



*Original Research Article*

# Are Water Therapy Pre-rehabilitation (Non-Chemical Drug) Exercises Effective on the Electrical Activity of the Central Muscles of Patients with Chronic back Pain who are Candidates for Laminectomy Surgery? A Systematic Review

Seyed Taher Mousavi<sup>1</sup>, Mehrdad Zamani Esfahlani<sup>2\*</sup>

<sup>1</sup>Assistant Professor of Neurosurgery, Department of Neurosurgery, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

<sup>2</sup>Assistant Professor of Spine Surgery, Department of Orthopedics, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

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## KEYWORDS

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## ABSTRACT

**Introduction:** Since the effectiveness of water therapy pre-rehabilitation exercises in people with chronic back pain and candidates for surgery as well as its effects on the results of laminectomy surgery have not been collected in a comprehensive study, it was decided to conduct the present study to obtain the issue of whether the hydrotherapy pre-rehabilitation exercises are effective on the electrical activity of central muscles in patients with chronic back pain who are candidates for laminectomy surgery, or not.

**Methodology:** This study is a systematic review.

**Results:** Initially, 66 articles were found. Reviewing the abstracts of the articles led to the removal of 30 articles, and from the remaining 36 articles, 28 articles were removed by reviewing the texts of the articles, and among the remaining articles, 4 articles were removed due to the low quality of the article, and finally 4 articles were included in this study and analyzed.

**Conclusion:** Water sports pre-rehabilitation program can be an important part of the comprehensive rehabilitation program for patients with back pain.

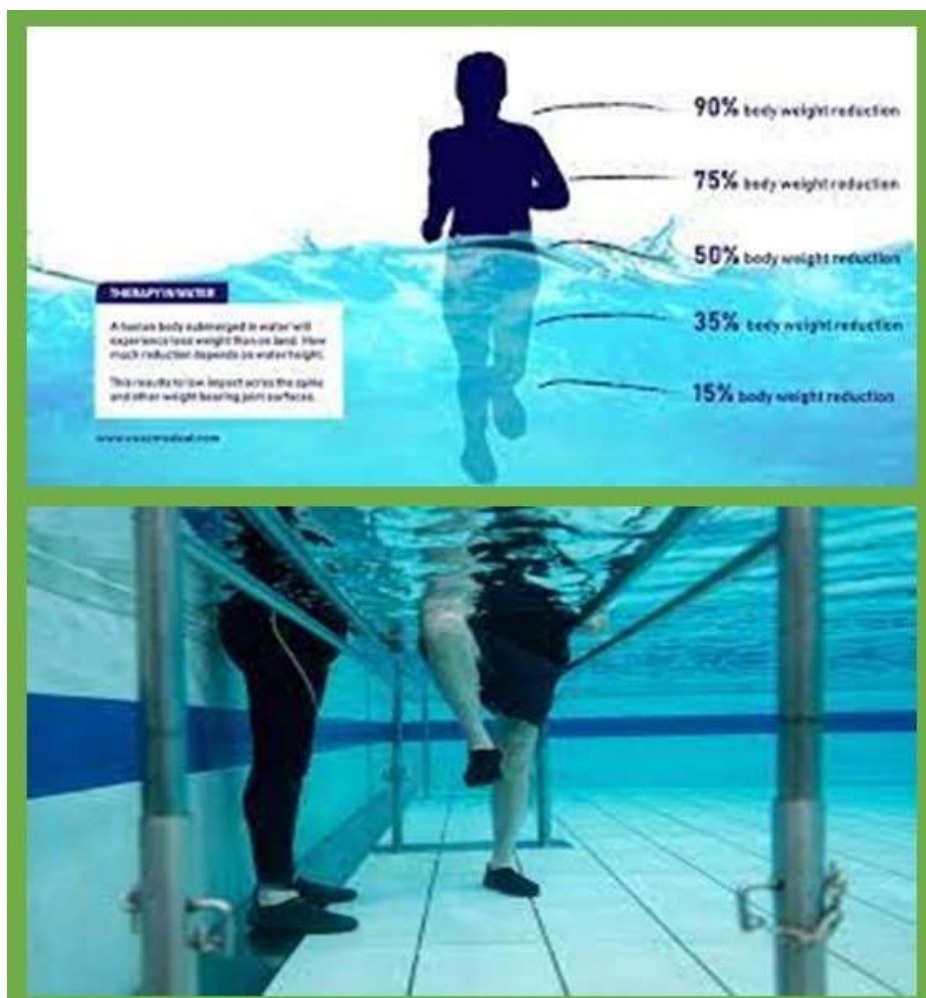
\* Corresponding author: Mehrdad Zamani Esfahlani

✉ E-mail: [zamaniesfahlani@gmail.com](mailto:zamaniesfahlani@gmail.com)

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## GRAPHICAL ABSTRACT



### 1. Introduction

The scientific evidence shows that the prevalence of back pain in women is higher than that of men due to various reasons, including pregnancy, childbirth, and child care, and the most common cause of back pain is based on the studies of postural weakness and weakness of important stabilizing muscles in the central region of the body, such as the multifidus muscles [1-3], transverse abdominus, rectus abdominus, and erector spinae. The scientific evidence indicates that chronic back pain is aggravated during the physical activity and most patients reduce their activity level to the minimum possible to avoid aggravation of pain, the strength, and endurance

of muscles and ligaments [4-6]. On the other hand, weakness and atrophy of the muscles in the central area causes a decrease in the stability and balance in the central area of the body and causes the inappropriate loads to be applied to the spine and the occurrence of back pain [7-9].

Any disturbance in the activity and function of the central muscles of the body causes a disturbance in the stabilizing system and instability in the central area, and ultimately causes back pain and functional disability in patients [10-13]. As mentioned earlier, in people with back pain, the multifidus and transverse abdominus muscles, which are the first important muscles that stabilize the spine, experience weakness, and

atrophy [14]. Then, to compensate for this defect, the surface muscles of the spine, such as the erect spinal muscles, try to compensate for this defect with their hyperactivity, which causes an increase in inter-articular pressure forces in the spine joints and brings pain and disability, which if not treated by applying loads and additional pressures on the spine joints cause intervertebral disc protrusion, and with the protrusion of the internal material of the intervertebral disc called nucleus pulposus, the spinal cord is under pressure and the symptoms of spinal cord compression appear. Studies show that the process of disc degeneration is related to the age and is directly related to the pressures and physical loads applied to the spine.



**Figure 1.** Water therapy pre-rehabilitation exercises



**Figure 2.** Water therapy pre-rehabilitation exercises

Any of the discs of the spine may be bulging. However, this damage is more common in the cervical and lumbar intervertebral discs, where

the bulging of the lumbar vertebrae occurs 15 times more often than the cervical vertebrae. The diagnostic tool for this injury is MRI and CT scan [15-17]. In this situation, one of the effective treatment methods is to remove pressure from the spinal cord performed with a type of surgery called laminectomy [18-20]. In this method, the protruding parts of the central area of the disc are removed from inside the spinal canal, and in this way the spinal cord is freed, and the pressure as well as stenosis of the spinal cord is removed. As a result, the symptoms of pain and disability of the patient are further improved [21-23].

Another major cause of pain in patients with chronic back pain is over-activity of the global muscles and reduced activity of local muscles. In this regard, one of the important foundations of back pain treatment is to normalize the activity of deep stabilizing muscle group such as the multifidus and surface muscles such as the erect spines so that strengthening these muscles plays a significant role in reducing pain and stabilizing the spine [24-26].

Therefore, the muscles weakness in the central region leads to an increase in pressure and dysfunction of the surface muscles of the back, providing the basis for the occurrence of muscle imbalance, which leads to the occurrence of back pain or its aggravation. Many studies have shown that exercise and controlled physical activity is the initial step in treatment to reduce pain and disability and increase range of motion, but the most important issue is choosing the most appropriate type of exercise [27-29].

Movement of a joint cause's stimulation of mechanoreceptors in joints and muscles changes the muscle activity by stimulating alpha motor neurons in the spinal cord and gray cells of the midbrain. On the other hand, the abnormal activity of deep and superficial muscle group causes the activity pattern of the receptors and subsequent muscle groups to be disrupted, the patient's ability to perform the optimal movements is reduced, and it causes pain or

aggravation of the patient's movement limitation [30].

Hydrotherapy with special features and advantages is one of the important and effective treatment methods for treating back pain, which has made it a very useful factor for rehabilitation. Many studies have shown that both methods of exercise therapy on land and exercise therapy in water improve the pain and disability of patients with chronic back pain. However, research has shown that exercise therapy in water has more healing effects than the exercise therapy on land. In addition, the hydrostatic pressure and water temperature help improve balance and control pain in patients, respectively. The bionic force of the water removes the pressure from the spine. Thus, it provides the basis for an earlier start of treatment than on dry land [31].

Although scientific advances, the new surgical methods, and postoperative follow-up have been effective, many patients still suffer from back pain and muscle weakness after laminectomy surgery. In recent years, pre-rehabilitation theory has been implemented with the aim of increasing the muscular and functional strength of patients as part of a comprehensive treatment program for chronic back pain in developed countries [32-34].

The theorists of pre-rehabilitation theory believe that pre-rehabilitation programs as a strategy to prevent the complications of immobility before surgery can lead to improve and increase the more favorable results of surgery, such as reducing the hospitalization period and decreasing the complications of immobility before and after surgery. Sports rehabilitation programs for patients with back pain in Iran are usually held after surgery for 8 weeks. However, so far no comprehensive research has been conducted on the effects of pre-rehabilitation exercises before surgery in combination with rehabilitation exercises after laminectomy surgery. Since the effectiveness of water therapy pre-rehabilitation exercises in people with

chronic back pain and candidates for surgery and its effects on laminectomy surgery results have not been collected in a comprehensive study, we decided to conduct the present study to answer the question of whether water therapy pre-rehabilitation exercises are effective in the electrical activity of the central muscles of patients with chronic back pain as candidates for laminectomy surgery, or not.

## 2. Method

**Study design:** The present study was conducted as a systematic review based on the steps of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement during the last six months of 2022 in Tabriz University of Medical Sciences [35-37].

**Determining the keywords:** At first, a face-to-face meeting was held with the presence of both researchers of the present study, and based on their experiences, the keywords of the present study were determined based on the search in the scientific texts. These keywords were as follows: Rehabilitation, Hydrotherapy, Laminectomy surgery, Chronic back pain, and Pain [38].

**Search Strategy:** The mentioned keywords were searched in English and Persian databases Iranmedex, SID, Magiran, MEDLINE, SCOPUS, science direct, PUBMED, cochrane library, google scholar, EMBASE, proQuest, and ebsco/CINAHL as well as the sources and the articles published during the 5 years ending in 2022 were selected for review in the present study. The search was done by both authors of this article separately, and if there was a difference in the selection of an article between the authors, a researcher who was not a member of the group of authors of this article would resolve the difference. The reason for selecting the articles in the last 5 years is that new studies are concluded.

**Selection criteria of articles:** Articles that were randomized clinical trials, those were conducted in human form, those whose target group was

laminectomy candidates, articles with full text, and those published in Persian or English languages were investigated that were included in this study. The review articles, letters to the editor, descriptive analysis, rare reports, and animal studies were excluded from the review process. It should be noted that the main criterion to select articles was the high quality of the articles checked based on the CONSORT checklist,

and the articles with high quality were included in this study.

**Extraction of information:** The information of each article, including the name of the first author, the year of the study, the sample size, the relevant intervention and the final result, were entered in the information registration form and their results were used.

**Table 1.** The summary of the most important information of the studies included in this systematic review

Final result	Type of intervention for each group	The sample size	First author/year
Hydrotherapy rehabilitation had no effect on people's activity level, but it led to a reduction in the pain intensity of the participants.	Intervention group: 4 sessions of water therapy per week for 6 weeks, a total of 24 sessions, and the length of each session was 45 to 60 minutes. Control group: They did their routine and daily life.	Intervention group: 15 people Control group: 15 people	Mahjur/2017
Both rehabilitation exercises in water and on land led to improvement in locomotor status and low back pain intensity.	Intervention group: doing stretching exercises and muscle strengthening exercises in water for 16 sessions every other day. Control group: doing stretching exercises and muscle strengthening exercises on dry land for 16 sessions every other day.	Intervention group: 15 people Control group: 15 people	Sawant/2019
Rehabilitation in water led to improvement of movement status and reduction of pain intensity of patients before laminectomy.	All patients did rehabilitation in water for 20 weeks, 3 times a week, and 45 to 60 minutes each time.	78 patients with low back pain symptoms before surgery.	Mirmoezzi/2021
Pre-rehabilitation exercises lead to the improvement of functional status and pain intensity after laminectomy.	Intervention group: 4 weeks before surgery and 4 sessions of water exercise every week, 8 weeks after surgery, and 4 sessions of water exercise every week. Control group: After surgery, they performed 4 sessions of water rehabilitation exercises for eight weeks.	Intervention group: 15 people Control group: 15 people	Bashiri/2021



### 3. Results

First, 66 articles were found. Reviewing the abstracts of the articles led to the removal of 30 articles, and from the remaining 36 articles, 28 articles were removed by reviewing the texts of the articles, and among the remaining articles, 4 articles were removed due to the low quality of the article, and finally 4 articles were included [39-41].

### Discussion

The results of the present research showed that the therapeutic exercise in water as rehabilitation had a significant effectiveness in both groups. Hydrotherapy exercises on selected central muscles have had a positive and significant effect on increasing strength and performance. On the other hand, hydrotherapy showed positive effects on superficial muscles, and based on that, increasing the activity of local muscles and the co-contraction of these muscles with superficial muscles is an effective factor in reducing the pain of people with back pain observed in this study.

Although the results showed that the electrical activity of the multifidus, transversus abdominus, rectus abdominus, and erector spinae muscles lead to improve motor condition, but based on the results of the meta-analysis studies, water therapy significantly reduced the pain score in the VAS criterion and increased physical activity is followed by people with back pain and these results suggest that water therapy is an important and effective part in the field of pain relief, promotion of physical activity, and subsequently improving the quality of life in patients with chronic back pain.

Therefore, based on the results of the present research, water therapy exercise as a pre-rehabilitation protocol in patients with chronic back pain candidates for laminectomy surgery had a significant clinical effectiveness compared with the usual and routine method after surgery.

Pain is a physiological phenomenon and an unpleasant emotional experience affecting the sensory nervous system of the body following an injury or disease.

The chronic pains are pains that have lasted for more than three months and are common among adults and cause problems in people's health and life quality. According to the studies, many physiological changes occur in patients with back pain, such as pain, functional disability, fatigue, and reduced spine stability, and movement patterns in both local and global muscles of the trunk are disturbed in these patients. On the other hand, a delay in the activation of the feed-forward mechanism of deep abdominal muscles, such as transverse abdominus, occurs in response to the postural deviations. Due to the existence of a direct relationship between the function of the deep muscles of the trunk and the dynamic stability of the spine, there is a theory that the disorder in the feed-forward function of the deep muscles of the trunk causes a disorder in the spine's structure. The spine's stability is provided as a result of cooperation and co-contraction and interconnection between three subsystems: passive, active, and nervous system. Defects and disturbances in each system cause compensatory mechanisms in the other systems. According to the zero-zone theory, the pressure and load on the lumbar region increases and the process of instability intensifies, causing an increase in the risk of damage to the structures and joints of the intervertebral discs. Likewise, based on scientific evidence, it has been shown that hydrotherapy exercises reduce the pressure and load on the musculoskeletal system and spine in patients with back pain. Due to the unique properties of water, including water's bionic force, viscosity, and hydrostatic pressure, this environment can reliably and safely reduce the effects of weight bearing by reducing the earth's gravity and allow people to exercise in water easily and without resistance.

Based on the theory of pain control, water reduces pain by affecting mechanoreceptors on the surface of the body. Furthermore, the heat of the water reduces muscle spasms and muscle relaxation helps reduce pain. The use of water therapy has a long history and water has always been used as a treatment for musculoskeletal pain. In general, pain reduction in water occurs through different mechanisms by affecting the surface mechanoreceptors of the body, water blocks pain receptors, and as mentioned earlier, the heat of water plays an important role in increasing the blood flow in the area, which causes relaxation and reduces spasms. On the other hand, the hydrostatic force of water helps reduce pain by suppressing the sympathetic nervous system. Based on the conducted studies, central stabilization exercises and movement control exercises and those special exercises that work on retraining the function of the deep muscles of the trunk have increased the strength and endurance of the deep muscles of the trunk, as well as the coordination and co-contraction of this group of muscles with increases the surface muscle group by increasing the coordination between the performance of these two muscle groups, stability, and balance of the trunk is established and posture control is performed optimally.

#### 4- Conclusion

Pre-rehabilitation before surgery is a very new subject in the field of rehabilitation in the world. Pre-rehabilitation theory, as a new framework, aims to increase patients' quality of life and return them to the normal life faster by reducing pain and increasing ability. The results obtained in the present research, which was conducted for the first time in Iran, are very important. Since it showed that the sports pre-rehabilitation program can be an important part of the comprehensive rehabilitation program for patients with back pain.

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