

Review Article

Biomechanical Factors could Affect Lumbar Disc Reherniation after Microdiscectomy

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Abstract

Low back pain affects an estimated half a billion people at any time worldwide. Although several noninvasive treatment strategies have been developed, in many cases, they cannot relieve patients' symptoms, thus low back discectomy is the appropriate treatment of choice. It is widely accepted that surgery alters the biomechanics of the functional motion segment and results in additional disc herniation at the adjacent level or the opposite side, more commonly than expected. After the discectomy, changes in vertebral load properties and kinetics could occur. As a result, biomechanical stress on the affected level as well as cyclic loads can cause lumbar disc reherniation (rLDH). Since the rate of recurrent disc herniation is about 5%-15%, further research should be done so as to quantify the postoperative lumbar spine kinematic pattern, with the use of wearable sensors technology, that could be a potential biomechanical factor causing rLDH.

Keywords: Low back pain; Surgery; Biomechanical factors; Lumbar Discectomy biomechanics; Spine biomechanics

1. Introduction

Low back pain affects an estimated half a billion people at any one time worldwide. Several noninvasive treatment strategies have been developed so far from combination of drug therapy to physical therapy rehabilitation protocols.

Unfortunately, these options in many cases cannot relieve patients' symptoms, thus low back surgery is the appropriate choice of treatment. The total rate of all elective lumbar spine operations is 148 per 100,000 in the population in the USA per year. Half of them refers to lumbar discectomy-almost 200.000 surgeries [1]. Eighty to 90% of herniated lumbar disc surgery attain satisfactory results during the first postoperative year [2, 3]. One of the most common reasons for unsatisfactory outcomes after lumbar discectomy surgery, is the recurrent lumbar disc herniation (rLDH). Epidemiological data show a rate of recurrent disc herniation of about 5% to 15% [4-8]. Since the total rate of inadequate results after first lumbar discectomy reaches from 5% to 20%, it's clear that recurrent herniation makes up for one of the most important factors that cause pain, disability and eventual reoperation. The possible sources of reherniation increased risks, has been the research purpose of many studies, in an effort to reduce postoperative recurrent rates. Some researchers reported that the most important factors include sex, age, smoking, localization of lumbar disc herniation, the amount of tissue removed, alcohol consumption, the patients' failure to comply with directions for restricted activities and primarily biomechanical factors. Thus the aim of this study is to review the most important biomechanical factors considered to cause lumbar disc recurrence after microdiscectomy [12].

2. Methodology

2.1 Search strategy

A literature review search database of Pubmed, Medline, EMBASE, AMED, CINAHL, Google Scholar and Scopus was conducted using the following relevant keywords and phrases that describe relevant studies: Recurrent lumbar disc herniation, lumbar discectomy, biomechanical factors of recurrent lumbar disc herniation, causes of lumbar disc reherniation, recurrence of after lumbar discectomy.

2.2 Inclusion and exclusion criteria

The titles and abstracts of articles retrieved from the searches were assessed independently by two reviewers. The same reviewers evaluated eligibility criteria of potential articles assessing full text, independently. Articles were only included being, suffice to the following criteria: were peer-reviewed, were published in English, assessed the spine, included the lumbar spine, included at least one of following as outcome measures: spine kinematics, kinetics. Articles were excluded if: they were review or case-study; they did not assess spine biomechanics.

3. Discussion

Spinal biomechanics is among the most common factors that can cause low back disorders and pain. Lumbar spine biomechanics, kinematics and kinetics, is substantial knowledge for adequate risk prevention and disorder management, for sports and rehabilitation, as well as for realistic load testing of spinal implants in in vitro studies [13]. While surgery itself increases risk with the biomechanical and anatomical alterations that causes, there may be space for modifying such predispositional factors that can be addressed preoperatively to reduce complication risk [14-17]. A major mechanical factor that might be incriminated for reherniations after lumbar discectomy is the insufficient sealing of annular rent making it a weekend spot vulnerable to mechanical intradiscal pressure changes.

Bibliographic reports about risk factors for recurrent disc herniation include structural weakness of the annular tissue, application of repetitive lifting or vibrational forces, overloading, as well as the size and level of the disc herniation prior to the operation [18-24]. Such changes in vertebral load properties and subsequently in lumbar spine biomechanics attributed to surgical intervention, may lead to higher risk of reherniation.

This was demonstrated by Kim et al who in an effort to prove it, used preoperative imaging [25]. The authors found that patients with sagittal motion $>10^\circ$ had a recurrence rate of 26.5% compared to those with $<10^\circ$ who had a rate of 4.1%. They also assessed disc degeneration by calculating disc height index preoperatively and found that those with recurrent LDH had significantly lower preoperative DHI versus those without recurrence. It has been proposed that drastic disc height loss increases intervertebral stability by reducing index-level kinematics. As a result, this correlation between disc height prior to operation and risk of reherniation has led some surgeons towards the direction of operating patients with herniations and normal disc height only after all possible conservative options have failed to provide a satisfactory outcome.

As discussed in a number of biomechanical studies, higher disc disruption will accelerate degenerative disc disease and consequently shift axial loads to the posterior column facet joints [26-28]. Poor patient outcomes have been associated with a number of pathological changes or conditions, such as facet joint degeneration, endplate degeneration, loss of disc height and lumbar instability [26, 29-32]. In conclusion, alterations in the biomechanical load adjacent to the fused segment increases significantly the effect of applied forces; underlying degenerative disease combined with aging, can cause recurrence of lumbar disc herniation. It is widely accepted that surgery alters the biomechanics of the functional motion segment and results in an additional disc herniation at the adjacent level or the opposite side more commonly than expected. As a result this condition constitutes a severe biomechanical factor of rLDH. The reason behind this is that the effect of cyclic loads after discectomy may increase ROM in lumbar spine, thus leading to spinal instability and possible rLDH [33].

4. Conclusions

Lumbar spine kinematics and kinetics are an important risk factor of rLDH following microdiscectomy. It is substantial to further quantify these biomechanical issues with the use of new technologies such as wearable sensors. Further research should be done so as to quantify the postoperative lumbar spine kinematic pattern that constitutes a biomechanical factor of rLDH. Wearable sensors technology could give valuable data towards that direction. Such information would be of great importance for further development of postoperative rehabilitation strategies in an effort to control rLDH.

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