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Discovery of the Regularity of Acupuncture Point Selection Prescription for Lumbar Disc Herniation based on Data Mining

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Abstract: ***This study aimed to explore the acupoint selection, combination patterns, and optimal core acupoint groups in acupuncture treatment for lumbar disc herniation (LDH) based on data mining of modern domestic and international randomized controlled trials (RCTs). Computerized searches were conducted in multiple databases, including VIP, CNKI, WF, SCI, and PubMed, for literature published between 2014 and April 30, 2024. A total of 808 articles involving 155 acupoints were analyzed using Excel, Jadad scale scoring, IBM SPSS Statistics 26, and RStudio 4.4.1. Results showed that electroacupuncture had the highest efficacy (92.37%). The top three high-frequency acupoints were Weizhong (BL40), Huantiao (GB30), and Shenshu (BL23). The most frequently used meridians were the Bladder Meridian of Foot-Taiyang, Gallbladder Meridian of Foot-Shaoyang, and Governor Vessel. The acupoint pair "Weizhong (BL40) → Huantiao (GB30)" had the highest support (57.18%) and confidence (83.24%) in association rule analysis. In conclusion, electroacupuncture is the most effective method for LDH treatment. The high-frequency acupoints and meridians identified in this study provide valuable guidance for clinical acupoint selection and combination in acupuncture therapy for LDH.***

Keywords: Acupuncture, Lumbar disc herniation, Data mining**.**

1. Introduction

Lumbar disc herniation (LDH) is a syndrome caused by degeneration of the intervertebral disc, rupture of the annulus fibrosus, and protrusion of the nucleus pulposus, which compresses and irritates the lumbosacral nerve roots and cauda equina, leading to an inflammatory response [1]. The global incidence of LDH is approximately 2%–4% [2]. The primary issue associated with LDH is low back pain, with over 60% of patients experiencing persistent pain or frequent relapses within a yea [2]. In 2019, The Lancet reported that 11%–12% of patients with intervertebral disc degeneration were disabled due to low back pain [3].

In recent years, the number of publications on acupuncture treatment for lumbar disc herniation has increased dramatically [4] In the field of traditional Chinese medicine (TCM), data mining has become a popular research focus. Through data mining, it is possible to identify acupuncture prescription and acupoint selection patterns from a vast number of documents, thereby uncovering the essence of TCM. Some scholars have conducted data mining and collation of clinical research literature on lumbar disc herniation, forming research results centered on the patterns of "disease—acupoints (primary and secondary acupoints), meridians, and acupuncture prescriptions" to develop clinically advantageous acupuncture protocols. Although several scholars have revealed the commonly used acupoints, prescriptions, and combination patterns for acupuncture treatment of lumbar disc herniation, the treatment information, acupoint patterns, and characteristics are complex and varied due to the diversity of included literature, differences in statistical methods, and temporal disparities. Therefore, this study aims to statistically analyze the acupoints used in domestic and international literature, identify the commonly used acupoints and meridians through frequency analysis, and optimize clinical acupuncture protocols for treating lumbar disc herniation. Additionally, this study will provide a comprehensive analysis of the therapeutic concepts and ideas of acupuncture treatment for lumbar disc herniation, offering guidance for clinical practice.

2. Materials and Methods

2.1 Source of Data

1) Databases: VIP Journal Full-text Database, China National Knowledge Infrastructure (CNKI), Wanfang Data Resource System (WF), China Biology Medicine disc (CBM), PubMed, and Web of Science; language restricted to Chinese and English.

2) Search period: from April 30, 2004 to April 30, 2024.

3) Search methods: see Supplementary Table 1 for details.

Table 1: Search Terms

serial number	Search Terms
1	Acupuncture Therapy OR acupuncture OR electro-acupuncture OR fire needle or warming needle OR warm acupuncture
2	lumbar disc herniation OR lumbago OR lumbocrural pain
3	randomized controlled trial OR controlled clinical trials OR randomized
4	1 AND 2 AND 3

2.2 Inclusion Criteria for Literature

1) Type of Literature: Clinical studies on acupuncture treatment for lumbar disc herniation (LDH) published both domestically and internationally between April 2014 and April 2024, including controlled trials.

2) Study Population: Patients diagnosed with "lumbar disc herniation" according to either traditional Chinese medicine or Western medicine criteria.

3) Clinical Interventions: Studies with acupuncture as the primary intervention, including needling, warm-needle moxibustion, electroacupuncture, and fire-needle therapy.

4) Acupuncture Prescription: Studies with clearly defined acupuncture point prescriptions.

5) Outcome Assessment: Studies that accepted the efficacy evaluation criteria used in the included literature, with the treatment group or experimental group showing superior efficacy compared to the control group.

6) Language: Limited to articles published in Chinese or English.

2.3 Exclusion Criteria for Literature

1) Studies focusing primarily on postoperative patients with lumbar disc herniation or similar types of literature.

2) Literature involving animal laboratory research, literature reviews, retrospective cohort studies, retrospective randomized controlled trials (RCTs), expert experience summaries, case reports, expert consensus, and scientific hypotheses.

3) Studies using pharmacological treatments or non-acupuncture therapies as the primary intervention.

4) Studies involving auricular acupuncture, equilibrium acupuncture, sinew acupuncture, scalp acupuncture, floating acupuncture, nine-needle techniques, wrist-ankle acupuncture, and manual manipulations, etc.

5) Duplicate publications or studies for which the full text is unavailable.

6) Studies where the primary acupuncture points used are Dong's extraordinary points, Jin's three-needle techniques, trigger points, or corresponding points.

*Any patient meeting any of the above criteria will be excluded.

2.4 Database Construction

1) Literature Search: Two independent reviewers will search the relevant databases and select studies based on the inclusion and exclusion criteria. The eligible studies will be entered into NoteExpress 3.2.0.

2) De-duplication: NoteExpress 3.2.0 will be used to identify and remove duplicate studies.

3) Re-screening: Two reviewers will independently review the titles, publication years, authors, abstracts, and full texts of the studies to determine their final eligibility. Any discrepancies will be resolved by a third researcher.

4) Data Standardization and Extraction: The acupoints recorded in the studies will be standardized according to the national TCM higher education planning textbook for the 14th Five-Year Plan, edited by Liang Fanrong and Wang Hua, titled Acupuncture and Moxibustion.

2.5 Quality Assessment of Literature

The Jadad Scale is a classic tool for assessing the quality of RCTs, proposed by Jadad et al. in 1996. Based on the three principles of "randomization, control, and blinding," the scale primarily includes the following aspects: concealment of randomization; generation of the random sequence; implementation of blinding (including the acupuncturist, participants, and outcome assessors); and handling of withdrawals and dropouts. The modified Jadad Scale considers scores of 1–3 as low quality and 4–7 as high quality. The quality of the included studies was assessed independently by two evaluators, who then cross-checked their results. Any discrepancies were resolved by a third researcher.

2.6 Data Analysis Methods

1) Tools and Methods

Data were organized using Excel and then imported into IBM SPSS Statistics 26 for frequency analysis. Association rule analysis was performed using RStudio 4.4.1.

2) Frequency Analysis Method

Data were entered into Excel 2019 spreadsheets. Using Excel functions, the meridian attribution, nature, and therapeutic effects of each acupoint were sorted and statistically analyzed. The organized data were then imported into IBM SPSS Statistics 26 for frequency analysis to identify high-frequency meridians and acupoints. The results were subsequently imported into Excel to create three-line tables, summarizing the patterns of acupoint and meridian selection in acupuncture treatment for LDH. High-frequency acupoints were extracted based on different TCM syndromes or meridian differentiation, and the primary and secondary acupoints were identified for further analysis. These high-frequency acupoints were analyzed in RStudio 4.4.1 using code to more intuitively reveal the patterns of acupuncture prescriptions for LDH, such as acupoint combination principles.

3) Association Rule Analysis Method

Association Rule Mining (ARM) is a method that characterizes the associations and degrees of relationships among objects in a database, i.e., the implicit correlations in the data [5]. It consists of two main stages: first, identifying all high-frequency data from the dataset; second, mining the interrelationships among frequently occurring data [6]. Acupuncture is based on TCM theory and is used for syndrome differentiation and treatment according to the pathogenesis and symptoms. Acupoints are commonly used in pairs or groups. Association rule analysis is employed to determine the regularities between the values of two or more variables, i.e., to identify the commonly used combinations of two or more acupoint groups.

3. Data Mining-Based Research and Results

3.1 Results of Literature Frequency Analysis

1) Literature Collection

This study collected a total of 1,198 articles on acupuncture

treatment for lumbar disc herniation (LDH) published over the past decade. The distribution of articles across databases is as follows: China National Knowledge Infrastructure (CNKI) with 1,022 articles; Wanfang Data Knowledge Service Platform (WF) with 71 articles; VIP Chinese Journal Service Platform (VIP) with 61 articles; Web of Science with 18 articles; and PubMed with 26 articles.

Using the Jadad scale, the methodological quality of the included RCTs was evaluated based on parameters such as randomization, study methods, blinding type and procedures, and follow-up. The results showed that there were 212 high-quality articles, 594 low-quality articles, and 60 articles with a quality score of zero. Among all the articles, 747 studies explicitly mentioned the use of random number tables, 169 studies employed methods to prevent clinicians and participants from predicting the allocation sequence, only 31 studies used blinding, and 191 articles described the reasons for withdrawal and loss to follow-up. For details, see Table 2.

Table 2: Jadad Literature Quality Assessment

Evaluation Item	Randomization Concealment			Generation of Random Sequence			Blinding			Withdrawal and Dropout			Quality Score	
Score	2	1	0	2	1	0	0	2	1	0	1	0	1-3	4-7
Number of Articles	749	54	61	170	632	58	5	31	17	809	194	672	596	212

2) Usage of Various Acupuncture Therapies

In the literature collected for this study on acupuncture treatment for LDH, a variety of therapeutic methods were identified, which can be classified into two categories: single therapies and combined therapies. There were four types of single therapies, including needling (17.49%), electroacupuncture (6.08%), warm-needle moxibustion (7.82%), and fire-needle therapy (0.62%). Among these, needling had the highest frequency of use, while electroacupuncture achieved the highest efficacy rate at 92.37%, see Table 3.

Table 3: Frequency and Effectiveness Analysis of Various Types of Acupuncture Treatments

Therapeutic Methods	Frequency	Percentage (%)	Average Efficacy Rate (%)
Needling	144	17.49	85.10%
Warm-needle moxibustion	63	7.82	90.27%
Electroacupuncture	49	6.08	92.37%
Fire-needle therapy	5	0.62	91.89%

3) Frequency Analysis Results of TCM Syndromes

Among the collected literature with clear inclusion criteria, only 112 articles specifically identified the TCM eight-principle and zang-fu organ syndromes for LDH and provided corresponding acupoint prescriptions based on the syndromes. These articles covered four syndromes. The statistical analysis revealed the following distribution: Liver-Kidney Deficiency syndrome (12 articles, 28.57%), Cold-Damp syndrome (43 articles, 26.19%), Qi Stagnation and Blood Stasis syndrome (55 articles, 23.81%), and Damp-Heat syndrome (2 articles). Additionally, the frequency of acupoint usage across the syndromes showed that the Qi Stagnation and Blood Stasis syndrome had the highest acupoint usage frequency (452 times, 51.42%), followed by Cold-Damp syndrome (307 times, 34.92%) and Liver-Kidney Deficiency syndrome (100 times, 11.38%). For details, see Table 4.

Table 4: Frequency Analysis of TCM Syndromes

Syndrome Type	Article Count Statistics		Acupoint Usage Frequency Statistics	
	Number of Articles	Percentage (%)	Frequency of Use	Percentage (%)
Liver-Kidney Deficiency Syndrome	12	10.71%	100	11.38%
Cold-Damp Syndrome	43	38.39%	307	34.92%
Qi Stagnation and Blood Stasis Syndrome	55	49.11%	452	51.42%
Damp-Heat Syndrome	2	1.79%	20	2.28%

4) Acupoint Usage

In this study, a total of 155 acupoints were identified from the collected data, including points from the fourteen regular meridians, extra points, Jiaji points (EX-B2), and Ashi points. Among these, the top ten most frequently used acupoints were Weizhong (BL40, 615 times, 10.06%), Huantiao (GB30, 567 times, 9.28%), Shenshu (BL23, 509 times, 8.33%), Dachangshu (BL25, 450 times, 7.36%), Jiaji points (EX-B2, 447 times, 7.31%), Yanglingquan (GB34, 427 times, 6.99%), Ashi points (323 times, 5.28%), Kunlun (BL60, 310 times, 5.07%), Chengshan (BL57, 298 times, 4.87%), Zhibian (BL54, 282 times, 4.61%), Yaoyangguan (GV3, 261 times, 4.27%), and Xuanzhong (GB39, 200 times, 3.27%). All of these acupoints were used more than 200 times, as detailed in Table 5.

Table 5: Frequency Analysis of Acupoints (n≥10)

Primary Acupoints	Frequency	Percentage
Weizhong (BL40)	615	10.06
Huantiao (GB30)	567	9.28
Shenshu (BL23)	509	8.33
Dachangshu (BL25)	450	7.36
Jiaji Points (EX-B2)	447	7.31
Yanglingquan (GB34)	427	6.99
Ashi Points	323	5.28
Kunlun (BL60)	310	5.07
Chengshan (BL57)	298	4.87
Zhibian (BL54)	282	4.61

5) Analysis of Acupoint Meridian Frequency

The specific acupoints and their corresponding meridians were statistically analyzed, with the meridians ranked by frequency from highest to lowest as follows: the Bladder

Meridian of Foot-Taiyang (3,307 times, 49.73%), the Gallbladder Meridian of Foot-Shaoyang (1,444 times, 21.71%), the Governor Vessel (Du Meridian) (480 times, 7.22%), the Jiaji Points (447 times, 6.72%), the Ashi Points (325 times, 4.89%), the Stomach Meridian of Foot-Yangming (204 times, 3.07%), the Spleen Meridian of Foot-Taiyin (140 times, 2.10%), and the Kidney Meridian of Foot-Shaoyin (110 times, 1.57%). These acupoints were used more than 100 times each, with detailed results presented in Table 6.

Table 6: Frequency Analysis of Acupoint Meridian Distribution

Meridian	Frequency (Times)	Percentage (%)
Bladder Meridian of Foot-Taiyang	3307	49.73
Gallbladder Meridian of Foot-Shaoyang	1444	21.71
Governor Vessel (Du Meridian)	480	7.22
Stomach Meridian of Foot-Yang	204	3.07
Jiaji Points (EX-B2)	447	6.72
Ashi Points	325	4.89
Spleen Meridian of Foot-Taiyin	140	2.1
Kidney Meridian of Foot-Shaoyin	110	1.57
Conception Vessel (Ren Meridian)	47	0.71
Small Intestine Meridian of Hand-Taiyang	43	0.64
Extra Points	37	0.56
Liver Meridian of Foot-Jueyin	35	0.53
Large Intestine Meridian of Hand-Yangming	18	0.27
Triple Energizer Meridian of Hand-Shaoyang	11	0.17
Pericardium Meridian of Hand-Jueyin	7	0.11
Lung Meridian of Hand-Taiyin	0	0
Heart Meridian of Hand-Shaoyin	0	0

3.2 Results of Association Rule Analysis

Using RStudio 4.4.1 software and the code provided in Appendix 1, association rule analysis was performed on all acupuncture prescriptions. The parameters were set as follows: maximum antecedent number of 5, support ≥10%, and confidence ≥80%. The resulting association rules were sorted in descending order of confidence, and the top 10 rules were selected. The lift values of these top 10 acupoint combinations were all greater than 1, indicating that these combinations were statistically significant. The top three acupoint combinations by support are as follows: Weizhong (BL40) → Huantiao (GB30) (support 55.18%, confidence 83.24%), Yanglingquan (GB34) → Huantiao (GB30) (support 44.80%, confidence 86.19%), and Yanglingquan (GB34) → Weizhong (BL40) (support 44.31%, confidence 85.24%). For detailed information, see Table 7.

Table 7: Top 5 Association Rules for Primary Acupoints by Confidence

Antecedent	Consequent	Support (%)	Confidence (%)	Lift	Instances
Huantiao (GB30)	Weizhong (BL40)	57.18	83.24	1.11	462
Yanglingquan (GB34)	Huantiao (GB30)	44.80	86.19	1.25	362
Yanglingquan (GB34)	Weizhong (BL40)	44.31	85.24	1.13	358
Chengshan (BL57)	Weizhong (BL40)	33.04	90.51	1.20	267
Kunlun (BL60)	Weizhong (BL40)	32.55	87.96	1.17	263

4. Analysis and Discussion

4.1 Analysis of the Basic Situation of the Literature

Based on the statistical results of the collected literature, it can be observed that the number of clinical RCTs on acupuncture treatment for lumbar disc herniation over the past decade is substantial. This indicates that the clinical significance of acupuncture in treating lumbar disc herniation has gained increasing attention from researchers both domestically and internationally, and has been validated through numerous RCTs. From the over 4,000 articles retrieved using the search terms, the number of studies that could ultimately be included after screening was relatively limited.

Although the Jadad scale is relatively simple and brief, and may not provide the most comprehensive methodological quality assessment for clinical research trials, it remains one of the most commonly used tools for evaluating the quality of literature. Moreover, this scale has been widely applied as an effective tool for assessing the quality of clinical trial research protocols, allowing researchers to analyze the quality of literature based on trial quality outcomes. Studies have shown that, compared to other scales, the Jadad scale provides the best evidence of validity. According to the Jadad scale and its criteria, the included clinical randomized controlled trials were scored. As shown in Table 5, out of the 808 included RCTs, a significant 73.76% were rated as low quality, while only 26.23% were considered high quality, with 60 studies scoring 0 points.

In summary, the current body of RCTs on acupuncture treatment for lumbar disc herniation, both domestically and internationally, is extensive, reflecting the high level of attention from researchers. However, the quality assessment of the literature reveals that, overall, the quality of research is generally low, particularly in Chinese literature. This is mainly manifested in less rigorous trial designs, such as the lack of detailed descriptions of randomization methods, merely stating the use of random number tables or other randomization schemes, failure to mention blinding, and not documenting dropouts and their specific reasons.

4.2 Analysis of the Characteristics of Acupuncture and Moxibustion Methods

1) Trend in Literature: This study included a total of 808 prescriptions for treating sciatica using various acupuncture therapies. Among these, single therapies such as simple acupuncture, warm needle moxibustion, electroacupuncture, and fire needle therapy accounted for only 261 prescriptions, representing 32.30% of the total. In contrast, combined or complementary therapies, such as acupuncture + Chinese medicine, acupuncture + Western medicine, acupuncture + rehabilitation, acupuncture + massage, fire needle + Chinese medicine, warm needle moxibustion + Chinese medicine, electroacupuncture + rehabilitation, and electroacupuncture + Chinese medicine, totaled 547 prescriptions, making up 77.70% of the total. The literature collected over the past decade shows a relatively high proportion of studies combining multiple treatment methods for lumbar disc herniation, indicating that the current approaches to acupuncture treatment for this condition are diverse and have demonstrated superior outcomes. However, recent years have seen a greater emphasis on combining various acupuncture therapies with integrated Chinese and Western rehabilitation treatments.

2) Analysis of Total Effective Rate: Through a comprehensive

analysis of the 808 included studies, it was found that among the commonly used acupuncture therapies, the most frequently used single therapies were acupuncture, warm needle moxibustion, and electroacupuncture. The most frequently used combined therapies were acupuncture + Chinese medicine, acupuncture + massage, and acupuncture + rehabilitation. The analysis revealed that electroacupuncture had the highest total effective rate, reaching 92.37%.

3) Analysis of Literature Deficiencies: The literature review highlights several design flaws in studies on acupuncture treatment for lumbar disc herniation. First, diagnostic criteria for the disease vary widely, with different guidelines existing both between and within countries. Additionally, inconsistencies between surgical indications and non-surgical treatment criteria for lumbar disc herniation affect inclusion standards, indirectly impacting clinical outcomes. Second, the selection and number of acupoints lack a solid basis and are highly subjective. The acupoints used for treating lumbar disc herniation are often overly complex, and there is no unified approach to acupoint selection based on syndrome differentiation. Furthermore, the descriptions of treatment methods are often vague, and protocols lack consistency. For example, parameters for electroacupuncture, such as frequency, waveform, and intensity, are not detailed, undermining the credibility of the results. Similarly, for acupoint injection therapy, different studies use different types of drugs, and most clinical studies fail to specify the exact acupoint injection prescriptions, lacking rigor.

In summary, there are numerous reports on acupuncture treatment for lumbar disc herniation, with varying treatment methods. However, the results consistently demonstrate definite efficacy and the absence of side effects. Traditional Chinese medicine, particularly acupuncture, has become an effective approach for treating lumbar disc herniation. Nevertheless, current clinical randomized controlled trials still face many issues, such as inconsistent efficacy evaluation standards, non-standardized operations, and incomplete objective evaluation systems. Therefore, it remains difficult to determine which method—acupuncture, electroacupuncture, warm needle moxibustion, acupoint injection, acupoint application, or acupoint catgut embedding—holds the most advantage. Even when the same method is used, differences in efficacy evaluation standards and acupoint selection across studies lead to varying outcomes, making it challenging to identify the optimal acupoint selection and treatment protocol from the multitude of methods reported in the literature.

4.3 Analysis of Syndrome Characteristics

Traditional Chinese medicine categorizes lumbar disc herniation into four syndromes based on symptoms and etiology: Qi stagnation and blood stasis syndrome, cold-dampness syndrome, damp-heat syndrome, and liver-kidney deficiency syndrome. According to the frequency statistics from the literature, only 112 studies (13.86% of the total) explicitly mentioned syndrome differentiation and acupoint selection based on patient symptoms, while 86 studies (10.64% of the total) discussed acupoint pairing based on syndrome differentiation. The diagnostic criteria and syndrome classifications in these studies were often inconsistent and lacked detail. After unifying the syndrome descriptions, it was found that cold-dampness syndrome, blood stasis syndrome, and liver-kidney deficiency syndrome appeared most frequently. This indicates that the symptoms of low back and leg pain caused by lumbar disc herniation are generally due to external pathogenic factors such as wind, cold, dampness, or heat, or traumatic injuries leading to Qi and blood stagnation, resulting in pain. Alternatively, it may be caused by congenital kidney essence deficiency, leading to insufficient nourishment of tendons and vessels, resulting in pain. The pathogenesis is closely related to the organs, Qi and blood, and meridians. Among the organs, the kidney has the closest relationship with this condition.

The Suwen·Jinkui Zhenyan Lun states, “The north wind arises in winter, and the disease is in the kidney, with its transport point in the waist and thighs.” The Suwen·Maiyao Jingwei Lun mentions, “The waist is the residence of the kidney; if it cannot turn or shake, the kidney is exhausted.” The Suwen·Liujie Zangxiang Lun further explains, “The kidney... fills the bones.” The kidney stores essence, governs bones, and generates marrow. It is considered the “official of strength” and is responsible for the waist and legs. The strength of the waist and legs depends on the sufficient nourishment of kidney essence, indicating that low back and leg pain is a manifestation of kidney deficiency. Kidney deficiency is the internal cause, while external factors such as wind-cold invasion or traumatic injuries lead to meridian obstruction, Qi and blood stasis, and insufficient nourishment of tendons and bones, causing pain.

Early records in the Zhouli·Tianguan·Jiyi mention, “Sourness nourishes the bones,” with Zheng Xuan annotating, “Sourness is the taste of wood, and wood roots resemble bones in the ground.” Additionally, the Guanzi·Sishi states, “Wind generates wood and bones.” These ancient texts imply the TCM principle that the liver and gallbladder, which belong to the wood element and are internally and externally related, govern tendons and influence the junctions of tendons and bones. The gallbladder, receiving surplus Qi from the liver, nourishes these junctions and aids bone growth, particularly in tissues that are neither purely tendons nor bones but a combination of both.

The spleen and stomach, as the source of Qi and blood production, play a crucial role. The spleen, as the foundation of postnatal health, governs the muscles of the limbs. As stated in the Sanyin Jiyi Bingzheng Fanglun, “Loss of will harms the kidney, depression and anger harm the liver, and overthinking harms the spleen, all leading to low back pain. This is because the liver and kidney share a system, and the spleen and stomach are internally and externally related. Spleen stagnation and stomach obstruction most commonly cause low back pain.” Spleen deficiency leads to insufficient Qi and blood production, resulting in liver blood deficiency. When the spleen affects the kidney, kidney essence is impaired, leading to insufficient nourishment of tendons, bones, and muscles, causing pain. The spleen governs the transportation of fluids, and its dysfunction leads to fluid retention, forming phlegm that accumulates in the lumbar region, obstructing Qi and blood, and causing pain.

Based on association rule analysis, for kidney deficiency

syndrome, acupoints such as Taixi (KI3) and Shenshu (BL23) are often selected to tonify the liver and kidney and strengthen tendons and bones. For cold-dampness syndrome, Mingmen (GV4) and Yaoyangguan (GV3) are commonly used to warm the meridians, dispel cold, and relieve pain. For blood stasis syndrome, Xuehai (SP10) and Geshu (BL17) are frequently chosen. Xuehai, located on the spleen meridian, is associated with blood accumulation, while Geshu is related to activating blood circulation, resolving stasis, nourishing blood, regulating Qi, and relieving pain. The combination of these two points can achieve the effects of promoting blood circulation, resolving stasis, nourishing blood, regulating Qi, and alleviating pain. For damp-heat syndrome, Sanjiaoshu (BL22) and Quchi (LI11) are commonly selected.

4.4 Application of Acupoints and Meridians

1) Analysis of Acupoint Application

Data mining of modern acupuncture prescriptions for lumbar disc herniation, both domestically and internationally, revealed that 12 acupoints were used more than 200 times. These include Weizhong (BL40), Huantiao (GB30), Shenshu (BL23), Dachangshu (BL25), Jiaji points (EX-B2), Yanglingquan (GB34), Ashi points, Kunlun (BL60), Chengshan (BL57), Zhibian (BL54), Yaoyangguan (GV3), and Xuanzhong (GB39). The most frequently used meridians were the Bladder Meridian of Foot-Taiyang and the Gallbladder Meridian of Foot-Shaoyang, supplemented by Jiaji points and Ashi points.

Ge Hong's Zhouhou Beiji Fang records that Jiaji points, also known as Huatuo Jiaji points, were used by Hua Tuo based on the Huangdi Neijing for treating low back pain. The Suwen·Miuci Lun states, "When pathogenic factors invade the collaterals of the Foot-Taiyang meridian, causing spasms, back stiffness, and pain radiating to the ribs, puncture the points along the spine starting from the neck. Press quickly, and if pain is felt, puncture three adjacent points for immediate relief." This indicates that Jiaji points have long been used to treat low back pain.

Ashi points are determined based on various sensations such as "relief" or "pain." The Neijing repeatedly mentions different sensations at acupoints, such as "puncture where a lumpy sensation is felt" (Suwen·Ci Yaotong Lun) and "moxibustion where a firm, painful sensation resembling a tendon is felt" (Suwen·Gukong Lun). The concept of Ashi points is far richer than "using pain as the guide," and thus should not be simplified as such.

2) Analysis of Meridian Application

In modern randomized controlled studies, the most frequently used meridians were the Bladder Meridian of Foot-Taiyang, the Gallbladder Meridian of Foot-Shaoyang, and the Governor Vessel (Du Meridian), with frequencies of 3,307, 1,444, and 487 times, respectively. The pathways of these meridians are closely related to lumbar disc herniation.

The Huangdi Neijing·Suwen·Qijiao Bian Da Lun states, "Pain between the lower back and hips, with severe cases causing an inability to bend, as if the hips and thighs are separated." The Lingshu·Jingmai describes, "The Bladder Meridian of Foot-Taiyang... when affected, causes spine pain, a sensation of the waist breaking, an inability to bend the thighs, stiffness in the popliteal fossa, and a tearing sensation in the calves, known as ankle reversal. It governs tendon-related diseases... pain in the neck, back, waist, buttocks, popliteal fossa, calves, and feet, and dysfunction of the little toe."

The lumbar region is part of the Governor Vessel's pathway, and the Bladder Meridian runs alongside the spine, internally and externally connected to the Kidney Meridian. The Nanjing·Twenty-Ninth Difficulty states, "Diseases of the Governor Vessel cause spinal rigidity and reversal." Shen Jin'ao's Zabing Yuanliu Xizhu notes, "Many elderly people develop hunchbacks due to deficiency of the Governor Vessel and insufficient marrow." Thus, lumbar disc herniation is often attributed to Governor Vessel deficiency.

The Suwen·Gu Lun states, "Diseases of the Governor Vessel cause spinal rigidity, reversal, and low back pain with an inability to turn." The Shishi Milu records, "Pain in the spine is due to kidney water depletion, failing to nourish the brain, causing dryness and difficulty in the 'River Cart' pathway, resulting in pain." Here, the "River Cart pathway" refers to the Governor Vessel.

The Lingshu·Jingmai states, "The Gallbladder Meridian of Foot-Shaoyang... governs bone-related diseases... pain in the chest, ribs, thighs, knees, outer legs, Juegu (GB39), anterior ankles, and all joints... For such pains, excess should be reduced, deficiency should be tonified, heat should be treated swiftly, cold should be retained, and sinking should be treated with moxibustion. If neither excess nor deficiency is present, treat the meridian." The Suwen·Re Lun states, "Shaoyang governs bones."

The principles "Foot-Taiyang governs tendon-related diseases," "Foot-Shaoyang governs bone-related diseases," and "Diseases of the Governor Vessel are treated on the Governor Vessel, focusing on the bones" reflect the concept of "where the meridian passes, it governs." Therefore, treatment of lumbar disc herniation often involves acupoints from the Bladder Meridian, Gallbladder Meridian, and Governor Vessel. Although lumbar disc herniation is a modern disease named based on a series of symptoms, its etiology and pathogenesis are interconnected, and its symptoms are relatively straightforward. Thus, referencing meridian differentiation based on the location of symptoms holds significant value.

4.5 Analysis of Core Acupoints and Compatibility Patterns

1) Analysis of Main Acupoint Association Rules

Association rules, an unsupervised algorithm used to discover correlations between data attributes, were employed to identify effective acupoint combinations from a large dataset of acupoint prescriptions. Among the top 10 strong association rules for main acupoints, the combination with the highest support was Huantiao (GB30) → Weizhong (BL40), with a support of 57.18% and a confidence of 83.24%. This

indicates that Huantiao and Weizhong co-occurred in 57.18% of the prescriptions, and when Huantiao was used, Weizhong appeared 83.24% of the time. These two acupoints were also the most frequently used, and their combination synergistically promotes tendon relaxation, unblocks meridians, and alleviates lower limb pain. In summary, the Huantiao → Weizhong pairing is the most closely associated and preferred combination for acupuncture treatment of lumbar disc herniation, forming the core acupoint group.

2) Core Prescription Analysis

Without differentiating syndrome types or meridians, frequency analysis revealed the core prescription for acupuncture treatment of lumbar disc herniation to include the following 10 acupoints: Weizhong (BL40), Huantiao (GB30), Yanglingquan (GB34), Shenshu (BL23), Jiaji points (EX-B2), Dachangshu (BL25), Ashi points, Chengshan (BL57), Kunlun (BL60), Zhibian (BL54), Xuanzhong (GB39), and Yaoyangguan (GV3).

3) Rationale for Acupoint Selection

The selection of core acupoints aligns with the understanding of the pathogenesis of lumbar disc herniation by both traditional Chinese and Western medicine. In Western medicine, lumbar disc herniation is caused by degenerative changes or external forces leading to the rupture of the lumbar annulus fibrosus, resulting in nucleus pulposus protrusion and symptoms such as low back pain, sciatica, spasms, lower limb soreness, numbness, and movement disorders. In TCM, this condition is not explicitly named but is scattered across descriptions of “Bi syndrome,” “low back Bi,” “low back pain,” “low back and leg pain,” “ankle reversal,” “atrophy syndrome,” “spasm syndrome,” and “thigh wind.” TCM attributes the disease to internal factors such as kidney deficiency and external factors such as wind-cold-damp invasion or trauma, with kidney and Governor Vessel deficiency being the root cause. Pain primarily occurs along the pathways of the Bladder Meridian of Foot-Taiyang, Gallbladder Meridian of Foot-Shaoyang, and Governor Vessel.

Additionally, acupoints from the Spleen Meridian of Foot-Taiyin (e.g., Sanyinjiao (SP6)) are selected to regulate blood and Qi in the liver, spleen, and kidney meridians. Acupoints from the Stomach Meridian of Foot-Yangming (e.g., Zusanli (ST36)) are used to tonify Qi and blood while promoting blood circulation to prevent stasis. Acupoints from the Kidney Meridian (e.g., Taixi (KI3)) are employed to tonify the kidney and alleviate Bi syndrome.

Modern medicine suggests that the pathogenesis of lumbar disc herniation may involve mechanical stress injury, inflammatory factors, and neuropathic damage due to sciatic nerve compression. Clinically, this manifests as radiating pain along the sciatic nerve pathway. Weizhong (BL40), the most frequently used acupoint (615 times), is the core acupoint in the co-occurrence network and closely linked to the core prescription. As the “He-sea point” of the Bladder Meridian of Foot-Taiyang, Weizhong is where meridian Qi converges, akin to rivers merging into the sea. Huantiao (GB30), located at the intersection of the Gallbladder Meridian of Foot-Shaoyang and the Bladder Meridian, treats both low back and leg pain. Anatomically, Huantiao corresponds to the lateral thigh, near the greater trochanter, involving the gluteus maximus, sciatic nerve, and branches of the femoral artery.

In conclusion, the core acupoints and their compatibility patterns identified in the literature follow specific rules, aligning with TCM principles of syndrome differentiation, meridian-based acupoint selection, and Western medical approaches to disease treatment.

5. Conclusions

This study utilized data mining techniques to explore the clinical acupoint selection and application patterns for lumbar disc herniation, yielding the following conclusions:

1) Acupuncture treatment for lumbar disc herniation involves a variety of methods, with combined therapies being more frequently used than single therapies. Among all methods, electroacupuncture demonstrated the highest overall effectiveness.

2) A large number of acupoints are used for lumbar disc herniation. This study identified 155 acupoints, among which Weizhong (BL40), Huantiao (GB30), Shenshu (BL23), Dachangshu (BL25), Jiaji points (EX-B2), Yanglingquan (GB34), Ashi points, Kunlun (BL60), Chengshan (BL57), Zhibian (BL54), Yaoyangguan (GV3), and Xuanzhong (GB39) were used more than 200 times.

3) Data mining results indicate that the Bladder Meridian of Foot-Taiyang, Gallbladder Meridian of Foot-Shaoyang, and Governor Vessel (Du Meridian) play significant roles in acupuncture treatment for lumbar disc herniation. Stimulating these acupoints regulates the stagnation of Qi (related to nerves) and blood (related to blood stasis) in the meridians, promoting the smooth flow of Qi and alleviating symptoms of low back and lower limb pain.

4) The primary syndrome differentiations for lumbar disc herniation are liver-kidney deficiency syndrome, cold-dampness syndrome, Qi stagnation and blood stasis syndrome, and damp-heat syndrome. The core acupoints are Weizhong (BL40) and Shenshu (BL23).

5) Among the association rules, the acupoint combination with the highest support is Huantiao (GB30) → Weizhong (BL40).

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