Review

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A narrative review of non-operative treatment, especially traditional Chinese medicine therapy, for lumbar intervertebral disc herniation

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Summary **Lumbar intervertebral disc herniation (LIDH), as the main contributor to low back pain and sciatica, imposes a heavy burden on both the individual and society. Non-operative treatment or conservative treatment has proven effective in alleviation of the symptoms of LIDH and are considered to be a first-line choice for most cases. Active lifestyle, physical therapy, complementary and alternative medicine therapy or Traditional Chinese medicine (TCM) therapy, and pharmacotherapy are routinely used as effective non-operative treatment for LIDH patients. However, how to choose one or several conservative treatments with higher efficacy, less side effects, minimal injury, and low cost is still a challenge for doctors and LIDH patients. Furthermore, there are some national characteristics for some conservative treatments in different countries, which bring difficulties for the widespread use of these methods. Here we initiated a search on the non-operative treatment especially TCM therapy for LIDH mainly using PubMed, Web of Science, China National Knowledge Internet (CNKI), and Chinese biomedicine database since the 1980s with no restriction of language. According to these related references, we gave a narrative review which emphasizes up-to-date knowledge regarding the effectiveness and safety of various conservative methods with special consideration for TCM therapy including acupuncture, autonomy, Chinese massage, and Chinese herbal medicines, for LIDH treatment. We hope this review will further contribute to an understanding of conservative treatment as an important choice for LIDH patients and provide useful information for the development of more effective conservative methods for LIDH treatment.**

Keywords: Lumbar intervertebral disc herniation (LIDH), low back pain, sciatica, non-operative treatment, traditional Chinese medicine (TCM) therapy

1. Introduction

Lumbar intervertebral disc herniation (LIDH) is one of the most common spinal degenerative disorders affecting 1-3% of the general population (*1*). It is a pathological condition that is defined as a displacement of disc components (nucleus pulposus or annulus fibrosis) beyond the intervertebral disc space (*2*). LIDH is one of the most common causes of lower-back pain and sciatica. Its diagnosis can be confirmed by radiological examination. However, MRI or CT findings of herniated disc are not always accompanied by clinical symptoms (*3*). As the main contributor to low back pain and sciatica, LIDH greatly affects people's work, daily lives and quality of life, even permanent neurologic deficit and lifelong incontinence due to cauda equina syndrome (*4*). In recent years, with the changes in human's work and lifestyle, the incidence of LIDH has gradually increased and the onset age has tended to be younger. It mainly occurs among working adults aged < 50 years and has become a worrying occupational health issue because it sometimes affects continuation or resumption of employment (*5*). Therefore, LIDH imposes a heavy burden on both the individual and society.

As is well known, the aims of intervention for LIDH is to relieve pain, increase mobility and function, improve quality of life, and minimize adverse effects of treatments. Currently, a variety of therapeutic

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interventions have been proposed for the treatment of LIDH, including non-operative treatments (or conservative treatments) and surgical options. The choice of treatment, conservative or surgical, usually depends on symptom severity. In some cases, the recommendation for immediate surgery is necessary because of severe neurological symptoms, such as cauda equina syndrome. It is reported that only 15-20% of LIDH patients require immediate operative intervention (Figure 1A) (*1*). In other cases, the choice may be less clear. Although surgical treatment is one of the most common options for LIDH patients, the efficacy of this procedure relative to non-operative care remains controversial (*6*). Compared with conservative therapy, surgical treatment provided faster relief from back pain symptoms in patients with LIDH, but did not show a benefit over conservative treatment in midterm and long-term follow-up. No noteworthy difference could be observed between the therapeutic outcomes of conservative and surgical treatment after a period of 2 years (*7,8*). Moreover, the most common cause of poor outcome following lumbar disc surgery is recurrent herniation. Recurrence has been noted in 5% to 15% of patients with surgically treated LIDH (*9*). Conservative treatments of LIDH have been reported to have unique advantages, with the clinical symptoms of most patients diminished or even completely gone within a few weeks (*10*). In 2013, in USA more than 1 million patients received an epidural steroid injection as a conservative treatment for LIDH, let alone those seeking other conservative treatment methods within USA and those outside USA (*11*). Hence, some non-operative treatments have proven effective in alleviation of LIDH symptoms and are considered to be a first-line choice for most cases, particularly in the initial 6 weeks of conservative management (*12*). As shown in Figure 1B, active lifestyle, physical therapy, complementary and alternative medicine options (*e.g.*, acupuncture, acupotomy, Chinese massage, and Chinese herbal medicine), and pharmacotherapy (*e.g.*, non-steroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, systemic steroids, and steroid injections) are routinely used as effective non-operative treatments for LIDH patients (*7,13*). In all of these non-operative treatments, some complementary and alternative medicine therapies or Traditional Chinese medicine (TCM) therapies, such as acupuncture, acupotomy, Chinese massage, and Chinese herbal medicine, have particularly attracted more and more attention for LIDH patients. TCM, as an important component of complementary and alternative medicine, evolved over thousands of years with its own unique system of theories, diagnostics and therapies in Asian countries, especially China (*14*). In the world including Western countries, these TCM therapies have been increasingly used in the last few decades and have become well known for its significant role in preventing and treating various diseases including LIDH (*15*).

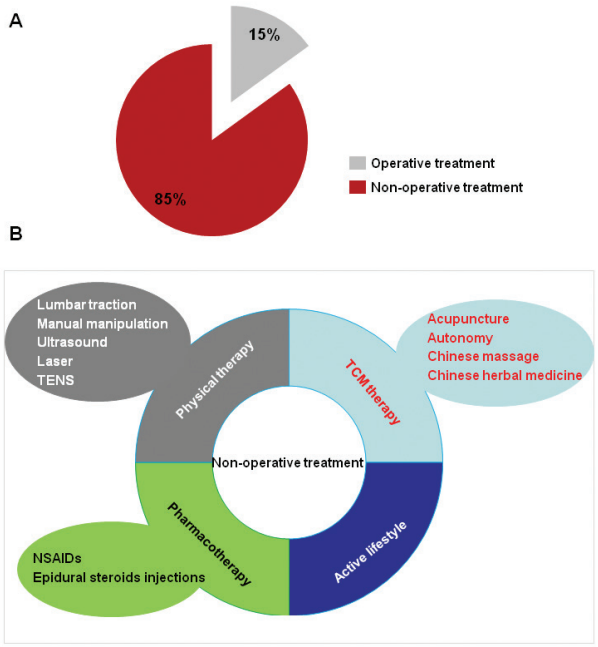

Figure 1. A variety of therapeutic interventions have been proposed for the treatment of LIDH, including non-operative treatment (or conservative treatment) and operative treatment. (A) The proportion of operative treatment and non-operative treatment. **(B)** Some routinely used effective non-operative treatments for patients with LIDH. (Abbreviation: NSAIDs: non-steroidal anti-inflammatory drugs, TCM: Traditional Chinese Medicine, TENS: transcutaneous electrical nerve stimulation.)

Therefore, a more detailed induction of conservative treatments for LIDH especially TCM therapies is necessary.

Currently, although conservative treatments are numerous, there is still a lack of satisfactory treatment for doctors and LIDH patients. Every method has some advantages and disadvantages. Moreover, there are some national characteristics for conservative treatment of LIDH in different countries, which brings difficulties for the widespread use of these methods. Therefore, how to choose one or several conservative methods with the characteristics of higher activity, less side effects, minimal injury, and low cost, has become the common goal for both doctors and LIDH patients. Here we will initiate a search of non-operative treatment especially TCM therapy for LIDH mainly using PubMed, Web of Science, China National Knowledge Internet (CNKI), and Chinese biomedicine database since 1980s with no restriction of language. According to these related references, we will give a narrative review, which emphasizes up-to-date knowledge regarding the effectiveness and safety of various conservative methods with special consideration of TCM therapy for LIDH treatment. We hope this review will further contribute to an understanding of conservative treatment as an important choice for LIDH patients and provide useful information for the development of more effective conservative methods for LIDH treatment.

2. How to choose: Rest in bed or stay active for acute low back pain and sciatica?

For over a century, bed rest has been considered to be the best solution for many musculoskeletal disorders. Traditionally, for LIDH patients with acute low back pain and sciatica, bed rest is one of the most basic symptomatic treatments and the basis for carrying out nonsurgical therapies. At the onset or acute phase of LIDH, 1-2 weeks of bed rest will be recommended for patients with severe pain (*16*). It is reported that the pressure on intervertebral discs is related to the patients' position and varies with body positions with the highest in sitting position and the lowest in recumbent position (*17*). When resting in bed, the pressure on intervertebral disc is reduced, which will be a benefit for removing tension of surrounding soft tissues, and restoring the biomechanical balance of the intervertebral disc? Rest in bed is also a benefit for improving local blood circulation, and eliminating inflammation and edema of surrounding soft tissues, which is better for nutrient supplies of the intervertebral disc. Furthermore, rest in bed is a benefit for the repair of damaged fiber ring and avoiding stimulation on spinal marrow or nerve root caused by movement (*18*).

In the clinic, patients with acute LIDH are usually advised to rest in bed absolutely to promote the restoration of damage to the intervertebral disc and slow the progression of intervertebral disc herniation (*19*). This recommendation is based on orthopedic teaching; however, it may directly affect the number of days lost from work or other activities. Therefore, how many days of bed rest are suitable for LIDH patients with acute low back pain? A randomized clinical trial conducted by Deyo *et al*. showed that there is no benefit of bed rest for seven days compared with bed rest for two days in terms of disability reduction (*20*). The 1994 clinical guidelines recommend that bed rest should be for short periods of 2-4 days, and they still advise activity limitation (*21*). More recently, the routine of bed rest has been challenged because of a lack of any evidence supporting its effectiveness. Vroomen *et al*. found that among patients with symptoms and signs of a lumbosacral radicular syndrome, bed rest is not a more effective therapy than no treatment (watchful waiting) (*22*). A systematic review conducted by Waddell *et al*. showed that bed rest is not an effective treatment for acute low back pain but may delay recovery. Advice to stay active and to continue ordinary activities results in a faster return to work, less chronic disability, and fewer recurrent problems (*23*). Moreover, two systematic reviews conducted by Hagen *et al*. and Hilde *et al*. showed that for nonspecific low back pain, there is strong evidence that advice to stay active rather than rest in bed results in less time missed from work, improved functional status, and less pain, while for patients with sciatica, there is no difference in outcomes between staying active and resting in bed (*24,25*). Nowadays, advice to promote physical activity and discourage bed rest in patients with acute lumbar pain is implemented in many primary care guidelines (*26*). Therefore, the answer on how to choose for acute low-back pain and sciatica (rest in bed or stay active) is clearly, the older obsolete viewpoint of bed rest for LIDH patients should be discarded.

3. Some common TCM therapies for LIDH

Recently, TCM therapies have become increasingly popular and are used regularly by patients with chronic neurological disorders mainly including low back pain and sciatica. According to a 2004 survey, 43% of peripheral neuropathy patients use TCM therapies to manage symptoms, and many patients cited unsatisfactory pain control with standard medical treatment as the reason for selecting TCM (*27*). Most commonly used TCM therapies included acupuncture, acupotomy, Chinese massage, and Chinese herbal medicine.

3.1. *Acupuncture*

Acupuncture was developed in ancient China with pictographs dating from the Shang Dynasty (1600-1100 BC), which suggests that it was already practiced at that time. It has been used to heal various diseases and physiologic malfunctions in clinical practice for more than 2500 years in China. Acupuncture is based on the concepts of TCM in which health is seen as the result of the balance of energy called *qi* in the body. When this energy is imbalanced, health is compromised and disease occurs. It is believed that *qi* flows through channels or meridians and acupuncture is used to correct this imbalance via insertion of needles that stimulate skin spots located along the meridians (*28*). In recent years, acupuncture has become increasingly used as a complementary therapy in the Western world. Due to its efficacy, acupuncture has been recommended by the World Health Organization since 1980 as an effective alternative therapy for 43 different disorders including musculoskeletal pain (*29*). In 2002, the National Health Interview Survey found that 4.1% of the respondents reported using acupuncture in their lifetime, that 8 million of Americans had used this therapy (2 million in the previous year), and back pain was the most common reason for its use (34%) (*30*). Recently published National Institute for Health and Clinical Excellence (NICE) guidelines highlight the need for a course of acupuncture of up to 10 sessions over 12 weeks for patients with low back pain (*31*). In accordance with clinical practice guidelines from the USA, acupuncture for low back pain was weakly recommended in 2007, but moderate-quality evidence was reported in 2017, which revealed that acupuncture,

Table 1. Forty-nine most common used acupoints for LIDH

Meridians	Number	Acupoints (International common name)
Bladder Meridian	10	Geshu (BL17), Xiaochangshu (BL27), Shenshu (BL23), Dachangshu (BL25), Pangguangshu (BL28), Guanyuanshu (BL26), Weizhong (BL40), Zhibian (BL54), Chengshan (BL57), Kunlun (BL60)
Gallbladder Meridian	2	Huantiao (GB30), Yanglingquan (GB34)
Governor Vessel	2	Yaoyangguan (DU3), Shuigou (DU26)
Stomach Meridian	2	Zusanli (ST36), Juliao (ST3)
Spleen Meridian	2	Sanyinjiao (SP6), Xuehai (SP10)
Others	31	*Huatuo Jiaji* points (EX-B2), *Ashi* points (pressure points)

as a type of TCM therapy, has shown respectable efficacy and is broadly accepted internationally (*32*).

As acupuncture is increasingly being recommended worldwide, especially for treating low back pain, several hypotheses have been proposed to explain the analgesic effect of acupuncture. According to TCM theory, acupuncture possesses the effect of stimulating the circulation of blood and causing the muscles and joints to relax by stimulating acupuncture points. Li *et al*. investigated a universal rule on selecting acupoints in the treatment of LIDH by acupuncture in the recent 10 years (*33*). They indicated that there were 49 most common used acupoints for LIDH treatment by retrieving 173 references and using a hierarchical clustering statistical method. As shown in Table 1, 18 of these acupoints were mainly distributed in Bladder Meridian, Gallbladder Meridian, Governor Vessel, Stomach Meridian, and Spleen Meridian, and the rest were extra points (*Huatuo Jiaji*, EX-B2) and *Ashi* points. Modern studies indicated that the underlying mechanisms of acupuncture might include modulation of GABAergic neurons in the ventral tegmental area (VTA) through opioid receptors and suppression of dopamine (DA) release in the nucleus accumbens (*34*). Acupuncture also had the effect of activating A-δ fibers, which are involved in release of endorphins and are associated with an increase in levels of 5-hydroxytryptophan in the brain (*35*).

According to numerous recent studies, it is without doubt that acupuncture is an effective and safe treatment for relieving symptoms (*e.g*., low back pain and sciatica) and improving function of LIDH. Lee *et al*. conducted a randomized controlled pilot trial on acupuncture for low back pain due to spondylolisthesis (*36*). Their findings indicated that acupuncture would be helpful in patients with spondylolisthesis as a safe conservative treatment without severe adverse events as can happen in some surgical procedures. Moreover, several systematic review and meta-analysis articles were conducted to assess the effectiveness of acupuncture for treating sciatica. Qin *et al*. found that the use of acupuncture may be more effective than NSAIDs (*e.g*., ibuprofen, meloxicam, and diclofenac) and may enhance the effect of drugs for patients with sciatica (*37*). In addition, the warm needling therapy and electro-acupuncture therapy, which are derived from conventional acupuncture, have been widely used and exhibited a significant effect on treatment of LIDH. Taken together, acupuncture as an adjunct to conventional therapy provides short-term clinically relevant improvements in pain and functional measures for the treatment of LIDH.

3.2. *Autonomy*

Acupotomy is a new TCM therapy invented by Prof. Hanzhang Zhu (1949 - 2006) in 1976, who is a famous professor of Beijing University of Traditional Chinese Medicine (*38*). According to TCM meridian theory and modern surgical principles, Prof. Zhu combined an acupuncture needle with a modern surgical scalpel, created a bladed needle or acupotomy which had a thick flat-head and a cylindrical body used as the main treatment tool. As the tool is a combination of an acupuncture needle and surgical scalpel, it is also named a "small needle knife". Acupotomy is a closed lysis therapy, which converts open surgery to closed surgery, thus reducing risk, time, and cost. It can reach lesions deep inside the body and performs proper procedures like cutting and peeling. It can strip adhesions, release contractures, clear blockages, and is characterized by smaller wounds, fewer complications, higher safety, lower cost, and significant treatment efficiency (*39*). Because of these advantages, in clinical practice, acupotomy is widely applied to treat chronic soft tissue injury and bone hyperplasia including LIDH, cervical spondylosis, knee osteoarthritis (KOA) and so on.

In recent years, acupotomy has gradually become popular with LIDH patients and some related studies have shown the efficacy of acupotomy for the treatment of patients with low back pain and sciatica caused by LIDH. To evaluate the effectiveness and safety of acupotomy for treating LIDH, Mu *et al*. conducted a systematic review and meta-analysis which included 13 randomized controlled clinical trials (RCTs) and clinical control trials (CCTs) and 667 LIDH patients (*40*). They found that acupotomy exhibited more significant effects on relieving symptoms and improving symptoms than other therapies. Its mechanisms might involve recovering

the kinetic state of soft tissues from peeling adhesions, removing attached tissues, and reducing pressure on the nerves of LIDH patients (*41*). As chronic adhesion is resolved and contractures are released, tissues of lumbar intervertebral discs are free to move during activity with normal local function and pain resolved. Also, surrounding blood circulation of tissues of lumbar intervertebral discs can be improved.

Currently, acupotomy is not only widely used in China to treat LIDH, but also gradually popular with LIDH patients of other countries, especially Korea. Yuk *et al*. conducted a clinical study including 437 patients to evaluate the effect of acupotomy in patients with degenerative lumbar spine stenosis (*42*). They found that the verbal numeric rating scale (VNRS) and the oswestry disability index (ODI) scores of patients were significantly decreased, which means that acupotomy as a treatment for spinal stenosis has a significant effect on pain relief and functional recovery. Kim *et al*. found that acupotomy possesses a potential effect on recovering the kinetic state of soft tissue, and on reducing low back pain and radiating pain of patients suffering from LIDH (*41*). All these results provide evidence that acupotomy is effective for relieving pain and improving quality of life in patients with LIDH.

Taken together, acupotomy as an adjunct to conventional therapy provides a better and safe effect for treating LIDH. However, currently there are still not enough high grade evidence recommendations for acupotomy. In future studies, larger sample sizes and longer prospective randomized clinical trials are needed, and comparisons between acupotomy and other LIDH therapies must be implemented.

3.3. *Chinese massage*

Chinese massage (referred to as Tuina in China, Chuna in Korea, and Shiatsu in Japan) is one of the most popular complementary and alternative therapies, which has been practiced in China for over 2000 years. It involves a wide range of technical manipulations conducted by a practitioner's finger, hand, elbow, knee, or foot applied to muscle or soft tissue at specific body locations (*43*). Moreover, sometimes Tuina is conducted according to the principles of acupuncture including the use of acupoints or along specific meridians. There are six main styles of physical Tuina therapy, including wobbling, pushing, vibrating, squeezing, knocking and articular moving, of which squeezing involves pressing, pinching, kneading, grasping and rubbing. Constant softness and penetration under consistent intensities, frequencies and manipulation durations are applied to all these styles of Tuina (*44*). Previously, Chinese massage was mainly associated with pain relief. At present, it is a well-respected treatment modality known to be helpful and safe for a wide range of conditions including arthritis, anxiety, sleep problems, pain management and injury repair (*45*). For these reasons, Chinese massage is rapidly gaining international favor and is widely accepted as a complementary and alternative medicine therapy in the world.

Although Chinese massage is helpful for patients suffering from varied pathological states, it has been shown to be particularly effective for disorders of musculoskeletal origin including LIDH. Some related studies have shown the efficacy of Chinese massage for the treatment of patients with low back pain and sciatica caused by LIDH. Dr. Long conducted a study, which enrolled 82 LIDH patients who were definitely diagnosed by CT scanning and treated with Chinese message (*46*). He found that of 82 cases, 54 cases (65.8%) were cured, 26 cases were improved, and 2 cases failed. Cherkin *et al*. conducted a review of the evidence for the effectiveness, safety, and cost of massage therapy for acute and chronic back pain through three RCTs (*47*). They indicated that Chinese massage was effective for persistent back pain and might reduce the costs of care after an initial course of therapy. Yang *et al*. conducted a single center, two-arm, open-label RCT, which was a comparative effectiveness study of Chinese massage and conventional analgesics (ibuprofen) for pain relief and function recovery in patients with chronic low back pain (*43*). The results showed that Chinese massage was more effective for relieving pain and improving function. Moreover, the pain relief effects of Tuina might be associated with elevated pain thresholds and reduced AUC of C-fiber-evoked field potentials of the ipsilateral and contralateral nerves (*44*).

Because of the increased use of Chinese massage in the world, its safety and quality has gradually been paid more and more attention. Yin *et al*. conducted a systematic review to evaluate the adverse events of massage therapy in pain-related conditions (*48*). They indicated that disc herniation, soft tissue trauma, neurologic compromise, spinal cord injury, and dissection of the vertebral arteries were the main complications of massage, and spinal manipulation in massage has repeatedly been associated with serious adverse events especially, but the incidence of such events is low. However, although such serious adverse events associated with massage in general are few, for the practitioners to minimize massage adverse events, not only adequate training in biomedical knowledge are needed but also safe practice guidelines are required.

Taken together, Chinese massage as an adjunct to conventional therapy provides better and safe effects for treating LIDH. However, currently there are still not enough high grade evidence recommendations for Chinese massage. In the future, well designed and methodologically rigorous studies will be needed for collection of valuable, high-quality data to evaluate the efficacy of Chinese massage, and will contribute to providing a solid foundation for the clinical treatment of LIDH.

3.4. *Chinese herbal medicine*

Chinese herbal medicine has been used in the treatment of various disorders including LIDH for thousands of years in China, Japan, and other Asian countries. In terms of TCM theory, LIDH is known as "*Bi-Zheng*" and is usually caused by blood stasis and *qi* stagnation, cold-dampness, or deficiencies in liver and kidney function (*49*). Therefore, some Chinese herbal medicines such as Duo-Huo (*Radix Angelicae Pubescentis*), Dang-Gui (*Radix Angelicae Sinensis*), Huang-Qi (*Radix Astragali*), Du-Zhong (*Cortex Eucommiae*), and Niu-Xi (*Radix Achyranthis Bidentatae*), with the following efficacy are commonly used to treat conditions like LIDH: promoting blood circulation and relieving pain, nourishing the liver and kidney, strengthening muscle and bone, promoting blood circulation and clearing collaterals, dispelling wind and dampness, and invigorating *qi* (*50*). Modern pharmacological studies have shown that these Chinese herbs are chosen due to their known analgesic, anti-inflammatory, antispasmodic, and carminative effects (*51*). Moreover, some Chinese herbal formulations, which contain the above single herbs such as Duhuojisheng Tang and Buyanghuanwu Tang are also widely used in the treatment of LIDH. In recent years of clinical practice, several Chinese herbs and Chinese herbal formulations have been found to have potentially beneficial effects on relieving pain and improving function of LIDH patients. Therefore, the pharmacology of the Chinese herbal medicines most commonly used as an adjuvant treatment in LIDH therapy must be understood by some doctors and other health care providers.

Recently, the effectiveness of Chinese herbal medicine for treating LIDH has been reported widely. To evaluate the efficacy of Chinese herbal medicine for LIDH, a systematic review of randomized controlled trials was conducted by Luo *et al*. (*49*). They found that both Duhuojisheng Tang and Buyanghuanwu Tang are the most commonly used Chinese herbal formulations for LIDH treatment. They also found herbs that promote blood circulation, such as Dang-Gui (*Radix Angelicae Sinensis*), Ru-Xiang (*Olibanum*), Mo-Yao (*Myrrh*), and Chuan-Xiong (*Rhizoma Chuanxiong*), have beneficial effects for LIDH treatment. In addition, Qi-tonifying herbs, such as Huang-Qi (*Radix Astragali*), Du-Zhong (*Cortex Eucommiae*), and Niu-Xi (*Radix Achyranthis Bidentatae*), which improve kidney function or strengthen bones, are also effective. A brief outline on the pharmacology of these most commonly used Chinese herbal formulations and herbs is presented below (Table 2 and Table 3).

Duhuojisheng Tang, set up by Simiao Sun (a famous physician in the Tang Dynasty), is a famous traditional herbal formulation that has long been used to treat LIDH, osteoarthritis, osteoporosis, cervical spondylosis and so on (*50*). It contains 15 herbs including Duo-Huo (*Radix Angelicae Pubescentis*), Dang-Gui (*Radix Angelicae Sinensis*), Chuan-Xiong (*Rhizoma Chuanxiong*), Du-Zhong (*Cortex Eucommiae*), Niu-Xi (*Radix Achyranthis Bidentatae*), and so on. Duhuojisheng Tang has become the most frequently prescribed herbal formulation in Taiwan for treating diseases of the musculoskeletal system and connective tissues (*52,53*). Currently, much of the pharmacological research has shown that Duhuojisheng Tang has potent anti-inflammation, immunomodulatory, analgesia, and inhibition of platelet aggregation properties (*54*). Using Duhuojisheng Tang alone or combined with other therapies can effectively improve pain, leg-raising height and other clinical symptoms of patients with prolapse of lumbar intervertebral discs (*50*).

Buyanghuanwu Tang, set up by Qingren Wang (a famous physician in the Qing Dynasty), is a popular Traditional Chinese Medicine comprised of seven commonly used Chinese herbal drugs: Huang-Qi (*Radix Astragali*), Dang-Gui (*Radix Angelicae Sinensis*), Chi-Shao (*Radix Paeoniae Rubra*), Chuan-Xiong (*Rhizoma Chuanxiong*), Hong-Hua (*Flos Carthami*), Tao-Ren (*Semen Persicae*), and Di-Long (*Pheretima*) (*55*). There are nine main bioactive components, *i.e*., astragaloside I, astragaloside II, astragaloside IV, formononetin, ononin, calycosin, calycosin-7-*O*-β-d-glucoside, ligustilide and paeoniflorin in Buyanghuanwu Tang extract (*56*). This traditional herbal formulation has been widely used in Chinese clinical practice for treatment and prevention of ischemic cardio-cerebral vascular diseases and stroke-induced disability for thousands of years. According to the traditional Chinese medical literature, it is used to enhance blood circulation and activate energy (*qi*) flow through energy meridians (*57*). Currently, much of the pharmacological research has shown that Buyanghuanwu Tang has potent effects on regulating inflammation, apoptosis, angiogenesis and blood coagulation, and neurogenesis and nervous system development (*58*). Therefore, Buyanghuanwu Tang is commonly used to treat LIDH companied with spinal cord injuries and other nervous lesions. Using Buyanghuanwu Tang alone or combined with other therapies can effectively improve sciatica and low back pain, and enhance the quality of life of LIDH patients. Dr. Kang reported that Buyanghuanwu Tang exhibited significant effects in improving syndromes of patients with lumbar vertebral canal stenosis (*59*). Moreover, Buyanghuanwu Tang could effectively promote recovery of low limb numbness in patients with lumbar surgery (*60*).

Angelicae Sinensis Radix (Dang-Gui in Chinese, Dong Quai in English, Toki in Japanese, or Tanggwi in Korea), is the root of *Angelica sinensis* (*Oliv.*) Diel and has been used for thousands of years worldwide. Since, it has both properties of nourishing blood and promoting blood circulation and removing blood stasis, it is usually used for tonifying, replenishing, and invigorating blood as well as relieving pain,

Table 2. Traditional herbal formulations commonly used in LIDH treatment

Names	Composition	Biological activity	Evidence on treating LIDH	*Ref.*
Duhuojisheng Tang	Includes 15 herbs: Duo-Huo (*Radix Angelicae Pubescentis*), Dang-Gui (*Radix Angelicae Sinensis*), Chuan-Xiong (*Rhizoma Chuanxiong*), Du-Zhong (*Cortex Eucommiae*), Niu-Xi (*Radix Achyranthis Bidentatae*), Xi-Xin (*Asarum*), Qin-Jiao (*Radix Gentianae Macrophyllae*), Fu-Ling (*Poria cocosWolf*), Rou-Gui (*Cassia Bark*), Fang-Feng (*Radix Saposhnikoviae*), Ren-Sen (*Panax ginseng*), Gan-Cao (*Glycyrrhiza uralensis*), Di-Huang (*Rehmannia glutinosa*), Sang-Ji-Sheng (*Chinese Taxillus Twig*), and Bai-Shao (*Radix Paeoniae Alba*)	Anti-inflammation, immunomodulatory, analgesia, and inhibition of platelet aggregation	Clinical: Effectively improving pain, leg-raising height and other clinical symptoms of patients with prolapse of lumbar intervertebral disc	*50-54*
Buyanghuanwu Tang	Includes 7 herbs: Huang-Qi (*Radix Astragali*), Dang-Gui (*Radix Angelicae Sinensis*), Chi-Shao (*Radix Paeoniae Rubra*), Chuan-Xiong (*Rhizoma Chuanxiong*), Hong-Hua (*Flos Carthami*), Tao-Ren (*Semen Persicae*), and Di-Long (*Pheretima*)	Regulating inflammation, apoptosis, angiogenesis and blood coagulation, and neurogenesis and nervous system development	Clinical: Effectively improving syndromes of patients with lumbar vertebral canal stenosis; Effectively promote recovery of low limbs numbness in patients with lumbar surgery	*55-60*

Table 3. Single herbs commonly used in LIDH treatment

Common name	Other names	Latin name	Major active ingredients	Biological activity	Evidence on treating LIDH	*Ref.*
Angelicae Sinensis Radix	Dang-Gui, Dong Quai, Toki, or Tanggwi	*Angelica sinensis* (*Oliv.*) Diel	Polysaccharides, ligustilide and ferulic	Anti-inflammation, anti-fibrosis, antispasmodic activity, anti-oxidation, and neuro-protection, as well as cardio- and cerebrovascular protective functions	Clinical: Effectively improve pain and enhance life quality of LIDH patients	*14,50, 59-62*
Radix Astragali	Huang-Qi, or Milk vetch	*Astragalus membranaceus Bge. Var.* mongholicus	Isoflavonoids, triterpenoid saponins, polysaccharides, amino butyric acids and various trace elements	Antioxidant, antitumour, hepatoprotective, anti-diabetic, antimicrobial, antiviral and immune enhancement activities	Clinical: Effectively improve the syndromes of low limbs numbness in patients with lumbar vertebral canal stenosis	*14,50, 59,60, 63,64*
Cortex Eucommiae	Du-Zhong	*Eucommia ulmoides Oliv.*	Lignans, iridoids, flavonoids, polysaccharides, terpenes, and proteins	Blood pressure reduction, blood lipid regulation, cardiovascular protection, anti-obesity, anti-inflammation, anti-virus, enhancement of immunologic function, resistance against senility and anti-fatigue	Preclinical: Promoting the proliferation of osteoblasts and improving bone mineral density of rats Clinical: Effectively improving low back pain and lumbar vertebral canal stenosis of LIDH patients	

lubricating the intestines, and treating female irregular menstruation and amenorrhea (*14*). Over 70 compounds have been identified from Dang-Gui, including polysaccharides, ligustilide and ferulic. Scientific reports on crude extracts and pure compounds and formulations of Dang-Gui revealed a wide range of pharmacological activities, including anti-inflammation, anti-fibrosis, antispasmodic activity, anti-oxidation, and neuro-protection, as well as cardio- and cerebrovascular protective functions (*61*). Some reports indicated that crude extracts or formulations of Dang-Gui could effectively improve pain and enhance life quality of LIDH patients (*50,59,60,62*). Dr. Yu indicated that Dang-Gui injection exhibited significant effects for treating the third lumbar transverse process syndrome with effectively improving pain and enhancing the quality of life (*62*).

Radix Astragali (Huang-Qi in Chinese), isolated from the dried root of *Astragalus membranaceus Bge. Var*. mongholicus, is one of the most famous and frequently used herbal medicines and healthy food supplements used as a tonic. It has been used for over 2000 years in TCM prescriptions for the treatment of animal bites and poisons, wounds and burns, nephritis, diabetes, albuminuria, hypertension, cirrhosis, and various cancers (*14,63*). Chemical constituent investigations indicated that it contains several bioactive constituents including, isoflavonoids, triterpenoid saponins, polysaccharides, amino butyric acids and various trace elements (*14*). Modern pharmacological studies have shown that Huang-Qi and its active constituents possess antioxidant, antitumour,

hepatoprotective, anti-diabetic, antimicrobial, antiviral and immune enhancement activities (*63*). Recently, some reports have indicated that crude extracts or formulations of Huang-Qi could effectively improve pain and enhance life quality of LIDH patients (*50,59,60,64*). Jiang *et al*. found that large doses of Huang-Qi could effectively improve the syndromes of low limb numbness in patients with lumbar vertebral canal stenosis (*64*).

Cortex Eucommiae (Du-Zhong in Chinese), the bark of *Eucommia ulmoides Oliv.*, has been traditionally used to treat many diseases in China in the form of tonics, analgesics, and sedatives for more than 2000 years (*55*). The natural products identified from Du-Zhong include lignans, iridoids, flavonoids, polysaccharides, terpenes, and proteins. Modern pharmacological studies have showed that Du-Zhong has some effects like blood pressure reduction, blood lipid regulation, cardiovascular protection, anti-obesity, anti-inflammation, anti-virus, enhancement of immunologic function, resistance against senility and anti-fatigue (*65*). In the clinic, it is mainly used to treat hypertention, lumbar diseases, and obstetrical and gynecological disease. Recently, some reports have indicated that crude extracts or formulations of Du-Zhong could effectively improve pain and enhance quality of life of LIDH patients (*50,59,60*). Du-Zhong exhibited significant effects for promoting the proliferation of osteoblasts and improving bone mineral density (*66*). Furthermore, some Chinese herbal formulations of Du-Zhong exhibited significant effects on treating LIDH. Fu *et al*. reported that a Chinese herbal formulation of Du-Zhong (Du-Zhong-Qiang-Yao-Tang) could more effectively improve low back pain and lumbar vertebral canal stenosis of LIDH patients compared to Mecobalamine (*67*).

Taken together, as Chinese herbal medicine has become popular in the world, more and more LIDH patients seek it as an alternative therapy. However, from the current clinical studies, Chinese herbal medicine is not the preferred therapy in the treatment of LIDH. Chinese herbal medicine is usually combined with other therapies for treating LIDH. In addition, although these Chinese herbal formulations and herbs are commonly prescribed by traditional Chinese physicians for LIDH treatment in the clinic, there are few clinical studies published currently in English. Thus, more rigorous trials are needed to confirm the efficacy of these Chinese herbal medicines for LIDH therapy in the future.

4. Pharmacotherapy

Pharmacotherapy, as one of most important conservative treatments, is widely used to improve symptoms of LIDH patients, of which drugs with anti-inflammatory and neurotrophic effects are commonly used. A randomized clinical trial enrolling patients from 13 multidisciplinary spine clinics in 11 US states was conducted by Weinstein *et al*. (*6*). They indicated that when LIDH patients chose non-operative treatments, about 61% patients received anti-inflammatory medications (NSAIDs, cyclooxygenase 2 inhibitors, or oral steroids), 46% received opiates, and more than 50% received injections (*e.g*., epidural steroids). As pharmacotherapy appears so important in LIDH treatment, the efficacy and side effects of these commonly used therapies especially oral NSAIDs and epidural steroids injections must be understood by some doctors and other health care providers.

NSAIDs are the most widely used over-the-counter drugs as well as the most prescribed class of drugs for a variety of conditions including pains, rheumatoid arthritis, osteoarthritis, musculoskeletal disorders, and other comorbid conditions (*68*). Millions of people suffer from pain resulting in the prolonged use of NSAIDs being common. Diclofenac, Ibuprofen, and Meloxicam are popular NSAIDs widely used in the clinic. They are reported to exhibit a significant effect on improving acute low back pain and sciatica caused by LIDH. Valat *et al*. reported Meloxicam and Diclofenac were equivalent in relieving the acute pain associated with osteoarthritis of the lumbar spine, however, Meloxicam was much better tolerated (*69*). Toroudi *et al*. found that Ibuprofen showed an analgesic effect to alleviate post-discectomy surgery pain in patients with LIDH (*70*). However, a systematic review conducted by Vroomen *et al*. indicated that compared with placebo, NSAIDs might be no more effective at improving global pain at 5 to 30 days in people with sciatic pain caused by LIDH (low-quality evidence) (*71*). In addition, NSAIDs also have undesirable side effects including ulcers, bleeding, kidney failure, and increased risk of heart attack and stroke (*72*). Therefore, although NSAIDs might be more effective in the acute stage of LIDH, it should be cautious for patients welfare to choose NSAIDs in the treatment of pain especially sciatic pain caused by LIDH.

Epidural steroid injections as a nonoperative management are commonly utilized to treat radicular pain due to LIDH especially in western countries (*71*). It may modulate the inflammatory cells, cytokines, or other pain mediators associated with lumbar disc herniation-related pain (*73*). Compared with no epidural steroids, epidural steroid injections may be more effective at improving limb pain and increasing patients' satisfaction at 2 weeks, but may be no more effective after more than 2 weeks in people with disc herniation. Moreover, it may be no more effective in the longer term at improving disability, as measured by the Roland Morris Disability Questionnaire and ODI scores, or functional outcomes such as straight leg raising and lumbar flexion (*3*). However, there is considerable controversy about the clinical efficacy of epidural steroid injections in the management of LIDH.

Radcliff *et al*. reported that patients with LIDH treated with epidural steroid injections had no improvement in short or long-term outcomes compared with patients who were not treated with epidural steroid injections (*73*). Given these data, we concluded that more studies are necessary to establish the value of epidural steroid injections for symptomatic LIDH.

5. Physical therapy

Physical therapy is widely used to treat patients with musculoskeletal disorders including LIDH. There are a vast variety of techniques that are commonly used by physical therapists in the treatment of low back pain and sciatica caused by LIDH. Some of the therapies include, but are certainly not limited to, education, exercise, lumbar traction, manual manipulation, application of heat, cryotherapy, ultrasound, laser, and transcutaneous electrical nerve stimulation (TENS) (*74*). For LIDH patients, it is a most common conservative treatment received during the first six weeks. According to a Spine Patient Outcomes Research Trial (SPORT) conducted by Weinstein *et al*. at 13 sites across the United States, about forty-four percent of LIDH patients received active physical therapy during the trial (*6*). Fritz *et al*. indicated that many patients with lumbar spinal stenosis pursuing conservative management receiving physical therapy, using physical therapy was associated with reduced likelihood of patients receiving surgery within 1 year (*75*). Studies of physical therapy for acute low back pain and sciatica caused by LIDH are heterogeneous because the intervention method differs. Therefore, it is difficult to assess one method of physical treatment, which would seem definitively to be superior to another. Individualized education during physical therapy, particularly when LIDH patients are focused on fear avoidance and staying active, appears to be helpful (*76*). Although traction is widely used by physiotherapists for treating LIDH, there is strong evidence that traction, either alone or in combination with other treatments, has little or no impact on pain intensity, functional status, global improvement and return to work among people with low back pain and sciatica (*77*). Various types of exercises have been used in the management of low back pain. For example, William's flexion exercise, and McKenzie extension exercise are commonly used in treatment of low back pain. Mulligan Sustained Natural Apophyseal Glides (SNAGs) as one of most important manual therapy treatments is also widely used by physiotherapists to treat this condition. A randomized control trial was conducted by Waqqar *et al*. to determine the effects of McKenzie extension exercise versus Mulligan SNAGs for chronic mechanical low back pain (*78*). They indicated that McKenzie extension exercises program is clinically slightly more effective in the management of pain and disability as compared with Mulligan SNAGs, while Mulligan SNAGs are more effective in the improvement of lumbar ROM as compared with Mechanize EEP in the management of CMLBP. However, there is still little evidence from randomized controlled trials to support their use. In the future, more studies are necessary to establish the value of physical therapy for symptomatic LIDH.

6. Keeping active lifestyle for patients with LIDH in remission stage

According to the progress of LIDH, it is usually divided into three stages, namely acute stage, recovery stage and remission stage (*79*). In general, during the acute stage and recovery stage of LIDH, the main principle is improving blood circulation and relieving nerve root edema and inflammatory reaction, while in the remission stage, LIDH patients are advised to insist on an active lifestyle and functional training in their daily life and work to keep the stability of spinal biodynamics as far as possible to reduce recurrence of LIDH. Therefore, the above methods including TCM therapies, pharmacotherapy, and physical therapies are commonly used treatments in the acute stage and recovery stage of LIDH, and it is critical to keep an active lifestyle in the remission stage of LIDH. Moreover, LIDH is a multifaceted progressive irreversible condition and an inevitable part of aging with complex etiology. Although genetic influences are more dominant, the occupational and mechanical influences still persist as a major risk factor (*80*). Therefore, it should be better for LIDH patients to keep an active lifestyle in their daily life and work. Otherwise, some symptoms of LIDH like low back pain and sciatica will be triggered and aggravated. To reduce the incidence and recurrence rate of LIDH, the following notes should be advised repeatedly by doctors: (*i*) Don't bend over for a long time. (*ii*) Don't sit for a long time. (*iii*) Please pay attention to a warm waist. (*iv*) Please sleep on a hard bed. (*v*) Please eat more foods with higher calcium content such as milk, bean curd, sesame paste, earthnut, kelp, laver, and dried small shrimp.

7. Conclusion

LIDH is a common spinal disorder that usually favorably responds to conservative treatment. Here we give a narrative review on non-operative treatments such as TCM therapies including acupuncture, autonomy, Chinese massage, and Chinese herbal medicines, pharmacotherapy including NSAIDs and epidural steroid injections, physical therapy and keeping an active lifestyle, which are commonly used as nonsurgical management in clinics for patients with LIDH. Because all of these therapies possess their own advantages and disadvantages, we cannot make any conclusion that one method of non-operative treatment would seem

definitively to be superior to another, and little evidence is available to define optimal nonsurgical management. Nevertheless, these nonsurgical managements are widely used alone or in combination especially TCM therapies. Due to the convenient, safe, effective and less expensive characteristics of these TCM therapies, it should be a benefit for patients and society. However, currently there are still not enough high grade evidence recommendations for TCM therapies. In the future, well designed and methodologically rigorous studies will be needed for collection of valuable, high-quality data to evaluate the efficacy of non-operative treatments especially TCM therapies, and so will contribute to provide a solid foundation for the clinical treatment of LIDH.

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