Integrated therapy for lumbar strain in young/ middle-aged patients

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Abstract: Objective, This study aims to investigate the long-term therapeutic effects of conventional medical techniques—muscle release therapy and Pilates exercise, as well as their combination, on lumbar muscle strain in middle-aged and young patients. Methods: A total of 100 patients aged 20–50 years who visited six hospitals in Nanjing for lumbar muscle strain were randomly assigned to four groups: muscle release therapy group (Group A), Pilates exercise group (Group B), combined muscle release therapy and Pilates exercise group (Group C), and conventional acupuncture and massage therapy group (Group D), with 25 cases in each group. Each intervention session lasted 60 minutes and was conducted three times per week. The intensity of lumbar pain and lumbar spine mobility were assessed before the intervention and at 3, 6, and 12months post-intervention. Results: After three months of treatment, patients in the combined muscle release therapy and Pilates exercise group (Group C) showed significant improvements in all indicators compared to before treatment ($P<0.05$). At six months, this group continued to show significantly better outcomes than the other groups. The muscle release group (Group A) and the conventional acupuncture and massage group (Group D) had similar results, which were better than those in the Pilates exercise group (Group B). At 12 months, the combined treatment group (Group C) still had significantly better outcomes than the other groups. The Pilates exercise group (Group B) had better outcomes than the muscle release group (Group A) and the conventional acupuncture and massage group (Group D), but the differences between Group B and the other groups were not significant. The indicators of the muscle release group (Group A) and the conventional acupuncture and massage group (Group D) were similar. Conclusion: The combination of muscle release therapy and Pilates exercise is the most effective treatment for lumbar muscle strain in middle-aged and young patients.

Keywords: Lumbar muscle strain, Muscle release therapy, Pilates exercise, Core strength training, Therapeutic effect, Follow-up study

1. Introduction

The evolution of modern society has led to a shift in working patterns, with an increasing proportion of people engaging in sedentary work. Prolonged sitting often results in lumbar muscle strain, which can severely impact individuals' health, work efficiency, and quality of life. Therefore, it is of great significance to explore effective solutions to lumbar muscle strain. Theoretically, muscle strain can be alleviated by strengthening muscle strength and reducing muscle tension. However, it remains unclear whether short-term effects or long-term stable effects are better in improving and treating lumbar muscle strain. This study aims to investigate this issue through comparative experiments.

Currently, the primary medical approach used in clinical settings to reduce muscle tension is muscle release therapy. Muscle release therapy is a physical treatment technique mainly involving traction, stretching, and pressing. This method can release adhesions in muscles that cause joint stiffness and high muscle tension, increase the range of joint motion, and consequently enlarge tissue spaces. It also promotes the dilation of surrounding blood vessels and lymphatics, thereby improving local nutrition supply, enhancing metabolism, and gradually improving or restoring damaged tissues. This reduces the incidence of bone and joint diseases. When applied to strained lumbar muscles, muscle release therapy can renew blood circulation and accelerate muscle recovery. It can also reduce interference between different muscles, lower local muscle tension, decrease joint movement disorders, alleviate local pain, and effectively improve the

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terminal range of motion of the lumbar spine, thereby enhancing the effectiveness of rehabilitation treatment.

Another way to improve lumbar muscle strain is to strengthen muscle strength. Lumbar muscle strain mainly involves the abdominal muscles, namely the core muscles. Core muscles refer to the muscles surrounding the trunk, including the abdominal muscle group, hip muscle group, and muscles related to the spine and pelvis. Individuals with strong core muscles have a significantly lower probability of lumbar instability and lumbar muscle strain. In the treatment of lumbar muscle strain, core muscle strength training can effectively enhance the activity of the supportive muscles in the waist, increase lumbar muscle endurance, and thus strengthen spinal stability. This reduces the incidence of strain and is also an important measure to prevent the recurrence of lumbar muscle strain.

One of the representative methods for core muscle training is Pilates exercise. Pilates strengthens the core muscles (composed of the waist and abdominal muscles, including the transverse abdominis, internal oblique, external oblique, rectus abdominis, and erector spinae muscles). It not only improves body lines but also fundamentally enhances the overall health of the lumbar spine and corrects muscle imbalances. Pilates can strengthen muscles, maintain muscle stability and strength, and has certain effects on improving joint range of motion and functional limitations. Therefore, this study uses Pilates exercise as the second method and applies it to patients with lumbar muscle strain to observe its long-term therapeutic effects on lumbar muscle strain through targeted training of the core areas.

In summary, this study aims to explore the short-term, medium-term, and long-term therapeutic effects of conventional medical techniques—muscle release therapy, Pilates exercise, and a combination of both—on lumbar muscle strain in middle-aged and young patients.

2. Participants and methods

2.1. Participants

The participants in this study were 100 patients (an equal number of men and women, aged between 23 and 50 years) diagnosed with lumbar muscle strain by surgeons from six hospitals: Jiangsu Provincial People's Hospital, Nanjing Drum Tower Hospital, Nanjing Zhong da Hospital, Jiangsu Provincial Hospital of Traditional Chinese Medicine, Nanjing Military General Hospital, and Nanjing Hospital of Integrated Traditional Chinese and Western Medicine. The duration of their conditions ranged from 2 months to 2 years.

The diagnostic criteria for lumbar muscle strain included: chronic low back pain with recurrent episodes; soreness in one or both sides of the lumbosacral region; significant pain in one or both sides of the sacrospinalis muscles upon palpation, with no obvious impairment during general activities; and increased pain after strenuous activities, which alleviated after a period of rest.

The inclusion criteria were: age between 20 and 50 years; meeting the above diagnostic criteria; a disease duration of more than two months; a score between 2 and 10 on the Visual Analog Scale (VAS) for evaluating low back pain; willingness to accept treatment combining muscle release therapy with Pilates core training; and compliance with the arrangements of doctors and therapists, cooperating with muscle release treatment and persisting with Pilates training. If patients were undergoing other treatments such as acupuncture, Western medicine, or traditional Chinese medicine, they were required to discontinue these methods one week before the start of the study, which was considered as the lead-in period.

The exclusion criteria included: patients diagnosed or suspected of having lumbar disc herniation or congenital spinal stenosis; patients with low back pain caused by other diseases, such as osteomyelitis, tuberculous arthritis of the spine, or pain originating from organs like the bladder; patients whose specific disease could not be clearly diagnosed; patients with severe cardiovascular diseases such as congenital heart disease, or diabetes; patients who had undergone lumbar surgery or had congenital lumbar defects; patients with severe skin diseases or skin diseases at the massage site; and pregnant or breastfeeding women.

The criteria for elimination were: patients who, after being included in the study, did not follow the arrangements of doctors and therapists or did not actively cooperate with the treatment; and patients who were misdiagnosed and mistakenly included in the study.

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The criteria for dropout were: patients with poor self-discipline who could not follow the prescribed training and treatment schedules; patients who developed complications or experienced significant changes in their physiological condition during treatment; patients who voluntarily withdrew from the study for personal reasons; patients who received other treatments simultaneously due to subjective or objective reasons during the study period; and patients with incomplete follow-up records. In such cases, every effort should be made to contact the patients through phone calls, home visits, etc., to inquire about the reasons and record the situation at the time of their last treatment. Appropriate measures should be taken to complete the subsequent treatment if possible, but these cases will not be included in the study.

2.2. Research methods grouping of participants

With the assistance of relevant experts, 100 eligible patients were selected from six major hospitals in Nanjing. The intensity of low back pain was assessed using the Visual Analog Scale (VAS) score (ranging from 0 to 10), and the lumbar spine range of motion was evaluated using the lumbar activity score (see Appendix II) (ranging from 0 to 3, with lower scores indicating a smaller range of motion and more severe symptoms, and higher scores indicating a larger range of motion and milder symptoms of lumbar muscle strain; this is a reverse scoring system). Since both indicators are equally important for assessing the severity of lumbar muscle strain, to ensure balanced differences among groups during grouping, the two indicators were assigned equal weights (i.e., each accounted for 50% of the importance). Therefore, the lumbar activity score was multiplied by 3.33 to align its score range with that of the VAS (0-10). Given that the lumbar activity score is a reverse scoring system (higher scores indicate milder symptoms), the score was reverse-transformed (i.e., 10 - measured score × 3.33). The scores of the two indicators were then added together to obtain a composite score for each patient's lumbar muscle strain, calculated as follows: Composite Score = VAS Score + (10 - Lumbar Activity Score × 3.33). The patients were then ranked in descending order of their composite scores and divided into four groups using a serpentine method, with each group consisting of 25 patients to ensure that the severity of lumbar muscle strain was essentially consistent across groups. Group 1: Muscle Release Therapy Group (Group A) **: Patients received muscle release therapy, including traction, stretching, and pressing of the lumbar muscles to release adhesions and improve local nutrition supply. The treatment was conducted for 1 hour per session, three times per week. Group 2: Pilates Exercise Group (Group B)**: Patients underwent Pilates core training for 1 hour per session, three times per week. Group 3: Combined Muscle Release Therapy and Pilates Exercise Group (Group C) **: Patients received 30 minutes of manual muscle release targeting the affected lumbar muscles, followed by 30 minutes of Pilates core muscle training, three times per week. Group 4: Conventional Acupuncture and Massage Therapy Group (Group D) **: Patients received conventional acupuncture and massage therapy for 1 hour per session, three times per week.

All four groups underwent a 12-month intervention. The VAS pain score and lumbar spine range of motion were assessed at 3, 6, and 12 months to evaluate the short-term, medium-term, and long-term therapeutic effects on lumbar muscle strain, respectively. The study lasted for 12 months. After the 12-month intervention, participants were screened according to the exclusion and dropout criteria, and the number of participants in each group was standardized. A total of 80 eligible participants were selected. These 80 participants continued with their respective interventions and were tested again at 6 months (approximately 3 months after the first test) and 12 months after the start of the study to track the degree of lumbar muscle strain in each group.

2.3. Statistical methods

The statistical software SPSS 22.0 was used to process the data samples. The results are presented as mean ± standard deviation (X±S). The differences in VAS scores and lumbar spine range of motion scores before and after treatment were analyzed using F-tests and paired sample t-tests for each group.

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3. Results

3.1. Pre-Experiment comparison of experimental and control groups

Before the experiment, there were no statistically significant differences among the 80 participants in the four groups in terms of the evaluation of low back pain using the VAS, lumbar spine range of motion, or the composite score (P > 0.05, see Table 1).

Table 1 F-Test for Differences Among the Four Groups Before the Experiment

	VAS ($\bar{X} \pm S$)	Lumbar Mobility ($\bar{X} \pm S$)	Composite Score ($\bar{X} \pm S$)
Group A(N=20)	6,27±1.09	1.29±1.11	11.97±1.07
Group B(N=20)	6.39±1.22	1.30±1.17	12.06±1.15
Group C(N=20)	6.33±1.43	1.30±1.20	12.01±1.12
Group D(N=20)	6.45±1.37	1.33±1.23	12.03±1.13
P-value for Differences	0.736	0.813	0.927

3.2. Differences before and after the 3-month experiment in each group

Three months later, the VAS scores for low back pain, lumbar spine mobility, and composite scores of the four groups were compared with the values from three months earlier. Except for Group B, where the data after the experiment showed a decrease compared to the data before the experiment but the difference was not statistically significant (P > 0.05), the data of the other groups after the experiment significantly decreased compared to before, and the differences were statistically significant (P < 0.05). Particularly in Group C, the decrease after the experiment compared to before was extremely significant (P < 0.01, see Table 2).

Table 2 F-test for the Differences Between Pre- and Post-Experiment in Each Group After 3 Months of Treatment

		VAS ($\bar{X} \pm S$)	Lumbar Mobility ($\bar{X} \pm S$)	Composite Score ($\bar{X} \pm S$)
Before Treatment	Group A(N=20)	6.27±1.09	1.29±1.11	11.97±1.07
	Group B(N=20)	6.39±1.22	1.30±1.17	12.06±1.15
	Group C(N=20)	6.33±1.43	1.30±1.20	12.01±1.12
	Group D(N=20)	6.45±1.37	1.33±1.23	12.03±1.13
After Treatment	Group A(N=20)	4.93±1.47*	2.09±1.56*	7.91±1.68*
	Group B(N=20)	6.01±1.57	1.59±1.52	10.71±1.75
	Group C(N=20)	4.11±1.51**	2.32±1.62**	6.38±1.77**
	Group D(N=20)	4.73±1.55*	2.06±1.51*	7.87±1.72*

3.3. Differences among groups after the 3-month experiment

Do the four intervention methods show significant differences in their effects? We conducted a one-way analysis of variance (ANOVA) on the four groups of participants, and the results showed that the differences among the groups were statistically significant (P < 0.01, see Table 3). To further explore the differences between each pair of groups, we performed a q-test (also known as the SNK method). The results indicated that, except for the difference between Group A and Group D, which was not statistically significant (P > 0.05), the differences between all other groups were statistically significant (P < 0.01, see Table 4).

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Table 3 F-test for the Differences Among Groups After the Experiment (Ranked by Composite Score from Highest to Lowest)

	VAS ($\bar{X} \pm S$)	Lumbar Mobility ($\bar{X} \pm S$)	Composite Score ($\bar{X} \pm S$)
Group A(N=20)	4.93±1.47	2.09±1.56	7.91±1.68
Group B(N=20)	6.01±1.57	1.59±1.52	10.71±1.75
Group C(N=20)	4.11±1.51	2.32±1.62	6.38±1.77
Group D(N=20)	4.73±1.55	2.06±1.51	7.87±1.72
P-value for Differences	0.007*	0.007*	0.008*

Table 4 Q-test for Comparing the Means of the Four Groups

Comparison Groups	VAS	Lumbar Mobility	Composite Score
A Group vs. D Group	>0.05	>0.05	>0.05
B Group vs. D Group	<0.01**	<0.01**	<0.01**
C Group vs. D Group	<0.05*	<0.05*	<0.05*
A Group vs. B Group	<0.01**	<0.01**	<0.01**
A Group vs. C Group	<0.01**	<0.05*	<0.01**
B Group vs. C Group	<0.01**	<0.01**	<0.01**

3.4. Differences among groups after 6 months

The experiment continued, and the participants' low back pain evaluations and lumbar mobility scores were measured again six months after the intervention. The results showed that the differences among the four groups in terms of VAS and composite scores were statistically significant ($P < 0.05$), while the differences in lumbar mobility were not statistically significant ($P > 0.05$, see Table 5). To further explore the differences between each pair of groups, we performed a q-test (also known as the SNK method). The results indicated that, for VAS, the difference between Group A and Group D was not statistically significant ($P > 0.05$), while the differences between all other groups were statistically significant ($P < 0.05$). For lumbar mobility, only the difference between Group B and Group C was statistically significant ($P < 0.05$), while the differences between all other groups were not statistically significant ($P > 0.05$). In terms of composite scores, the difference between Group A and Group D was not statistically significant ($P > 0.05$), while the differences between all other groups were statistically significant ($P < 0.05$, see Table 6).

Table 5 F-Analysis of Data and Mean Differences Among Groups After 6 Months of Treatment

	VAS ($\bar{X} \pm S$))	Lumbar Mobility ($\bar{X} \pm S$)	Composite Score ($\bar{X} \pm S$)
Group A(N=20)	4.33±1.28	2.32±1.48	6.60±1.38
Group B(N=20)	5.15±1.34	2.16±1.44	7.96±1.39
Group C(N=20)	3.84±1.26	2.62±1.33	5.11±1.29
Group D(N=20)	4.22±1.32	2.36±1.45	6.36±1.39
P-value for Differences	0.021*	0.436	0.008**

Table 6 Q-test for Comparing the Means of the Four Groups

Comparison Groups	VAS	Lumbar Mobility	Composite Score
A Group vs. B Group	<0.05*	>0.05	<0.01**

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A Group vs. C Group	<0.05*	>0.05	<0.01**
A Group vs. D Group	>0.05	>0.05	>0.05
B Group vs. C Group	<0.01**	<0.05*	<0.01*
B Group vs. D Group	<0.05*	>0.05	<0.01**
C Group vs. D Group	<0.05*	>0.05	<0.01**

3.5. Differences among groups after 12 months

When the experiment reached the 12-month mark, the four groups of participants were tested again to evaluate the long-term differences in the effects of the four intervention methods. The results showed that there were no statistically significant differences among the groups in terms of VAS and lumbar mobility (P > 0.05), while the differences in composite scores were statistically significant (P < 0.05, see Table 7). The q-test (also known as the SNK method) for pairwise comparisons among the four groups revealed the following: For VAS, Group C had statistically significant differences compared to Groups A, B, and D (P < 0.05), while differences among the other groups were not statistically significant (P > 0.05). For lumbar mobility, Group C had statistically significant differences compared to Groups A and D (P < 0.05), while differences among the other groups were not statistically significant (P > 0.05). For composite scores, there were no statistically significant differences between Groups A and D (P > 0.05), while differences among the other groups were statistically significant (P < 0.05, see Table 8).

Table 7 F-Analysis of Data and Mean Differences Among Groups After 12 Months of Treatment

	VAS ($\bar{X} \pm S$))	Lumbar Mobility ($\bar{X} \pm S$)	Composite Score ($\bar{X} \pm S$)
Group A(N=20)	3.84±1.22	2.47±1.38	5.61±1.30
Group B(N=20)	3.67±1.34	2.66±1.32	4.81±1.33
Group C(N=20)	3.28±1.26	2.95±1.22	3.46±1.24
Group D(N=20)	3.76±1.25	2.53±1.34	5.34±1.29
P-value for Differences	0.584	0.466	0.032*

Table 8 Q-test for Comparing the Means of the Four Groups

Comparison Groups	VAS	Lumbar Mobility	Composite Score
A Group vs. D Group	>0.05	>0.05	>0.05
B Group vs. D Group	>0.05	>0.05	<0.05*
C Group vs. D Group	<0.05*	<0.05*	<0.01**
A Group vs. B Group	>0.05	>0.05	<0.05*
A Group vs. C Group	<0.05*	<0.05*	<0.01**
B Group vs. C Group	<0.05*	>0.05	<0.01**

3.6. Trends in indicator changes for four groups over one year

From the study results, it can be observed that as the intervention period extended, both low back pain and lumbar mobility improved across all groups. We created dynamic line charts for the four groups of participants to track the changes in low back pain, lumbar mobility, and composite scores over time. The VAS and composite scores of all groups gradually improved with the intervention time (see Figure 1 and Figure 3), while lumbar mobility gradually decreased (see Figure 2). Groups A and D had a very high degree of consistency. Group C was significantly better than the other groups. Group B was initially worse than the other groups at 3 and 6 months, but by 12 months, it had already surpassed Groups A and D.

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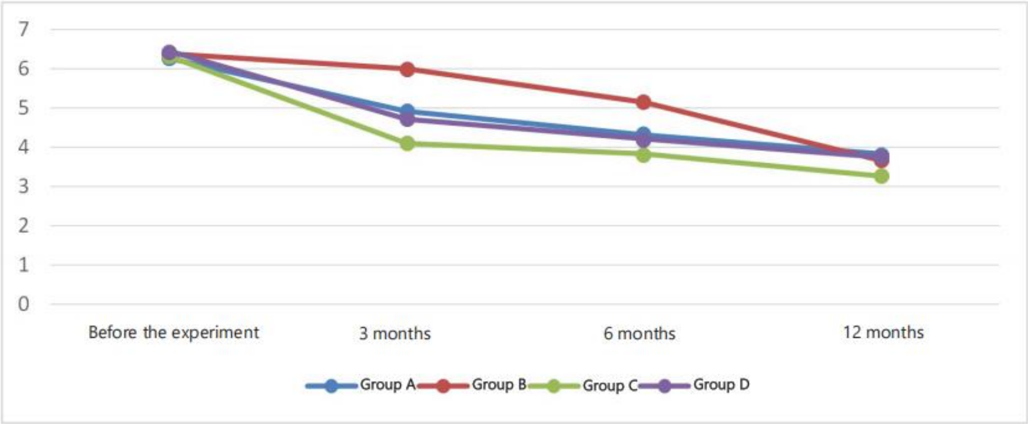

Figure 1 Trend of VAS Changes for the Four Groups of Participants During the 12-Month Treatment Period (n=80)

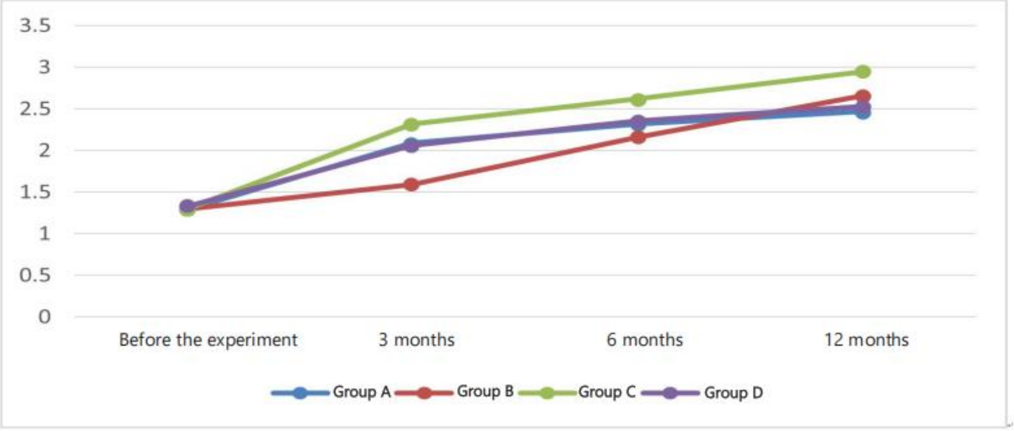

Figure 2 Trend of Lumbar Mobility Changes for the Four Groups of Participants During the One-Year Treatment Period (n=80)

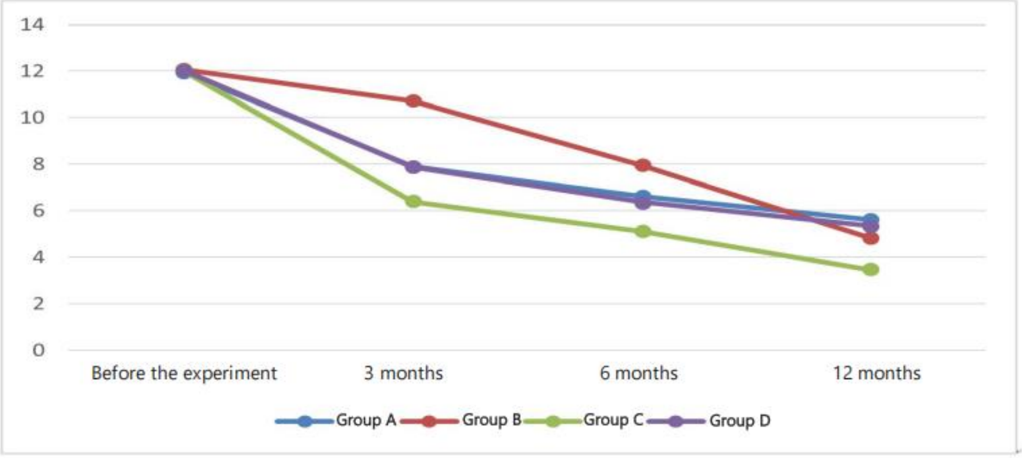

Figure 3 Trend of Composite Score Changes for the Four Groups of Participants During the One-Year Treatment Period (n=80)

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4. Discussion

4.1. Importance of intervention duration

From the research results above, it is evident that the duration of intervention is the most significant variable independent of the method used. Regardless of the method, feedback at 3, 6, and 12 months after the start of the intervention shows that low back pain is decreasing, lumbar mobility is increasing, and the composite score for evaluating lumbago is rising. This indicates that as long as patients with lumbago persist in undergoing passive medical treatments, muscle release, or active core muscle training, they can improve the degree of lumbago and ultimately eliminate it. However, many patients with lumbago lack the perseverance to do so, which is the main reason for the poor therapeutic outcomes.

4.2. Comparison of muscle release and traditional acupuncture and massage

The muscle release group and the conventional acupuncture and massage therapy group had very similar short-term, medium-term, and long-term effects. Patients with lumbago often suffer from continuous muscle tension in the lumbar region due to poor posture, leading to adhesions, inflammation, pain, and restricted lumbar mobility. Both conventional acupuncture and massage therapy and muscle release techniques work by releasing the adhered muscle tissues, increasing the range of joint movement, thereby expanding the tissue spaces and promoting the dilation of surrounding blood vessels and lymphatics. This process improves local nutrition supply, enhances metabolism, and gradually improves or restores damaged tissues, ultimately reducing inflammation. Although conventional acupuncture and massage therapy can improve pain and restricted lumbar mobility in lumbago patients, the cost of continuous treatment is high, including medical expenses and time costs (time spent on treatment and travel). The high dropout rate in the conventional acupuncture and massage group in this study also indicates that adherence to this method is relatively poor. Additionally, the uneven distribution of medical resources exacerbates the problem. In the past, rehabilitation departments were only available in tertiary hospitals, leading to overcrowding and delays in treatment. Now, some community hospitals have started to add rehabilitation programs, and private rehabilitation hospitals have emerged, which to some extent alleviates the shortage and tension of medical resources.

4.3. Accessibility and cost-effectiveness of muscle release

Muscle release is a common technique in both medical and sports fields. Unlike traditional acupuncture and massage, this intervention can be obtained in market-oriented institutions such as massage parlors, personal trainers at gyms, or even through self-learning and self-application. Therefore, it is more accessible and less costly in terms of both time and money compared to traditional hospital-based treatments. The market demand for this approach is expected to grow significantly in the future, indicating a vast potential for the integration of sports and medicine.

4.4. Effectiveness of pilates core strength training

The Pilates core strength training in Group B showed less effectiveness in the early and medium stages compared to the muscle release and traditional acupuncture and massage groups. However, at the 12-month mark, it had surpassed the other two methods. Before inflammation is reduced or eliminated and muscle adhesions are released, patients undergoing core strength training can improve local circulation and accelerate metabolism, but the range and intensity of movement are limited. Therefore, the enhancement of core muscle strength is also limited. As a result, core strength training alone cannot achieve anti-inflammatory and pain-relieving effects in the short term, nor can it significantly enhance core muscle strength. Its effectiveness in improving lumbago is inferior to the other three methods. However, as core strength training continues, local microcirculation gradually improves, inflammation dissipates, and core muscle strength increases. This enhances the ability to counteract muscle strain and adhesions caused by poor posture, reducing the likelihood of secondary lumbago. Therefore, at the 12-month follow-up, significant improvements were observed in pain and restricted lumbar mobility, surpassing the muscle release and traditional acupuncture and massage groups. Whether this method will eventually outperform the combination of muscle release and core strength training requires further research.

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4.5. Combined approach of muscle release and pilates exercise

The group that combined muscle release with Pilates exercise showed the most significant short-term, medium-term, and long-term effects. Muscle release addresses local muscle adhesions and inflammation, while Pilates exercise focuses on strengthening and stabilizing the lumbar muscles. This dual approach of treatment and prevention yields remarkable results. The findings of this study indicate that the integration of sports and medicine is an effective way to treat lumbago. Among the four methods, the most effective ones are sports-based, followed by the second most effective at the 12-month follow-up. The effects of traditional acupuncture and massage are similar to those of muscle release alone. In terms of convenience and cost-effectiveness, non-medical sports methods have a clear advantage.

4.6. Role of sports colleges in integrated treatment

Sports colleges can play a significant role in the integrated treatment of lumbago and other chronic lifestyle-related diseases such as cervical spondylosis. Within these institutions, majors such as sports rehabilitation and rehabilitation therapy could offer relevant courses. Muscle release techniques should already be included in these programs. However, the current curricula may lack a focus on core muscle training and other sports-related aspects. Students have not systematically learned or mastered sports training methods through coursework. This was also verified by one of the authors' internship experiences at the rehabilitation department of a tertiary hospital in Nanjing, where only one professional with expertise in sports rehabilitation was available, and this individual had studied abroad. In other words, in China, the "sports" aspect of the "sports rehabilitation" major mainly relies on methods such as occupational therapy to assist patients. However, for ordinary people or patients with mild conditions and minor functional impairments, how to use sports methods to guide them in fitness and focus more on the "sports" aspect of "sports rehabilitation" remains a gap in the current training programs of sports colleges. At Nanjing Institute of Physical Education, the school currently addresses this deficiency through voluntary, fee-based short-term fitness coach training programs. The authors hope that this content can be incorporated into future curricula to reduce students' financial burden. Systematic coursework is likely to be more effective than short-term concentrated training.

5. Conclusion

The combination of muscle release techniques and Pilates exercise is the most effective treatment for lumbago in middle-aged and young patients. In the short and medium term, muscle release alone and traditional acupuncture and massage therapy are superior to Pilates exercise. However, in the long term, Pilates exercise outperforms both muscle release and traditional acupuncture and massage. Therefore, for middle-aged and young patients with lumbago, short-term treatment can rely on muscle relaxation or anti-inflammatory medications, while long-term treatment may benefit more from strengthening the core muscles.

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