

# Progress of core strength training intervention for lumbar disc herniation

Zeyu Zhou\*

Department of Physical Education, Hubei University, Wuhan, China

\*Corresponding author: 202121109012478@stu.hubu.edu.cn

**Abstract.** Core strength training is a highly functional form of training, because it has excellent features like less side effects and less money, so it does not cause a lot of stress to patients both physiologically and psychologically, and nowadays it is extensively used in the intervention of lumbar disc herniation; this type of training is aimed at muscles deep in the core area of the body, core strength can increase trunk stability and reduce injury. In recent years, there have been new developments in the way core strength training is applied, a number of research has demonstrated the effectiveness of combined core strength training in the intervention of lumbar disc herniation. This paper briefly reviews the mechanism of core strength training intervention for lumbar disc herniation and the current status of core strength training in lumbar disc herniation intervention in the past five years, to provide new ideas for the use of exercise in lumbar disc herniation interventions.

**Keywords:** Core strength training, Lumbar disc herniation, Surgical treatment.

## 1. Introduction

Degenerative disease of the spine caused by rupture of the lumbar annulus fibrosus and nucleus pulposus resulting in irritation or compression of nerve roots usually called lumbar disc herniation (LDH); restricted range of motion, aching in the legs and lower back, and abnormally decreased muscle performance are the main symptoms caused by nerve compression [1].

One research showed that as many as 95% of lumbar disc herniations have focal sites from the fourth lumbar vertebra to the fifth lumbar vertebra and from the fifth lumbar vertebra to the first sacral vertebra [2]. LDH has a prevalence of 2%-5% in the common population, and the morbidity of recurrent LDH ranges from 5%-18% [3,4].

LDH is caused by a variety of factors, the most basic reason for the disease is the degenerative disease of the lumbar spine itself. Mechanical injury to the lumbar spine is also a significant factor in LDH, for instance sitting for too long without moving, long periods of heavy workloads and some sports injuries that are caused by athletic Program that requires a high degree of strength in the lumbar muscles group and so on. Some genes have also been mentioned in related studies in association with disc degeneration, includes genes encoding collagen I, vitamin D receptor, etc [5]. There are also lumbosacral congenital anomalies, such as joint asymmetry and deformity, lumbar sacral vertebralization, sacral lumbar vertebralization and others can cause changes in the stress borne by the lumbar spine during exercise. In addition, overweight, smoking and pregnancy are also important contributing factors and it cannot be ignored.

Conventional intervention methods for LDH include medication, physical therapy and surgery, etc. Whereas, current treatment methods have some limitations. For instance, drug therapy may have some degree of side reactions for some people and slower recovery after surgical treatment. In recent years, exercise interventions for LDH are becoming increasingly popular, core strength training is even more widely used in the treatment of LDH, this treatment has fewer side effects while reducing symptoms, as well as being convenient and cost saving. Therefore, this paper looks at the mechanisms of exercise intervention in lumbar disc herniation and the way it is used, summarize the current research progress, in order to provide more theoretical evidence for exercise interventions in LDH.

## 2. Assessment of LDH

The assessment methods for LDH are usually divided into the following four categories. Laboratory tests being conducted when chronic inflammatory disease is suspected; X-rays is an imaging study performed in a low back pain setting, three views are included in it and the whole condition of the spine can be understood through X-rays; computed tomographic (CT) is the most sensitive way to assess bone structure, and Calcified disc herniation or any pathological process that may trigger bone abnormalities can be assessed during the CT examination; magnetic resonance imaging (MRI) is the best test for diagnosis of suspected LDH and it has a 97% accuracy rate, also it is better than CT for differentiation of inflammatory, malignant or inflammatory causes of LDH [6].

## 3. Treatment of LDH

### 3.1. Conservative Treatment

The medication, physical therapy, and exercise therapy mentioned before are all conservative treatments. Conservative treatment is usually the primary choice for patients with LDH, and patients experience improvement in LDH symptoms 6-12 weeks after receiving conservative treatment; commonly used therapeutic drugs include NSAIDs, baclofen, glucocorticoid injections and others, among them, NSAIDs are the main drugs for the therapy of LDH; commonly used manipulative treatments such as tuina and massage can reduce low back pain and improve functional condition, but there is a risk of increasing LDH with manipulative treatments [7,8]. Core strength training as an exercise training method has the function of improving neuromuscular function and improving pain symptoms [9].

### 3.2. Non-conservative Treatment

Non-conservative treatment is surgical treatment. Although surgical treatment has proven to be an effective treatment measure that provides rapid symptomatic relief and also has the advantage of increasing stability, promoting bone healing and restoring alignment, the disadvantages or complications of surgical treatment from a long-term perspective should also be noted [10]. A study of 34,639 LDH cases showed a 2.1% rate of repeat surgery within three months and a 2.7% rate of complications [11]. The positive aspects of surgical treatment are accompanied by the negative aspects, so careful consideration should be given to various aspects before choosing a treatment option; if the symptoms of LDH are more serious, such as muscle immobility or movement disorders caused by restricted movement, which have serious impact on patients' life, surgical treatment can be chosen; for patients with milder symptoms, if they do not improve after 6-12 weeks of conservative treatment, surgical treatment can also be considered.

## 4. Core Strength Training Intervention for LDH

Core strength training (CST) is a type of training that targets the muscle groups in the core region of the body. From the front to the back of the core are the abdominal and paravertebral muscle groups and the gluteals, from the top to the bottom are the diaphragm and the hip belt and the pelvic floor muscles [12].

Among the primary risk factors for LDH, lumbar instability should be the focus of attention, and the risk increases with age, because after reaching a certain age, the muscles in the core area will have a certain degree of degenerative changes, such as muscle strength loss and muscle atrophy are phenomena that can make the chance of LDH higher. Exercise of the deep spinal muscles and femoral muscles is extremely important to maintain the spine in a neutral position, such as the femoral flexors, gluteus medius, transversus abdominis and pelvic floor muscles, and core strength training is aimed at training these muscle groups [9].

A number of scores are commonly used in LDH interventions to check the effect of treatment, commonly used indicators are ODI score, JOA score and VAS score. The ODI score is a total of 50 points and is usually used to evaluate the patient's lumbar spine function, with the score inversely correlated with lumbar spine function; patients' recovery after treatment was assessed using the Japanese Orthopaedic Society Assessment Treatment Score Assessment (JOA), it is a total score of 29 points and includes three aspects of self-awareness, symptoms and daily life, and the score is proportional to the recovery effect; For the pain level a visual analogue score (VAS score) was used, Scoring range is 0~10 points and scores are proportional to pain level [13].

By strengthening all areas of muscle strength and coordination in the core area, the stability of the joints dominated by the muscles can be increased, thus achieving the efficacy of preventing and treating LDH. Core strength training intervention for LDH belongs to the category of sports rehabilitation and is widely used in rehabilitation medicine. A search of the literature revealed two main approaches to core strength training interventions for LDH in the last five years, which were organically combined with conventional conservative treatment and surgical treatment and this article will discuss the effects of core strength training in LDH interventions from these two aspects.

#### **4.1. CST combined with Conservative Treatment Intervention for LDH**

The muscles of the core are not by nature muscles that cause the body to move, but exist as muscles that stabilize the body, and the correct completion of any movement is based on a condition of physical stability, otherwise there is a risk of injury; The nature of the muscles in the core area determines a training style that is different from traditional strength training; common CST movements include hip bridges, swallow flies, and plank supports, which are also widely used in exercise interventions for LDH. In their study, Zhang Tao and colleagues divided 120 patients with LDH into a conventional treatment group and a training group, with the former receiving three conservative treatment methods: rehabilitation education, medication, and physical therapy; the training group received core lumbar muscle strength training based on conventional rehabilitation treatment, including double-bridge exercise and single-bridge exercise; the intervention period was one month; the results showed a better improvement in VAS, ODI and JOA score scores after treatment compared to the conventional treatment group ( $p < 0.05$ ), moreover, the overall efficiency of treatment was 15% higher in the training group than in the conventional treatment group, 95% and 80%, respectively ( $P < 0.05$ ); Finally, it was reached the conclusion that lumbar spine function can be significantly improved with core strength training and also relieves pain [14].

The combination of core strength training and TCM is also very effective in the rehabilitation of LDH, for example, the combination with Tui Na in TCM. Tui Na is a traditional Chinese medicine technique that can loosen tense muscles and relieve pain through special techniques, as well as stimulate specific acupuncture points to improve blood circulation throughout the body. In a study by Ding Yi and others, they divided 84 patients with LDH into three groups: the Tui Na treatment group, the suspension exercise training group (suspension exercise can train local core stabilizing muscles), and the suspension tui na exercise technique group; all three groups were given health education and the intervention period was 4 weeks; the results showed that the JOA scores and VAS scores of the hanging push-up exercise technique group were both better than the push-up treatment group and the hanging exercise training group ( $P < 0.05$ ), furthermore, in terms of cure rate, the highest was in the suspension and push-up exercise technique group, followed by the suspension training group and the lowest in the push-up group, with 75%, 64.29% and 53.57% respectively ( $p < 0.05$ ), and the relapse rate was lower in the hanging tui na exercise technique group (7.14%) than in the tui na group (42.86%) and the hanging training group (25%), with a statistically ( $P < 0.05$ ); finally, it was concluded that the combination of suspension exercise training and tui-na technique was more effective [15].

In addition, nerve root closure is a special type of medication that can be combined with core strength training to provide good intervention for LDH; nerve root closure refers to the injection of medication directly into the area where the nerve is compressed, which can provide fast relief of pain and other symptoms. Wu Yongfu and others divided 48 patients with LDH in the study and control

groups; patients in the control group were injected with a 1:1 mixture of 2% lidocaine and tretinoin, and the study group started core strength training (including dorsal, abdominal, and lateral bridges) on the second day after surgery; the results showed that the study group had better VAS scores and JOA scores than the control group at all post-treatment time periods ( $p < 0.05$ ) at all time periods after treating, meanwhile and the whole efficacy of the study group was 8.34% higher than that of the control group, 91.67% and 83.33%, respectively ( $P < 0.05$ ); finally, the conclusion is that nerve root closure therapy combined with core strength training can promote patients' recovery, improve the medium and long-term treatment effect, and reduce recurrence [16].

#### 4.2. Application of CST in Postoperative Rehabilitation of LDH

Among the surgical treatments, discectomy and laminectomy for radiculopathy caused by LDH are common [6]. The question of how to help patients recover quickly after surgery and get rid of postoperative syndrome is a worthwhile one, and many studies have confirmed that adding CST to different conventional interventions can lead to better results in postoperative rehabilitation.

It has been suggested that traditional postoperative rehabilitation of lumbar disc herniation focuses only on muscle training around the disease, with a single training modality and a lack of stabilization exercises for the entire spinal system [17]. Traditional rehabilitation training combined with CST has good rehabilitation effect. In a study by Yin Yeh-Lin and others, 80 patients with LDH treated with minimally invasive surgery were allocated into an observation group and a control group; the control group underwent conventional rehabilitation nursing interventions (including passive rehabilitation training and active back training), while the observation group combined CST (including hip bridges, plate supports and so on) on the basis of the rehabilitation nursing interventions; the intervention period for both groups of patients was 3 months; the results indicate that the VAS, ODI and JOA scores improved in both groups, and the improvement was better in the observation group compared to the control group of patients ( $P < 0.05$ ), moreover, PCS and MCS scores (quality of life evaluation indicators) were higher in the observation group at 3 months postoperatively compared to the control group ( $P < 0.05$ ); finally, it was concluded that the postoperative pain symptoms of LDH patients could be effectively relieved by core muscle training combined with rehabilitation care, meanwhile, the quality of life of patients could be improved [18].

In addition to traditional rehabilitation training, core strength training can also have good rehabilitation effects when combined with manual therapy, medication and other interventions. In a study by Helen Cheng and colleagues, 100 LDH patients were distributed into control and observation groups; in the control group, patients were intervened with conventional measures (including tui na, medication, acupuncture, and others), while in the observation group, core muscle training was added to the conventional interventions; the results show that better improvement in JOA, ODI and VAS scores in the observation group compared to the control group ( $P < 0.05$ ), and the overall efficiency of patient healing was 12% higher in the observation group than in the control group, 98% and 86%, respectively ( $P < 0.05$ ); finally, it was concluded that core muscle group training in LDH patients could significantly reduce visual pain and improve lumbar spine function after surgery, thus increasing the treatment efficiency [19].

### 5. Discussion

In the lumbar spine, which is the most common among disc herniations, followed by the cervical spine; in terms of pathophysiology, disc herniation is thought to be a combination of a local rise in inflammatory chemokines and nerve compression by the herniated nucleus pulposus [20]. The cause of LDH is not only its own degenerative disease and genetic factors, but also caused by people's living habits, such as long-term heavy work and many bad habits. The occurrence of LDH is a cumulative process. With age, the intervertebral disc fibrocartilage cells also undergo aging and decrease in proteoglycan, the later causes lack of water and disc collapse as important factors in the increased pressure on the annulus fibrosus, thus when the disc is repeatedly imposed with a source of

mechanical stress, it can gradually lead to the occurrence of symptoms, and these symptoms are often chronic [6].

Today, conservative treatment (medication, physiotherapy, acupuncture, and others) and surgical treatment (open surgical treatment and minimally invasive surgery) are the two ways to intervene in herniated lumbar discs; conservative treatment should be observed at 6-12 weeks, and if the symptoms in conservative treatment are still not relieved or tend to worsen, the patient can choose open surgery or minimally invasive surgery according to his situation. Studies have shown that only 10-20% of patients clinically require surgery, but there is a certain degree of chance that the paravertebral muscles will be damaged during surgical treatment and may lead to poorer stability of the lumbar spine after surgery, which eventually does not achieve the desired treatment effect, and even more patients will have recurrence after surgery [21]. For many patients the duration of the disease is so long that they are unable to return to work for a long time, causing great stress to them financially and psychologically.

CST is now widely used as a form of exercise therapy. In the last five years, core strength training in LDH is mainly used in an integrated way, but also reflects the high compatibility of core strength training, both with Western and Chinese medical treatment, can have better efficacy than a single treatment, and as an exercise therapy, it causes less side effects to patients, less psychological stress, and saves money. The studies included in this paper demonstrated that the combination of core strength training has a higher recovery rate compared to single treatment, but the recovery rate of the combination of different treatment approaches also varies, which indicates that the research on the combination of core strength training and certain treatment models is not perfect, and there is still a need to consider how to maximize the recovery rate of the combination treatment.

Besides CST, there are many other forms of exercise therapy. Studies have shown that in recent years, non-specific low back pain has been treated with a combination of physical and mental exercise (non-intensive physical activities such as yoga, qigong and pilates) with promising results worldwide [22].

## 6. Conclusion

Overall, the application of core strength training has solved many problems for LDH patients both physically and psychologically, improving the treatment and recovery outcomes and shortening the duration of the disease. The good progress of core strength training in LDH intervention also shows the importance of exercise in maintaining physical health, and that exercise should be used not only as an ideal treatment but also as a means of prevention. Besides core strength training, there are many other exercise modalities that can be used in LDH intervention; the applied form of core strength training provides ideas for the combined treatment of LDH with these exercises. It is hoped that more advanced and richer treatment modalities will be available in the future to intervene in LDH, thus improving the treatment effect and enabling patients to return to normal life as soon as possible.

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