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# The effect of core stabilization exercise (CSE) and high-power laser (HPL) on chronic low back pain (CLBP) in female athletes

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## Abstract

**Purpose:** Low back pain (LBP) frequently occurs in daily life. Chronic low back pain (CLBP) is defined as pain in the lumbosacral area of the spine, of more than 12 weeks' duration. The aim of this study was to compare the effect of high-power therapy (HPL) with core stabilization exercise (CSE), in the treatment of CLBP. **Method:** A total of 30 female patients participated in this study, with a mean (SD) age of 32.23 (7.85) years. Patients were randomly assigned into two groups and treated with HPL (HPL group, n=15), and core stabilization exercise (EXS group, n=15). ROM of lumbar spine was measured by an inclinometer. The outcomes measured pain and functional disability using visual analog scale (VAS), Roland Disability Questionnaire (RDQ), and Modified Oswestry Disability Questionnaire (MODQ). Statistical analyses were performed to compare within and between group differences. **Results:** ROM, VAS, RDQ and MODQ showed significantly improve after 4-week treatment in both groups ($P<0.05$). However, there was no significant between-group differences in any variables ($P>0.05$). **Conclusions:** Both treatments were effective in the treatment of CLBP in female athletes.

***Keywords**:* Chronic low back pain (CLBP), Core Stabilization Exercise (CSE), High Power Laser therapy (HPL).

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## INTRODUCTION

Almost 80% of people in industrialized countries experience at least one period of low back pain (LBP) during their lifetime (Gordon & Bloxham, 2016; Lim, Ma, Berger, & Litscher, 2018). LBP can be divided into three groups in terms of duration of the disease: acute (less than 6 weeks), subacute (between 6 weeks to 12 weeks) and chronic (more than 12 weeks) (Lim et al., 2018). Forty percent of patients with acute LBP are at risk for chronic low back pain (CLBP) (Lim et al., 2018). In Iran, LBP is the third leading cause of disability in the age range of 15 to 65 years (Nezhad Roomezi, Rahnama, Habibi, & Negahban, 2012). Most people who suffer from this problem are exposed to major physical and mental problems throughout their lives, such as decreased physical, mental and social functions, decreased general health, and constant or intermittent pain (Tavafian, Jamshidi, Mohammad, & Montazeri, 2007).

Despite the high prevalence, the exact cause of LBP has not been determined. The development of various treatments is the reason for the lack of a specific cause for LBP (Georgopoulos et al., 2022). Although many treatments for low back pain have been suggested, there is currently no consensus on the most effective treatment (Sertpoyraz, Eyigor, Karapolat, Capaci, & Kirazli, 2009; Tegner, Frederiksen, Esbensen, & Juhl, 2018).

Exercise therapy is one of the most common treatment methods that has been considered in recent years (Karlsson et al., 2020; Twomey & Taylor, 1994). Lack of central stability in the spine has been suggested as a predisposing factor for LBP (George et al., 2007). In recent years, in exercise therapy, special attention has been paid to the design of exercises that aim to maintain stability and increase local stability of the lumbar region via the effect on muscles such as transverse abdominis, Multifidus, diaphragm, pelvic floor and oblique abdominal (Javadian, Behtash, Akbari, Taghipour, & Zekavat, 2008).

The results of Goldby et al. (2006) indicate that core stabilization exercises (CSE) are more effective in reducing pain in patients with CLBP than manual therapies (Cairns, Foster, & Wright, 2006). However, Cairns et al. (2005) showed that adding a CSE program to a routine physiotherapy program in patients with LBP did not lead to further improvement (Cairns et al., 2006; Hermet et al., 2018).

Another method used to treat LBP is laser therapy. Laser therapy is a non-invasive and painless method (Alayat, Atya, Ali, & Shosha, 2014; Braddom, 2010). The results of some research show that laser therapy can significantly reduce pain in both acute and chronic levels such as rheumatoid arthritis, chronic joint disease, carpal tunnel syndrome, fibromyalgia syndrome, knee injury, shoulder pain and postoperative pain. Be (Alayat, Atya, et al., 2014; Braddom, 2010). Generally, two types of lasers are used in physiotherapy: low power (LPL) and high power (HPL) (Chen et al., 2021). Over the past three decades, low power laser with a wavelength of 1000-600 nm and an output power of 5-500 mW has been used as a non-pharmacological method in the treatment of musculoskeletal problems (Santamato et al., 2009; Thabet et al., 2021). HPL is a new method of physiotherapy in the treatment of CLBP (Abdelbasset et al., 2021; Alayat, Atya, et al., 2014; Braddom, 2010). The HPL, with a maximum power of 3 kW and a wavelength of 1064 nm, is more penetrating than conventional low-power lasers, especially in deep and large joints, and seems to be able to have a greater effect in reducing pain, microcirculation, activation of angiogenesis and fibroblasts, stimulation of collagen synthesis than low-power lasers (Kim, Cho, Kim, Weber, & Hwang, 2010). Safdari et al. (2014) examined the effect of CSE on pain and functional disability in patients with chronic LBP. The results showed after 6 weeks of treatment, there is a significant improvement in LBP (Alayat, Atya, et al., 2014). Another study by Saladin et al. (2014) on the long-term effects of high-powered lasers in patients with CLBP. The results of this study showed that HPL combined with physical activity can be more effective in reducing pain and disability related to LBP compared to laser therapy alone and placebo laser combined with physical activity (Alayat, Atya, et al., 2014).

Since laser therapy is a new method in physiotherapy and has had relatively positive results in similar studies on range of motion and pain relief, as well as the fact that research on the effect of high-power laser on chronic low back pain especially in female athletes is very low, the purpose of this study was to evaluate the effect of two methods of HPL and exercise therapy as CSE in the treatment of CLBP in female athletes.

## METHOD

The research method is a clinical trial and a design is pretest-posttest using a control group. The study population consisted of patients who experienced LBP at least 3 months prior to the study. Subjects were selected according to the inclusion and exclusion criteria. Inclusion criteria in both groups were female gender, being in the age range of 15 to 45 years, the presence of lumbar pain at rest, the presence of lumbar pain during movement and the absence of sciatica. The study subjects had not received any surgery to the lumbar vertebrae region; had no vertebral compression fractures, spinal tumors, or intervertebral disc infections; were free of inflammatory diseases such as rheumatism; and had no heart disease or structural abnormalities.

One hundred and twenty-two athletes with CLBP attended Shafa physiotherapy clinic located in the city of Ardabil in northwest of Iran. Out of 122 volunteers, 81 athletes did not qualify for the study. Eight of the eligible volunteers also refused to participate in the study for various reasons.

At the end, 30 subjects randomly and equally (15 subjects in each group) were divided into two groups:

exercise therapy (EXS) and laser therapy (HPL) (Table1). Before starting the treatment program, the consent form was completed by the participants. Range of motion (ROM) of Lumbar spine, pain and functional disability were measured before and after the treatment at the appropriate time.

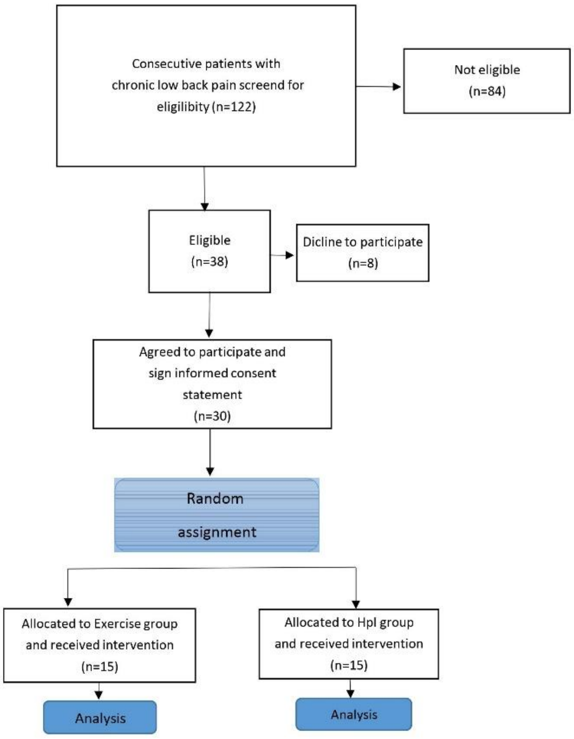
The instruments required in the study were inclinometer, visual analog scale (VAS), Roland Disability Questionnaire (RDQ), the Modified Oswestry Disability Questionnaire (MODQ), and high-power laser device.

Using an inclinometer, the ROM of flexion, extension, lateral flexion (right and left) and rotations (right and left) of the lumbar spine was measured. Visual pain scale (in percentage) was used to measure pain (VAS). For this purpose, a horizontal bar with a length of 100 mm was used, the left end of which was "zero" meaning painless and the other end was "10". "It meant the greatest amount of pain(Jensen, Karoly, & Braver, 1986; Price, McGrath, Rafii, & Buckingham, 1983). The MODQ consisted of 10 items that assessed the level of functional disability of the patient in 10 sections. Each section of the questionnaire consisted of 6 options, in the worst case, each section was given a score of 5. The total maximum score of each 10 sections was 50. The total disability was obtained by multiplying the total scores of each section by 2. In general, the performance disability questionnaire is scored between 0-100. Thus, a score of 0 means perfect health and painless functioning, 0-25 means mild disability, 25-50 means moderate disability, 50-75 means severe disability and 0-100 severe disability(Kofotolis & Kellis, 2006). The RDQ consists of 24 items. This questionnaire contains a wide range of daily activities that are disrupted by low back pain. The total score is determined by the sum of the selected options(Mousavi, Parnianpour, Mehdian, Montazeri, & Mobini, 2006).

As it mentioned, subjects were randomly divided into two groups: exercise therapy (EXS) and high-power laser (HPL). In the HPL group, the modality applied to the patients was a HPL or a Class 4 scanner made by the Italian company Pagani. In this study, laser therapy was applied to the subjects for 12 sessions, three days a week, one at a time. The steps and how to do the same work as the article by Fiore et al.(Conforti & Fachinetti, 2013; Fiore et al., 2011; Koes, Van Tulder, & Thomas, 2006) Laser therapy in each session consisted of three stages. Stage 1: laser with an energy of 12 J.cm-2 was applied to the entire painful lumbar region. Second stage: laser with energy of 19 J.cm-2 was applied on trigger points. Third stage: laser with an energy of 6 J.cm-2 was applied to the entire painful lumbar region (Fiore et al., 2011).

The subjects of the EXS group performed the selected exercises for a total of 4 weeks, three sessions per week and each session for 45 minutes. The training program was designed in three levels of easy, medium and hard (advanced). The first week, the easy training program was conducted and then with increasing physical fitness, intermediate level training and after 20 days, the advanced level training program was gradually added. Before starting the core stabilization exercise (CSE), the subjects warmed up and did stretching exercises for 10 to 15 minutes. Initially, the movements were performed isometrically, 3 times with an 8 seconds rest between repetitions, which increased the intensity of the exercise along with the increase in physical fitness of the subjects.

**Table1:** Flowchart of treatment.




### Statistical Analysis

Data were analyzed using SPSS software version 22. After the normality of data distribution was confirmed by Kolmogorov-Smirnov test, the dependent t-test was used to compare the within-group differences and the independent t-test was used to compare the between-groups differences. Hypotheses were also tested with a significance level of $p<0.05$.

## RESULTS

There was no significant difference between the two groups in terms of age, body mass and BMI ($p <0.05$). The changes of dependent variables in each of the groups and between the two groups were examined, the results of which can be observed in Figures 1, 2, 3 and Table 2.

According to Figure 1, 2 and 3, there was a significant improve in pain and functional disability of patients before and after treatment in both groups (p<0.05). There were no significant differences between the two groups (p>0.05).
Considering Table 1, it can be seen that the ROM of the lumbar spine in both groups after treatment has increased significantly compared to before (p<0.05), without any between group differences (p >0.05).

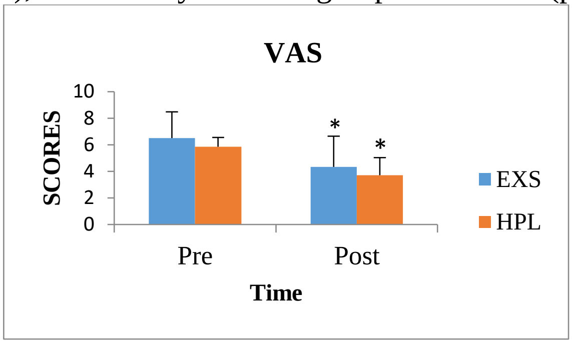



**Figure1:** Within-group and between-group differences of VAS. Values represent means ± SEM. *shows significant increase in both groups compared with baseline in both groups (p <0.05).

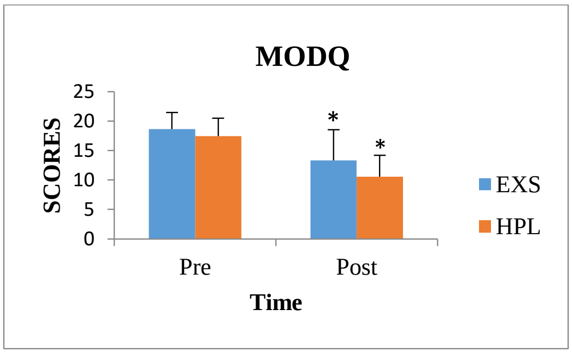



**Figure2:** Within-group and between-group differences of MODQ. Values represent means ± SEM. *shows significant increase in both groups compared with baseline in both groups (p<0.05).

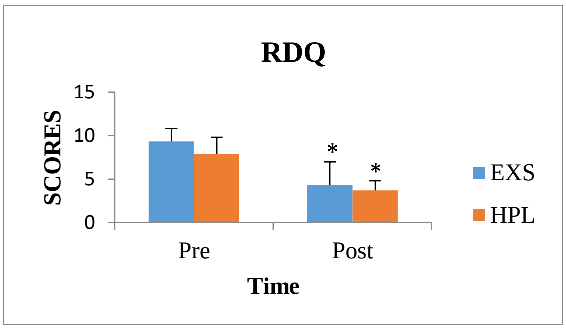



**Figure3:** Within-group and between-group differences of RDQ questionnaire. Values represent means ± SEM. *shows significant increase in both groups compared with baseline in both groups ($p<0.05$).

**Table2:** Within-group and between-group differences of ROM. Values represent means ± SEM. *shows significant increase in both groups compared with baseline in both groups ($p<0.05$).

| ROM | Groups | Pre (mean ± SD) | Post (mean ± SD) | Within-group Differences | Between-group Differences |
|---|---|---|---|---|---|
| **FLEXION** | EXR | 56.00 ± 3.31 | 64.33 ± 3.15 | 0.003* | P>0.05 |
| | HPL | 49.33 ± 2.71 | 58.66 ± 2.82 | 0.005* | |
| **EXTENTION** | EXR | 15.00 ± 2.18 | 18.66 ± 2.20 | 0.077 | P>0.05 |
| | HPL | 15.33 ± 2.15 | 20.00 ± 2.39 | 0.002* | |
| **LTR FLX (R)** | EXR | 18 ± 1.74 | 23.33 ± 1.51 | 0.003* | P>0.05 |
| | HPL | 18.33 ± 1.59 | 22.13 ± 1.74 | 0.014* | |
| **LTR FLX (L)** | EXR | 18.00 ± 1.67 | 24.00 ± 1.90 | 0.003* | P>0.05 |
| | HPL | 17.00 ± 1.60 | 21.66± 1.86 | 0.001* | |
| **ROTATION (R)** | EXR | 22.53 ± 1.12 | 25.06 ± 1.07 | 0.002* | P>0.05 |
| | HPL | 21.86 ± 1.09 | 24.53 ± 0.990 | 0.004* | |
| **ROTATION (L)** | EXR | 23.13 ± 0.68 | 25.13 ± 0.68 | 0.002* | P>0.05 |
| | HPL | 21.73 ± 0.66 | 24.00 ± 0.59 | 0.002* | |

## DISCUSSION

The results of the present study showed that both exercise therapy and HPL significantly reduce pain and disability in female athletes suffered from CLBP, although no significant differences were observed between the two types of treatment. As shown in Figures 1, 2, 3 and Table 2, in both groups, after 4 weeks, the amount of pain and functional disability decreased and the ROM of the lumbar spine increased significantly ($p<0.05$).

The results of the study by Roomezi et al. (2012) are consistent with the present study and showed that in patients with CLBP following twelve sessions of CSE, pain and functional ability have significantly improved. They reported that exercise therapy increased muscle strength in the central part of the trunk and reduced tension in the ligaments and joints of the vertebrae, keeping them in a normal position, which resulted in reduced pain(Nezhad Roomezi et al., 2012). Furthermore, CSE appear to improve intervertebral disc nutrition due to their mobility, and to some extent reduce pain perception by releasing endorphins(Sertpoyraz et al., 2009). Recent findings demonstrate that in the postural muscles of healthy individuals, 54-74 percent of the fibers are type(Demoulin, Crielaard, & Vanderthommen, 2007). Studies by Manion et al. (2000) showed that the percentage of type I fibers decreases in patients with CLBP(Mannion et al., 2000). In their study, they stated that CSE could reduce selective atrophy of type II fibers in the multifidus muscle and affect the diameter of muscle fibers(Thomas et al., 1999) .Moreover, the studies indicated that there is a significant relationship between the cross-sectional area of the multifidus muscles and the reduction of pain in patients who have performed CSE (Hides, Jull, & Richardson, 2001). Many researchers believe that exercise should be part of the treatment of patients with LBP, but there are also differences regarding the type of exercise, the duration of the exercise and the mechanism of its effect. Moreover, Hides et al. (2001) indicated that four weeks of CSE rapidly increase the cross-sectional area of the multifidus muscles (Hides et al., 2001). The results of recent studies show that following LBP, the deep fibers of the multifidus and the transverse abdominal muscle are more affected than other muscles, which means that atrophy in the deep stabilizing muscles of the trunk, followed by a smaller cross-section of these muscles, causes more muscle fatigue in patients with CLBP(Cunningham et al., 2022).

One of the main objectives of the present study was the effect of HPL on CLBP in female athletes. The results of present studies showed that treatment using HPL reduced pain, disability and increased lumbar spine ROM of female athletes with CLBP. The results of this study were consistent with the other researchers (Ansari et al., 2006 and Draper et al. 2010) and they also reported an improvement in ROM and a significant reduction in pain and movement disability in patients with CLBP. It seems that when the tissues of the body are exposed to HPL light, an increase in metabolism and blood circulation occurs, which causes analgesic effects and rapid absorption of edema (Anwar et al., 2022; Draper, Mahaffey, Kaiser, Eggett, & Jarmin, 2010; Oliveira, 2022). It seems that the higher output power of HPL can absorb more energy at different tissue levels and provide more energy density to the tissue. It also seems that the greater the penetration depth in HPL photons, the better the biochemical effects in the deeper tissues (Conforti & Fachinetti, 2013). HPL can easily penetrate the tissue and produce photochemical and photomechanical effects. Photochemical effects cause the mitochondrial oxidative reaction and subsequently increase the production of DNA, ATP and RNA. Another effect of HPL is its rapid and immediate analgesic effect, which is related to the photomechanical effects of this type of laser, which is associated with various mechanisms such as reducing the transfer of pain-promoting substances and increasing the production of morphine. This analgesic property may be due to the anti-inflammatory effect of HPL, which is more gradual and lasts longer (Alayat, Elsodany, & El Fiky, 2014; Choi et al., 2017; Roberts, Kruse, & Stoll, 2013). In general, it seems that HPL due to high penetration depth, analgesic, anti-inflammatory and anti-inflammatory effects can reduce pain and disability and improve ROM in the lumbar joints (Alayat, Elsodany, et al., 2014; Choi et al., 2017; Conforti & Fachinetti, 2013; Roberts et al., 2013).

## CONCLUSIONS

It seems that both CSE and HPL can improve the symptoms of CLBP in female athletes. Exercise therapy may work by increasing the strength of the muscles in the central part of the trunk, reducing the tension in the ligaments and vertebral joints, improving the nutrition of the intervertebral disc, while HPL is likely to improves symptoms through its photochemical and photochemical effects.

**Ethical Considerations**

**Compliance with ethical guidelines**

All ethical principles were observed in this research.

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**Authors' contributions**

All authors equally contributed to the preparation of this article.

**Conflict of interest**

The authors declared no conflict of interests.

## REFERENCES

Abdelbasset, W. K., Nambi, G., Elsayed, S. H., Soliman, G. S., Alessi, A. A., Alsalem, I. N., & Alwadai, S. M. (2021). A Prospective Comparative Study of Pulsed High-Intensity Laser Therapy and Pulsed Electromagnetic Field on Chronic Nonspecific Low Back Pain. Photobiomodulation, Photomedicine, and Laser Surgery, 39(5), 362-368.

Alayat, M. S. M., Atya, A. M., Ali, M. M. E., & Shosha, T. M. (2014). Long-term effect of high-intensity laser therapy in the treatment of patients with chronic low back pain: a randomized blinded placebo-controlled trial. Lasers in medical science, 29(3), 1065-1073.

Alayat, M. S. M., Elsodany, A. M., & El Fiky, A. A. R. (2014). Efficacy of high and low level laser therapy in the treatment of Bell's palsy: a randomized double blind placebo-controlled trial. Lasers in medical science, 29(1), 335-342.

Anwar, N., Li, S., Long, L., Zhou, L., Fan, M., Zhou, Y., . . . Yu, L. (2022). Combined effectiveness of extracorporeal radial shockwave therapy and ultrasound-guided trigger point injection of lidocaine in upper trapezius myofascial pain syndrome. American Journal of Translational Research, 14(1), 182.

Braddom, R. L. (2010). Physical medicine and rehabilitation e-book: Elsevier Health Sciences.

Cairns, M. C., Foster, N. E., & Wright, C. (2006). Randomized controlled trial of specific spinal stabilization exercises and conventional physiotherapy for recurrent low back pain. Spine, 31(19), E670-E681.

Chen, Y.-J., Liao, C.-D., Hong, J.-P., Hsu, W.-C., Wu, C.-W., & Chen, H.-C. (2021). Effects of laser therapy on chronic low back pain: A systematic review and meta-analysis of randomized controlled trials. Clinical rehabilitation, 02692155211057435.

Choi, H.-W., Lee, J., Lee, S., Choi, J., Lee, K., Kim, B.-K., & Kim, G.-J. (2017). Effects of high intensity laser therapy on pain and function of patients with chronic back pain. Journal of physical therapy science, 29(6), 1079-1081.

Conforti, M., & Fachinetti, G. P. (2013). High power laser therapy treatment compared to simple segmental physical rehabilitation in whiplash injuries (1 and 2 grade of the Quebec Task Force classification) involving muscles and ligaments. Muscles, ligaments and tendons journal, 3(2), 106.

Cunningham, E., Wedderkopp, N., Kjaer, P., Beynon, A., Noble, J., & Hebert, J. J. (2022). The relationships between physical activity, lumbar multifidus muscle morphology, and low back pain from childhood to early adulthood: a 12-year longitudinal study. Scientific Reports, 12(1), 1-9.

Demoulin, C., Crielaard, J.-M., & Vanderthommen, M. (2007). Spinal muscle evaluation in healthy individuals and low-back-pain patients: a literature review. Joint Bone Spine, 74(1), 9-13.

Draper, D. O., Mahaffey, C., Kaiser, D., Eggett, D., & Jarmin, J. (2010). Thermal ultrasound decreases tissue stiffness of trigger points in upper trapezius muscles. Physiotherapy theory and practice, 26(3), 167-172.

Fiore, P., Panza, F., Cassatella, G., Russo, A., Frisardi, V., Solfrizzi, V., . . . Santamato, A. (2011). Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of low back pain: a randomized controlled trial. Eur J Phys Rehabil Med, 47(3), 367-373.

George, S. Z., Childs, J. D., Teyhen, D. S., Wu, S. S., Wright, A. C., Dugan, J. L., & Robinson, M. E. (2007). Rationale, design, and protocol for the prevention of low back pain in the military (POLM) trial (NCT00373009). BMC musculoskeletal disorders, 8(1), 1-11.

Georgopoulos, V., Akin-Akinyosoye, K., Smith, S., McWilliams, D. F., Hendrick, P., & Walsh, D. A. (2022). An observational study of centrally facilitated pain in individuals with chronic low back pain. Pain reports, 7(3).

Gordon, R., & Bloxham, S. (2016). A systematic review of the effects of exercise and physical activity on non-specific chronic low back pain. Paper presented at the Healthcare.

Hermet, A., Roren, A., Lefevre-Colau, M.-M., Gautier, A., Linieres, J., Poiraudeau, S., & Palazzo, C. (2018). Agreement among physiotherapists in assessing patient performance of exercises for low-back pain. BMC musculoskeletal disorders, 19(1), 1-7.

Hides, J. A., Jull, G. A., & Richardson, C. A. (2001). Long-term effects of specific stabilizing exercises for first-episode low back pain. Spine, 26(11), e243-e248.

Javadian, Y., Behtash, H., Akbari, M., Taghipour, M., & Zekavat, H. (2008). The effects of stabilization exercise on pain, functional disability and muscle endurance in patients suspected. Journal of Mazandaran University of medical sciences, 18(65), 63-73.

Jensen, M. P., Karoly, P., & Braver, S. (1986). The measurement of clinical pain intensity: a comparison of six methods. Pain, 27(1), 117-126.

Karlsson, M., Bergenheim, A., Larsson, M. E., Nordeman, L., van Tulder, M., & Bernhardsson, S. (2020). Effects of exercise therapy in patients with acute low back pain: a systematic review of systematic reviews. Systematic reviews, 9(1), 1-25.

Kim, I. S., Cho, T. H., Kim, K., Weber, F. E., & Hwang, S. J. (2010). High power-pulsed Nd: YAG laser as a new stimulus to induce BMP-2 expression in MC3T3-E1 osteoblasts. Lasers in surgery and medicine, 42(6), 510-518.

Koes, B. W., Van Tulder, M., & Thomas, S. (2006). Diagnosis and treatment of low back pain. Bmj, 332(7555), 1430-1434.

Kofotolis, N., & Kellis, E. (2006). Effects of two 4-week proprioceptive neuromuscular facilitation programs on muscle endurance, flexibility, and functional performance in women with chronic low back pain. Physical Therapy, 86(7), 1001-1012.

Lim, T.-K., Ma, Y., Berger, F., & Litscher, G. (2018). Acupuncture and neural mechanism in the management of low back pain—an update. Medicines, 5(3), 63.

Mannion, A., Käser, L., Weber, E., Rhyner, A., Dvorak, J., & Müntener, M. (2000). Influence of age and duration of symptoms on fibre type distribution and size of the back muscles in chronic low back pain patients. European Spine Journal, 9(4), 273-281.

Mousavi, S. J., Parnianpour, M., Mehdian, H., Montazeri, A., & Mobini, B. (2006). The Oswestry disability index, the Roland-Morris disability questionnaire, and the Quebec back pain disability scale: translation and validation studies of the Iranian versions. Spine, 31(14), E454-E459.

Nezhad Roomezi, S., Rahnama, N., Habibi, A., & Negahban, H. (2012). The effect of core stability training on pain and performance in women patients with non-specific chronic low back pain. Journal of Research in Rehabilitation Sciences, 8(1), 57-64.

Oliveira, A. d. (2022). Agulhamento seco e massagem facial no tratamento da disfunção temporomandibular: relato de caso clínico.

Price, D. D., McGrath, P. A., Rafii, A., & Buckingham, B. (1983). The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. Pain, 17(1), 45-56.

Roberts, D. B., Kruse, R. J., & Stoll, S. F. (2013). The effectiveness of therapeutic class IV (10 W) laser treatment for epicondylitis. Lasers in surgery and medicine, 45(5), 311-317.

Santamato, A., Solfrizzi, V., Panza, F., Tondi, G., Frisardi, V., Leggin, B. G., . . . Fiore, P. (2009). Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of people with subacromial impingement syndrome: a randomized clinical trial. Physical Therapy, 89(7), 643-652.

Sertpoyraz, F., Eyigor, S., Karapolat, H., Capaci, K., & Kirazli, Y. (2009). Comparison of isokinetic exercise versus standard exercise training in patients with chronic low back pain: a randomized controlled study. Clinical rehabilitation, 23(3), 238-247.

Tavafian, S. S., Jamshidi, A., Mohammad, K., & Montazeri, A. (2007). Low back pain education and short term quality of life: a randomized trial. BMC musculoskeletal disorders, 8(1), 1-6.

Tegner, H., Frederiksen, P., Esbensen, B. A., & Juhl, C. (2018). Neurophysiological pain education for patients with chronic low back pain. The Clinical journal of pain, 34(8), 778-786.

Thabet, A. A., Ebid, A. A., El-Boshy, M. E., Almuwallad, A. O., Hudaimoor, E. A., Alsaeedi, F. E., . . . Alotaibi, S. H. (2021). Pulsed high-intensity laser therapy versus low level laser therapy in the management of primary dysmenorrhea. Journal of physical therapy science, 33(9), 695-699.

Thomas, E., Silman, A. J., Croft, P. R., Papageorgiou, A. C., Jayson, M. I., & Macfarlane, G. J. (1999). Predicting who develops chronic low back pain in primary care: a prospective study. Bmj, 318(7199), 1662-1667.

Twomey, L. T., & Taylor, J. R. (1994). Physical therapy of the low back (Vol. 18): Churchill Livingstone.