for degenerative lumbar pathology, were questioned about their participation in recreational sports at minimum of 1-year postoperative follow-up. 32 patients were involved preoperatively in some recreational sporting activities (in 1 of the 3 most common sports: golf, swimming, or biking). In this cohort of patients 100% of them managed to return to their respective sport by 3 - 9 months after lumbar fusion. The bikers (n=10) were the first group to re-engage in cycling at an average of 3.3 ± 2.3 months, while the golfers (n=13) needed an average of 8.6 ± 3.6 months to return to their sport. All patients experienced pain reduction in comparison to their preoperative state [17].

Degenerative spinal disorders are commonly seen in elder population. Golf is one of the most popular sports among senior residents. Zuckerman et al. investigated the return-to-play process of 6 non-professional golfers after surgery, 2 of whom underwent lumbar fusion because of degenerative spinal disease. Both of them were females. Patient 1, aged 48, with 20 years of non-surgical treatment, managed to participate in golf-related activities 5 months postoperatively with full return to golf after 6 months. Patient 2, aged 67, with 12 years of non-surgical treatment, needed 6 months to first golf training, while full RTP took 18 months. Both patients experienced significant back and leg pain relief. In this study degenerative patients returned to golf sooner than deformity patients [18].

In the bigger case series, Shifflett et al. included 34 golfers (mean age 57 years, range 32 - 79 years), who underwent lumbar fusion surgery for degenerative spinal disorders. Preoperatively, 79% of them reported back or leg pain affecting their ability to play. At follow-up of one year, 65% of the patients managed to re-engage in golfing activities. The minority of the cohort (29%) presented persistent back or leg pain, limiting their ability to play golf. Most of the golfers played a comparable amount of golf (77%) with their handicaps remaining at the same level or improved as preoperatively (80%) [19].

The problem of RTS is especially concerning for professional athletes who are qualified for lumbar fusion. Shah et al. analyzed data of 10 elite athletes after spinal fusion for degenerative disorders and their RTP process. Six of them (2 cricketers, 3 marathoners, 1 tennis player) underwent lumbar fusion. Postoperatively, each patient was subjected to an intensive rehabilitation program. The protocol consists of five steps: early protected mobilization, dynamic stabilization, return to training, return to sports, maintenance. All patients successfully returned to professional participation in their sports. The average time before return to training was 6 weeks and return to contact sports took on average 12 weeks. As there are no standardized protocols of RTP, the authors of this study point out that athletes need to be asymptomatic with full strength and range of motion before returning to sports [20].

Bardin described a case of a professional runner with lumbar disc degeneration and instability causing LBP with radiculopathy. Conservative treatment failed to succeed, therefore the patient was qualified to lumbar fusion. Postoperatively an intensive rehabilitation programme, including re-education of posture, proprioception and balance training, trunk and leg muscles strengthening, was implemented. After 6 months the patient was able to resume long-distance running and after 12 months was able to perform competitive running at a level comparable to previous performances.

Lumbar fusion surgery with extensive rehabilitation protocols may produce excellent results as RTS is concerned [21]. Another successful return to professional sport was described by Garces et al. The authors presented a case report of a wrestler who underwent lumbar fusion and managed to return to professional wrestling in one year [22].

Even a complicated spondylotic history with numerous surgical interventions does not exclude the possibility of a successful return to sport. Reteneberger et al. presented a case of a 63-year-old skier with advanced spinal degeneration. The patient had undergone several interventions and he developed degenerative spondylolisthesis at two levels in consequence of adjacent segment disease (ASD). A long spinal fusion from vertebra Th10 to the pelvis was performed. The patient made exceptional progress within one year postoperatively. He managed to return to skiing, although he needed minor adjustments in his technique as sagittal balance and spinal biomechanics were altered. The authors point out that spinal surgeries, especially major spinal fusion, affect sagittal balance and thus body posture and may influence the ability to engage in certain sports, where body posture is essential. Nonetheless, successful RTP is possible [23].

Although arthrodesis achieved by interbody fusion with instrumentation remains a gold standard for degenerative spinal disease, different approaches are currently under investigation. Total disc replacement (TDR) is a technique where special types of implants are used, which allows some range of motion in the operated segment. It has been reported that patients operated for monosegmental degenerative disc disease with TDR implants have a high chance of successful RTS. At 4 year follow-up, 79% of the cohort of 50 patients have achieved RTS, while 86% of them were forced to stop normal sport activities preoperatively [24].

Summary

Current literature lacks data about RTS among patients operated for DSD, in particular high quality studies are needed. The problem of returning to recreational sport is especially poorly documented. RTPs after spinal fusions performed for other spinal disorders such as idiopathic scoliosis, spondylolysis, spondylolisthesis type I (dysplastic) and type II (isthmic) were also reported. Some conclusions from those studies must be extrapolated to DSD patients in the view of current knowledge [13, 17, 25, 26].

Based on literature review following timeframes for RTS have been suggested: 1) golf - 6 months; 2) non-contact sports - 6 to 12 months; 3) contact sports - 6 to 12 months; 4) collision sports - not recommended [25].

RTP criterias vary between different studies significantly, as they are based mainly on experts' opinions. General criterias for a positive RTP decision may be presented as follows: 1) complete/nearly complete pain reduction and other symptoms withdrawal; 2) adequate flexibility, strength and range of motion must be regained; 3) radiographic evidence of successful fusion [13]. The need for completion of a structured rehabilitation plan was also underlined [20, 26].

Ultimately, the decision of RTS must be personalized for each individual and consider multiple factors including type of sport, assumed level of intensity, expectations and one's natural abilities. However, successful RTP can be achieved in the vast majority of cases but some people may never succeed [26].

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