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Review Article

Non-Surgical Management of Disc-Related Low Back Pain: An Algorithmic Approach and Practical Guideline

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ABSTRACT

Introduction: Low back pain (LBP) is a common health problem worldwide and the primary cause of years lived with disability. Studies on the non-surgical management approaches for disc-related LBP are sparse and scarce, so a clear and structured guideline in this area would be useful. This study summarizes the non-surgical management approaches for disc-related LBP in a review.

Materials and Methods: Intervention studies and review articles relating to the non-surgical approaches for disc-related LBP treatment were curated from PubMed, EMBASE, Cochrane, and Google Scholar databases before July 1, 2022.

Results: Several management approaches are suggested in the studies for disc-related LBP, including medications, acupuncture, lumbar orthoses, exercise therapy, manual therapy, physical therapy modalities, and spinal injections. Some of these options have been studied more, like exercise therapy and injections, and there are more favorable reports for them. Some others have been less studied and need to be investigated in future studies, like different physical therapy modalities.

Conclusion: Recommendations are based on low- to moderate-quality evidence or consensus in the management approach studies for disc-related LBP. Therefore, the authors recommend intensifying research efforts concerning all aspects of the non-surgical management of LBP.

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Introduction

Low back pain (LBP) is a common health problem worldwide and the primary cause of years lived with disability [1]. Intervertebral discs could be one of the nociceptive contributors to LBP [2]. In a recent systematic review, Brinjikji et al. discussed that disc bulging (odd ratio [OR]=7.5; 95% confidence interval [CI], 1.3-44.6), disc extrusion (OR=4.4; 95% CI, 2.0%, 9.7%), disc protrusion (OR=2.7; 95% CI, 1.5%, 4.6%), and disc degeneration (OR=2.2; 95% CI, 1.2%, 4.2%) have strong relationships with LBP, based on magnetic resonance imaging (MRI) findings [3]. Symptoms of disc-related LPB vary from axial pain to lower limb radicular pain.

Considering LBP's high healthcare costs and social burden [2], sooner returning a patient to active life and work seems imperative, and knowledge of available treatment and rehabilitation options could be helpful for physicians. Therefore, this study reviews the various suggested options for the treatment and rehabilitation of patients with disc-related LBP. While different definitions are provided for disc-related LBP, such as discogenic LBP, which is disc degeneration without disc herniation [4, 5], or disc herniation, which includes protrusion and extrusion [6], the authors decided to discuss the disc-related LBP that contains studies related to the management of most of the disc pathologies.

This study discusses the non-invasive treatment options for disc-related LBP, including acupuncture, lumbar brace, medications, exercise, manual therapy, physiotherapy modalities, and injections that were summarized and categorized in the algorithm (Figure 1). Intervention studies and review articles relating to the non-surgical approaches for disc-related LBP treatment were curated from PubMed, EMBASE, Cochrane, and Google Scholar databases before July 1, 2022.

Acupuncture

Acupuncture is one of the most accepted, low-cost, non-invasive alleviative treatments for disc-related LBP, which has modest side effects [7-10], and it seems more effective than sham or non-treatment, especially as a second line of treatment [11]. Most studies in this field are done in East Asia, especially in China. Most data on this technique has controversy. According to meridian theory and traditional Chinese medicine, acupuncture affects sensory nerves and decreases pain [12]. In a systematic review, deep acupuncture is recommended instead of shallow ones [13]. Some research has studied its combination with herbs such as Shinbaro or moxibustion to assess pain relief effects [14]. There is a consensus against acupuncture's routine use in the recent onset of lumbar radiculopathy [15]. Also, a specific protocol is not well determined [8], but some suggested points are BL 23, GB 30, BL 40, GB 34, BL 60, and GB 39 [8].

Lumbar brace/orthoses

The studies about the impact of lumbar braces on disc-related LBP are limited. In one clinical trial by Munoz, it was shown that the lumbar brace can improve sagittal balance and decrease LBP in patients with discopathy assessed by posturography [16]. In another study by Prateepavanich et al., it has been shown that a lumbosacral corset can improve the walking distance on the treadmill and decrease pain [17]. On the other hand, the thickness of lateral abdominal muscles and the cross-sectional area of lumbar multifidus muscles decreased in healthy volunteers after four weeks of lumbar brace application [18]. It seems that the use of lumbar support for a short time in patients with discogenic LBP could be helpful [19].

Medications

There are different systematic reviews and meta-analyses on oral medications in disc-related LBP. Most of them mention small to moderate effects, and some suggest no more effective than a placebo [20, 21]. Evidence for chronic discogenic LBP is controversial due to its adverse effects and small benefits [4, 21]. Non-steroidal anti-inflammatory drugs (NSAIDs) and opioids are the most common types of drugs prescribed for discogenic back pain [4, 21]. Here we discuss the evidence and effects of recommended medications in brief.

Evidence about NSAIDs is inconsistent. Although some reviews suggest that they are more effective than acetaminophen or even a placebo, they have side effects, especially in their first generations, and can be recommended just for the short term [21, 22]. One systematic review concluded that they are no more effective than placebo with no difference between the types of NSAID, but the evidence for this result is not strong [20]. All in all, it seems that the prescription is dependent on the physician's judgment between risks and benefits.

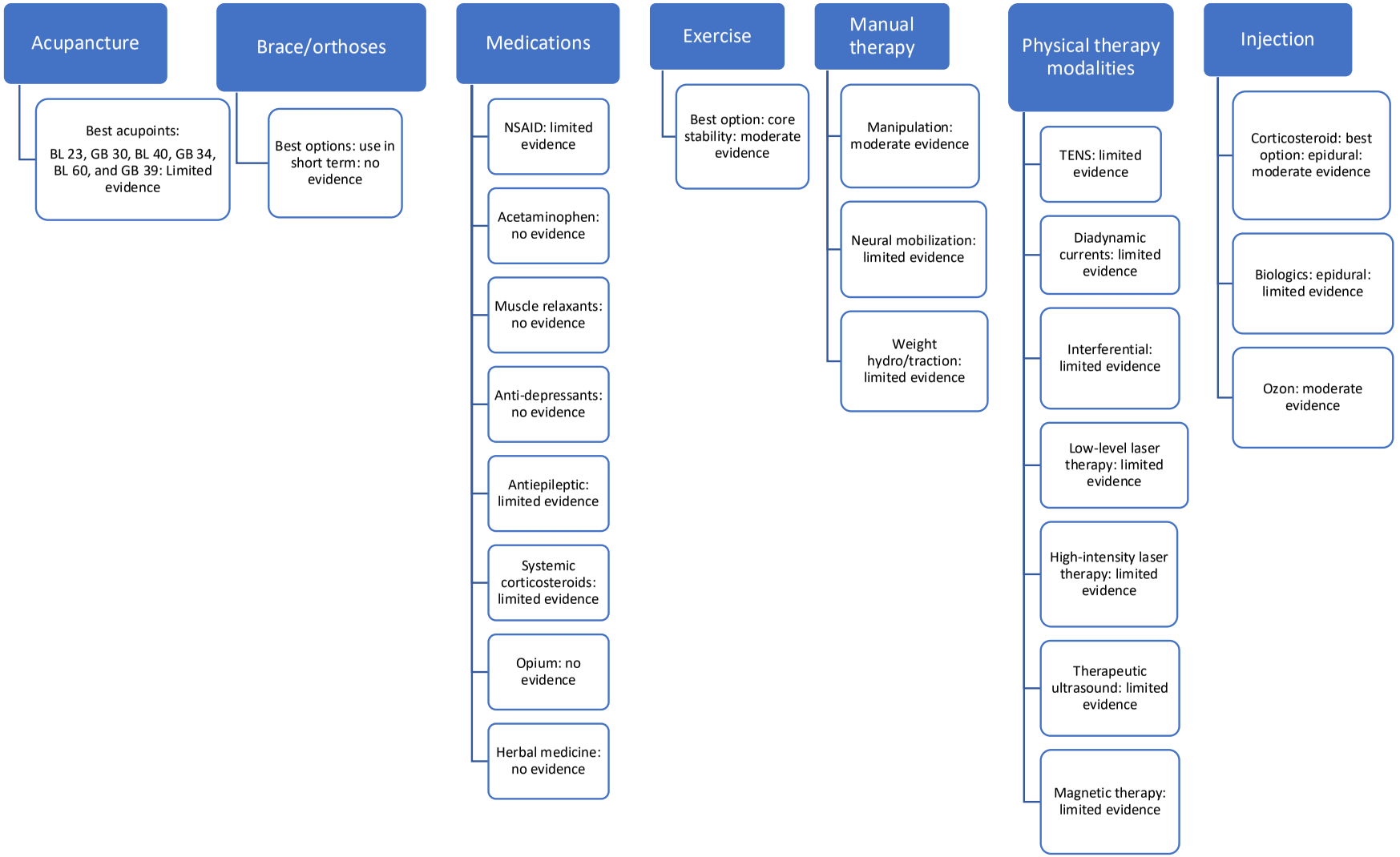

Figure 1. Algorithm for non-surgical treatment of disc-related low back pain

NSAID: Nonsteroid anti-inflammatory; TENS: Transcutaneous electrical nerve stimulation.

Acetaminophen is not commonly used in discogenic LBP because it does not have an anti-inflammatory effect. It is fair evidence for discogenic LBP [21]. The combination of pregabalin and NSAID was effective for sleep disturbance but not very effective in pain relief and did not improve pain relief in these patients [23]. Muscle relaxants are not well determined, and they seem not to be effective [4, 21]. Anti-depressants are ineffective except in patients with depression [4, 21]. Antiepileptic drugs have variable effects [4, 21]. In this category, topiramate has some weak evidence [21]. Benzodiazepines in combination with opioids may be effective in decreasing pain, but as they have side effects and no significant improvement in pain, they are not recommended [4, 21]. Systemic corticosteroids are not well determined [4, 21].

There is controversy about opium because of its adverse effects, but a low dose of opioids can be prescribed for the short term without significant adverse effects. It improves both pain and function, but patient selection is important [11, 21, 24].

Herbal medicine is mostly prescribed in the east of Asia, and its effect is not determined [4, 21].

Agmatine sulfate is a decarboxylated arginine and is a neuroprotective medicine. It has been used in a clinical trial and was effective in decreasing radicular pain in patients with lumbar disc-related radiculopathy [25].

Exercise therapy

Exercise therapies are traditionally well known to improve symptoms related to lumbar disc herniation [26], however, some studies have concluded almost the opposite [27, 28]. A recent systematic review shows no evidence of the effectiveness of exercise therapy, and its effect on reducing pain was significantly lower compared to epidural injections or surgery [27]. On the other hand, a high-quality trial provided moderate evidence that a protocol of lumbar stabilizing exercises (exercises that strengthen the stabilizer muscles) is significantly more effective than no treatment in reducing the severity of pain in patients with the herniated lumbar disc in short-term follow-up [29].

There are several exercise programs for the treatment of symptomatic lumbar disc herniation, including directional preference exercises or the McKenzie approach (back-movement exercises in a direction to the point where the pain moves proximally, where it is better tolerated) [30], specific stabilization exercises (also known as motor control exercises or core exercises) that stabilize the spine by increasing control of the multifidus and transversus abdominis muscles, strengthening other muscles, stretching, and general fitness exercises [29, 31-33]. The efficiency of exercises and different protocols is tough to establish, and each program's superiority has not been determined, although most appear to be safe (if they do not aggravate patients' symptoms) [34]. Nevertheless, the most beneficial exercises used for lumbar disc herniation are stabilizer exercises [31].

Core stability, motor control, or stabilization exercises are prevalent therapeutic exercises intended to retrain-educate the co-activation pattern of the abdominals, paraspinals, gluteals, pelvic floor musculature, and diaphragm [35, 36]. The biological reasoning behind core stability exercises is primarily grounded in the concept that the stability and control of the spine undergo alterations in patients with LBP [37]. Stabilizing exercises which commence with acknowledgment of the spine's natural position (midway between lumbar flexion and extension range of motion) are the position of balance and power for enhancing performance in different sports [35].

Beginning with low-level consistent isometric contraction of trunk-stabilizing musculature and their gradual incorporation into functional activities are required for core stability exercises [38, 39]. The core stability exercise approach employs motor learning rules to enhance the coordination of the spine's deep-trunk musculature. It seems that core stability exercises can alleviate pain, improve functional capacity, restore motor control, and strengthen the trunk, abdominal, and paraspinal musculature [40].

One conventional approach involves slowly increasing the lumbar spinal segments' mobilization, utilizing stretching and exercise, improving posture, and strengthening the muscles that stabilize the spinal column and pelvis. It has been challenging to demonstrate that this method accelerates recovery time or prevents future injuries, but some trials indicate that it is better than rest in the acute phase of sciatica [41]. A trial has studied the efficacy of traditional and suspension core stability programs with the designed device on discopathic LBP and concluded that the stability exercises, mainly suspension stability exercises, diminish pain, lessen the use of anti-inflammatory drugs, and improve quality of life [42].

In sum, there is not sufficient data to determine recommendations is for or against the use of structured exercise programs as independent treatments for patients with herniated lumbar discs [28]. However, it seems that

the most beneficial exercises used for lumbar disc herniation are stabilization exercises.

Manual therapy

Spinal manipulation is one of the non-invasive treatments for LBP. It has been investigated in acute and chronic LBP with or without radiculopathy and is recommended as the second line of therapy for disc-related LBP [11, 34, 43-45].

Based on different systematic reviews and clinical trials, manipulation has a modest effect on acute LBP and a significant effect on chronic LBP. In these reviews, patients with discogenic LBP were included, but patients with sciatica were excluded [46]. However, in some studies, it has been investigated for patients with radiculopathy showing promising results [45]. It has not been shown to have superiority over other treatments [28, 47]; however, in some studies, it was more effective than acupuncture or massage [21]. Totally, in most studies, it has been considered in combination with other therapies and not alone [21, 34, 43].

Also, neural mobilization has been assessed in patients with radiculopathy having excellent to good results in most patients. Still, as there is heterogenicity in clinical trials, the best approach is not determined [48]. Spinal mobilization with leg movement combined with exercise or other modalities had a remarkable improvement in pain and disability in patients with radiculopathy both in the short term and long term [44, 45].

Another form of spinal mobilization technique is weight hydro/traction, which has been shown effective in decreasing pain and improving flexibility and quality of life in patients with discopathy [49]. Still, there is not enough evidence to recommend it for disc-related LBP [28]. Although there is not a well-determined program, it seems that the best technique for considering is the one that centralizes the pain [45, 50].

Of course, these techniques are not completely safe and harmless. In a systematic review of patients with chronic LBP without sciatica and referral pain, it can cause some musculoskeletal and neural symptoms, but this relationship is not well determined [43].

Physical therapy modalities

A special selection of physical therapy interventions plays a significant role as adjuncts to the therapy [51, 52]. The most common procedures include electrotherapy, laser therapy, ultrasound, and magnetic field therapy. Their applications and evidence in the disc-related LBP are summarized below.

In general, electrotherapy can produce analgesic effects or facilitate motor function via varying parameters such as frequency, waveform, pulse duration, electrode configuration, and duration of stimulation; thus, it is possible to produce a range of therapeutic effects [53]. Transcutaneous electrical nerve stimulation (TENS), interferential current, and diadynamic currents are among the electrical modalities employed in the managing of musculoskeletal pain conditions [54, 55].

TENS has an analgesic effect, commonly used in pain clinics or at home by patients themselves; the safety and efficacy of TENS applications have been stated in various pain conditions [53, 56, 57]. Although several studies have reported the beneficial effects of TENS applications on symptom relief in patients with LBP [56, 58], some authors have suggested that TENS is not effective in the routine management of chronic LBP [59]. There is some evidence for the use of TENS in disc-related LBP [60].

Diadynamic currents are monophasic, low-frequency, and sinusoidal pulsed currents, with frequencies reaching up to 100 Hz [61]. It has been reported that diadynamic currents could have positive effects on chronic LBP by reducing pain via muscle fiber stimulation, pain masking, vasodilatation, and hyperemia [58, 62]. A study by Rajfur et al. examined 127 patients with chronic LBP with six different electrical currents, concluding that other electric currents are more efficient than diadynamic currents [62]. Nevertheless, there is insufficient evidence for diadynamic current use in disc-related LBP [58].

Interferential current therapy involves applying medium-frequency waves at 4,000 Hz, whose amplitude is modulated at low frequencies ranging from 0 to 250 Hz [63]. An asserted benefit of interferential current compared to low-frequency currents is its capacity to reduce the skin's impedance and its ability to produce an amplitude-modulated frequency parameter, resulting in a low-frequency current produced deep within the treatment area [64]. A few studies have investigated the effects of interferential currents on chronic LBP [62, 65, 66]. One study showed the ineffectiveness of using interferential currents as an adjunct to exercise therapy for discogenic LBP [65]. Another research compared the efficacy of selected electrical therapies on chronic LBP and concluded that using interference currents led to greater remission of symptoms than TENS currents and high voltage elec-

trical stimulation [62]. Also, a study found that treatment with transregional interferential currents for two weeks, compared to routine care, had a significant short-term effect on reducing pain and improving function in people with chronic LBP [66]. Overall, there is limited evidence in favor of using interferential currents for treating disc-related LBP [65, 67].

Low-level laser therapy (LLLT), also known as photobiomodulation, is a form of low-intensity light therapy with photochemical effects capable of reducing inflammation and edema, inducing analgesia, and fostering healing in various musculoskeletal pathologies [68]. One trial (with 60 participants) states that there is no difference between LLLT, mechanical traction, and ultrasound for patients with acute lumbar disc herniation LBP in the improvement of pain intensity, disability, and size of the herniated mass on MRI [69]. There is insufficient evidence to recommend the use of low-power lasers in the treatment of disc-related LBP [69].

High-intensity laser therapy (HILT) is a new application of laser treatment. This procedure is painless, non-invasive, convenient, and effectively stimulates deep tissues, with functions including anti-inflammation, anti-pain, and detumescence effects [70]. However, studies on HILT's efficacy on disc-related LBP are few [71, 72]. A randomized clinical trial (RCT) by Chen et al. demonstrates that HILT can accelerate the enhancement of lumbar segment motion, angle of straight leg raising, and overall function and facilitate the early return of patients with lumbar disc protrusion to their families and society [71]. A study comparing the effects of HILT, ultrasound, and exercise therapy on discopathy concluded that all methods were effective in reducing pain and improving function, but that HILT and ultrasound had a more prolonged effect on the quality of life vitality, social functioning, and mental health [72].

Therapeutic ultrasound consists of inaudible acoustic vibrations delivered at a frequency between 0.75 and 3.0 MHz and an intensity between 0.5 and 3 W/cm^2 [73]. There is inadequate evidence to endorse the application of ultrasound in the treatment of lumbar disc herniation with radiculopathy, while reports are in favor of using ultrasound [69, 74, 75]. One study shows no difference between ultrasound, mechanical traction, and laser, regarding improvement in disability and repeated MRI scans [69].

Magnetic therapy entails weak static magnetic fields generated by a permanent magnet [76]. A few studies have investigated the therapeutic effect of magnetic field therapy in managing disc-related LBP [77, 78]. Taradaj et al. showed short-term (3 weeks) beneficial effects of magnetic fields (10 mT, 50 Hz, 20 min) in the management of patients with discopathy-related LBP [78]. Also, they concluded that the application of magnetic therapy with a low induction value of 5 mT, which is immensely popular in clinical practice, proved pointless in treating symptoms of chronic lumbosacral discopathy [78]. Moreover, two other RCTs about lumbar radiculopathy, in 2002 and 2012, concluded that the application of magnetic therapy significantly reduces pain symptoms and leads to an improvement in functional ability in patients with lumbosacral radiculopathy in comparison to placebo [77].

Consequently, more data is required before any conclusions can be drawn on the efficacy of physical therapy modalities in patients with disc-related LBP. In other words, due to the low number of studies and variations in the applied interventions and assessment methods, current evidence provides limited guidance for physical therapy practice for disc-related LBP.

Injections

Spinal injections are among the most common therapeutic options for low back and lower extremity pain management [4, 28, 79]. There is still controversy concerning the short- and long-term effects of injection therapy as a minimally invasive procedure for the treatment of axial/radicular LBP; this may be the result of the variable methods of injection approach, target tissues, injective agents, and dosage in the literature [80, 81]. Hence, it seems necessary to provide a guide to assist physicians in selecting the more effective injection method based on current evidence.

Epidural steroid injections: The most popular and primitive spinal injection recommended in clinical guidelines is epidural steroid injection, regardless of the injection technique [28, 79]. Despite the extensive recommendations, based on the literature, the effect of this procedure on pain and disability is small and more effective in the short term (especially within the first month); also, there is conflicting data regarding whether this effect is clinically significant [81, 82].

In comparing the use of local anesthetics alone or with corticosteroids, although there are contradictory results about the efficacy of using local anesthetics alone, it may be accepted that epidural injection of local anesthetics in combination with steroids has an additional clinical effect [83, 84].

Concerning the best epidural injection approach, despite many review articles, it is not yet clear which approach is superior, especially in the long term, because of insufficient evidence. Nevertheless, it seems that the transforaminal epidural injection is better and more clinically effective than interlaminar and caudal approaches in the reduction of pain and disability [28, 82-84].

The use of biologics (cell-based therapy), including platelet-rich plasma (PRP) and mesenchymal stem cells (MSCs), called regenerative medicine, is suggested to improve symptoms and inhibit disc degeneration progress. Preclinical and clinical studies that have been performed so far are different in terms of techniques and mesenchymal cell sources (such as bone marrow, fat, and chondrocyte), and there is a lack of clinical studies and RCTs with high quality and strong evidence [85, 86]. However, according to current evidence, intradiscal and epidural injections of PRP and MSCs can be potentially effective treatment methods with weak and variable levels of evidence. It seems that the evidence is slightly stronger for intradiscal injections of biologics than for epidural injections. Therefore, further high-quality studies are essential to account for standard treatment approaches for disc-related LBP [4, 85, 86].

Ozone therapy is one treatment option for musculoskeletal disorders such as disc-related LBP. Current studies and systematic reviews have demonstrated the positive effect of ozone injection on the improvement of pain and function in patients with back pain related to lumbar disc herniation due to analgesic and anti-inflammatory effects and disc volume reduction [87-89]. The oxygen-ozone mixture is usually injected through intradiscal and intraforaminal or periradicular approaches. Some physicians may add concomitant paravertebral or intramuscular injections. The oxygen-ozone mixture can be combined with steroid and local anesthetic injections to provide better symptom relief [87, 88]. Although a few or no side effects and complications are reported in the literature when it is injected at therapeutic concentrations, physicians should be cautious about serious ozone therapy complications [87, 88].

Some other therapeutic medications have also been used for epidural injections in clinical trials, such as disease-modifying anti-rheumatic drugs (etanercept, tocilizumab) and tumor necrosis factor inhibitors (adalimumab). To date, because of the limited studies and lack of evidence, it is not ascertained if these medications are effective for pain and function improvement [79].

Conclusion

Recommendations are based on low to moderate-quality evidence or on consensus in the management approach studies for disc-related LBP. Some of these options have been studied more like exercise therapy and injections, and there are more favorable reports for them. Some others have been less studied and need to be investigated in future studies like different physical therapy modalities or drugs. Therefore, the authors recommend that research endeavors concerning all facets of the non-surgical management of LBP be intensified.

Ethical Considerations

Compliance with ethical guidelines

This article is a review with no human or animal sample.

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Authors' contributions

Conceptualization: Shima Ghannadi, Pardis Noormohammadpour, Mahshid Nazarieh, Faezeh Maleklou, Fatemeh Ejtehadi; Sudy design and supervision: Pardis Noormohammadpour, Babak Mirzashahi, Mohammad Hossein Pourgharib Shahi; Data acquisition, data analysis, and data interpretation: Babak Mirzashahi, Shima Ghannadi, Pardis Noormohammadpour, Mahshid Nazarieh, Fatemeh Ejtehadi, Faezeh Maleklou; Drafting of the manuscript: Shima Ghannadi, Mahshid Nazarieh, Faezeh Maleklou, Fatemeh Ejtehadi, Pardis Noormohammadpour; Review and editing: All authors.

Conflict of interest

The authors declared no conflict of interest.

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