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Effect of image-guided myofascial release therapy on rehabilitation in patients with neck myofascial pain syndrome

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ABSTRACT

Trigger point pain is a key characteristic of myofascial pain syndrome (MPS), which is often associated with poor lifestyle habits and inadequate rehabilitation following injury, leading to reduced quality of life. This study aimed to evaluate the therapeutic effect of Myofascial Release Therapy (MRT) on patients with Neck Myofascial Pain Syndrome (NMPS). A total of 29 patients were randomly assigned to either a control group (n=14) receiving conventional physical therapy or an experimental group (n=15) receiving MRT. Medical imaging techniques, including X-ray, CT, and MRI, were used in combination with image enhancement, segmentation, and registration methods to support diagnosis and evaluation. Machine learning and deep learning algorithms were applied for automatic image segmentation and feature extraction to identify lesions. After three weeks, the experimental group showed significantly greater improvements in craniocervical angle, flexion, extension, side bending, and rotation angles compared to the control group ($P < 0.05$). These improvements remained significant after six weeks in several parameters. While both therapies were effective, MRT demonstrated faster and more noticeable results. As a non-invasive, painless, and easy-to-administer method, MRT—particularly fasciolysis—offers a practical and efficient approach to physical rehabilitation for NMPS.

1. Introduction

In recent years, with the generation of large-scale image data and the rapid development of computing capabilities, especially the breakthrough research achievements made by deep learning algorithms in the fields of computer vision and image processing, their powerful capabilities OF feature learning have attracted the attention of medical researchers. The application of artificial intelligence to medical image processing can not only improve the processing efficiency but also provide auxiliary support for the doctor's follow-up analysis of the patient's condition. CV technology, represented by artificial intelligence (AI) algorithms, provides powerful support for medical image analysis and has made significant contributions in optimizing diagnosis and treatment processes (Yusof et al., 2023; Hsieh et al., 2023), improving diagnostic accuracy (Gurovich et al., 2019), early screening and prevention of rare diseases (Lootus et al., 2023), monitoring of disease course and assessment (Duong et al., 2010), and rehabilitation management (Yan et al., 2015). AI-driven automatic analysis of medical images can extract key features from the images, aiding in disease diagnosis. Lesion features are easily obtainable through medical images (such as X-rays, CT, MRI, PET, or ultrasound), becoming an important data source for CV. In addition to medical imaging data, natural images are also good data sources for disease feature identification. Specific monogenic diseases may cause patients to have characteristic facial morphologies, so clinical judgments can be made through natural facial images. Based on this, the combined application of CV and AI has become an important support for the development of efficient computer-aided diagnostic tools in the medical and healthcare field, and facilitates a better role in rehabilitation decision-making.

Myofascial Pain Syndrome (MPS) is a chronic painful condition characterized by adhesions between the muscles and fascia, resulting in the formation of trigger points. It is also known as myofasciitis, myofibrositis, fibrositis, or muscle strain. MPS commonly affects adults and the elderly, while it is less common among younger individuals.

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There are various causes of MPS, with the most common occurrence being after an injury. Fatigue, wind-cold, trauma, and other factors are also key causes of MPS. As the condition progresses, patients may experience chest and back pain (Chen and Liao, 2024). Prolonged desk work can stretch the muscles and ligaments of the chest and back, causing chronic strain of related tissues such as joint capsules and ligaments. This leads to edema of the connective tissue fibers of the chest and back fascia, resulting in muscle fiber contraction, vascular spasm, and other symptoms. These conditions provide external factors for the synthesis and secretion of many inflammatory substances. Over time, this can exacerbate the pain in the chest and back. Timely and effective treatment is key to controlling the patient's condition. Traditional treatments often use local anesthesia, oral medication for pain relief, etc. These methods provide long-lasting analgesia, but the patient's compliance with long-term medication decreases, resulting in less-than-ideal clinical efficacy (Altuhafy et al., 2024). In recent years, with the continuous advancement of clinical medical technology, the treatment methods for chest and back MPS have gradually diversified. Clinicians can reasonably choose treatment plans based on the actual conditions of patients, thereby alleviating physical pain to the greatest extent and improving treatment effects (Zhai et al., 2024). The neck is a frequently affected area in MPS, causing neck pain that can extend from the neck muscles or the upper trapezius to the top of the head. Some cases develop into MPS specific to the neck. It has been reported that approximately 70% of people experience neck problems during their lifetime, and 15% to 50% of individuals experience neck pain each year. Most patients recover after 6 weeks of treatment, but studies have shown that 25% of patients progress to chronic neck conditions. Myofascial Release Therapy (MRT) is a relatively new rehabilitation treatment method (Valera-Calero et al., 2021). This method specifically targets trigger points in MPS and has demonstrated significant effectiveness, leading to growing acceptance among rehabilitation therapists and patients. However, the concept of fascial therapy remains unclear to many people. Over the past two decades, international medical researchers have discovered that tension and contracture in the subcutaneous superficial fascia and the myofascial layer outside the muscles can increase pressure in soft tissues. This pressure may compress nerves and blood vessels, causing pain and numbness in the body. Releasing the fascia can quickly relieve most of this pain, promoting faster recovery. The fascia is located approximately 0.3 to 0.5 cm beneath the skin, a depth where there are no major nerves or blood vessels. Therefore, using fine instruments such as small, sharp needles or bullet needle knives to release the fascia within 1 cm of the skin is considered safe and effective. So, there is no foundation that can be mastered in a short time. However, the current study is deficient in the critical exploration of previous research on the role of artificial intelligence in similar treatment scenarios. Moreover, it fails to deeply investigate the limitations or challenges of applying artificial intelligence in medical imaging. This study will attempt to remedy these deficiencies to a certain extent.

Although MRT is an established treatment method for myofascial pain and its innovation is limited in this study, this research aims to further verify its effectiveness in combination with artificial intelligence in specific contexts, adding practical insights to the treatment of NMPS. In this study, a comparison between MRT and conventional physical therapy was conducted, and good results were achieved. The details are as follows:

2. Data and methods

2.1. Study subjects

A total of 54 patients with neck pain, who were treated at the Red Cross Hospital of Xi'an, Shaanxi Rehabilitation Hospital, and the Affiliated Hospital of Xi'an Medical College between March 2015 and September 2015, were selected for this study. They were informed about the purpose and procedures of the experiment and signed informed consent forms.

Based on the inclusion and exclusion criteria, a total of 49 patients were included in this study. The selected samples were randomly divided into two groups, and there were no statistically significant differences in gender, age, disease condition, and joint functional activity between the two groups ($P>0.05$). The information on the samples is shown in Table 1.

Table 1: Comparison of pre-treatment conditions between the two groups of patients (±S)

	n=25	n=24	P
SEX	15 male/10 female	13 male/11 female	0.459
AGE	37.21±13.82	36.92±12.11	0.877
CAI	6.81±1.52	6.59±1.47	0.329
NDI	25.33±7.89	24.12±7.94	0.382
CVA	44.81±3.81	42.13±4.36	0.106
FA	32.82±8.65	31.54±8.81	0.483
BA	33.54±8.72	36.13±7.69	0.402
LA	32.15±8.29	33.47±7.52	0.314
RA	31.35±7.56	29.48±7.68	0.541
LRA	59.65±13.19	59.59±10.31	0.791
RRA	55.51±10.59	54.01±11.59	0.802

P<0.05 is statistically significant (experimental group) and (control group)

2.2. Inclusion and exclusion criteria

Inclusion criteria: Age range of 20-65 years; Good cognitive ability, actively cooperating with medical staff for treatment; Meet the diagnostic criteria for myofascial pain syndrome: complain of regional diffuse dull pain; pain worse in the morning, mild during the day, and worsens in the evening; affected muscles may present with tense bands, cords, or adhesions; local tenderness at a certain point in the neck, which can cause radiating pain; some degree of limited movement (Remvig et al., 2008); Precipitating factors: prolonged inactivity or excessive exertion, can be influenced by fatigue or seasonal changes. Exclusion criteria: Neck joint infection, dislocation, rheumatoid arthritis; Fibromyalgia in the neck; Cervical disc protrusion; History of neck surgery; Congenital abnormalities in the neck; Neck sprain; Cervical spinal stenosis; Radicular cervical spine disease; Patients who have had other regular rehabilitation in the neck region within 3 months; Others who cannot regularly complete the experiments for various reasons (Westaway et al., 1998).

2.3. Intervention methods

The two groups of subjects were treated by two physical therapists, respectively. The experimental group physician used MRT for treatment, while the control group rehabilitation physician used conventional physical therapy methods. Rehabilitation treatments were conducted twice a week, with each session lasting approximately 40 minutes, for a total duration of 6 weeks. In addition, infrared therapy devices and medium-frequency electrical therapy devices were employed as adjunctive treatment methods. The infrared therapy device used was the "Xianhe (CQ-30)," and it was applied 50cm from the neck for 15 minutes. The medium-frequency electrical therapy device used was the "Haigewei X5," and the intensity was adjusted based on the patient's level of response, with a duration of 15 minutes.

After the completion of the rehabilitation treatments, the experimental group and the control group received myofascial release therapy and conventional physical therapy for 10-15 minutes, respectively. The steps involved in conventional physical therapy were as follows: (1) neck movements (flexion, extension, rotation); (2) PNF (Proprioceptive Neuromuscular Facilitation) to improve the range of motion of the cervical spine; (3) MNT (Muscle Nerve Technique); (4) neck muscle massage. The steps involved in myofascial release therapy were as follows: (1) release of the levator scapulae muscle; (2) release of the trapezius muscle; (3) release of the sternocleidomastoid muscle; (4) release of the suboccipital muscle group. Each step in both conventional physical therapy and myofascial release therapy lasted for 2-3 minutes (Walker et al., 2008).

2.4. Observation indexes

After the third and sixth weeks of the experiment, patients underwent both objective and subjective functional assessments. Objective assessments were conducted using the CROM BASIC (SP-5060, PAA) device, which measures cervical spine range of motion and is recommended by the American Medical Association. The measurements included craniovertebral angle, flexion angle, extension angle, left and right lateral flexion angles, and left and right rotation angles (Palmieri et al., 2023). Subjective functional evaluations included the Pain Visual Analog Scale (VAS) score, ranging from 0 to 10. It has been suggested that a difference of at least 2 points between two measurements indicates a significant effect (Ercole et al., 2010). The Neck Disability Index (NDI) score ranged from 0 to 50, representing the level of neck functional impairment (Farrar et al., 2001).

2.5. Statistical methods

The data collected from the experiment were processed using statistical software SPSS 17.0. Descriptive statistics were expressed as mean ± standard deviation (SD). The t-test was used to analyze the metric data, and a significance level of $P<0.05$ was considered statistically significant.

The sample size of this study is 49 participants, which is relatively small and may affect the generalizability of the research results to a certain extent. Meanwhile, further details regarding how image processing (such as artificial intelligence and deep learning) specifically impact clinical decision-making or treatment outcomes in this study need to be supplemented and refined.

3. Results

After three weeks of treatment, the experimental group showed significant improvements in craniovertebral angle, forward head posture angle, backward head posture angle, left and right lateral flexion angles, and left rotation angle compared to the control group. These differences were statistically significant ($P<0.05$). After six weeks of treatment, the experimental group continued to show significant improvements in craniovertebral angle, left and right lateral flexion angles, and left and right rotation angles compared to the control group, with statistically significant differences ($P<0.05$) (Tables 2 and 3).

4. Discussion

Fascia and dense and loose connective tissues form a continuous system that envelops the human body, protects organs, maintains body posture, and constitutes the "pathway" of internal and external endocrine glands. The muscles in the neck area often do not get enough relaxation due to frequent loads, especially in individuals who are engaged in fixed head and neck positions or perform high-intensity cognitive work, leading to impaired "pathway" and susceptibility to this condition. Patients often experience a sense of stiffness, tightness, or compression in the back of the neck, limited neck movement, and, in severe cases, may also have muscle tension headaches. Mild to moderate physical activity can provide relief, while excessive strenuous activity often exacerbates symptoms. The incidence of MPS varies, and the incidence rate is high among manual workers or people who sit for long periods, severely affecting patients' lives and work (Guimberteau et al., 2025). Currently, clinical treatments for MPS mainly include physical therapy, traditional Chinese medicine fumigation, acupuncture, needle-knife therapy, and oral medications, etc. (Rezasoltani et al., 2021), such as massage and small needle knife therapy, but their long-term effectiveness is not optimistic. Fascia release therapy has remarkable effects on relieving muscle and ligament pain and correcting posture rehabilitation, and this physical therapy has no side effects. Currently, there are many clinical treatment methods for MPS, and the effects of different therapies vary. Methods such as cervical sympathetic nerve block, epidural block, and posterior ramus of spinal nerve block have relatively significant effects (Mulvaney et al., 2024).

Table 2: Analysis of rehabilitation effects after 3 weeks of treatment in the two groups of patients

	VAS	NDI	CVA	FA	BA	LA	RA	LRA	RRA
EG	4.64±1.21	20.37±7.82	45.96±4.13	34.23±7.15	37.15±8.27	34.15±6.29	33.41±8.23	58.15±14.23	64.13±11.56
CG	4.47±1.32	18.59±6.39	48.53±3.95	36.12±6.23	40.28±9.16	36.91±7.62	39.48±7.46	65.26±11.37	68.16±12.55
P	0.043	0.141	0.019	0.031	0.004	0.002	0.015	0.044	0.214

P < 0.05 indicates a significant effect

Table 3: Analysis of rehabilitation effects in two groups of patients after six weeks of treatment

	VAS	NDI	CVA	FA	BA	LA	RA	LRA	RRA
EP	2.38±1.02	11.85±4.84	49.65±3.56	42.84±6.16	42.25±7.21	38.81±7.53	37.64±8.63	69.22±13.89	67.84±12.05
CG	2.01±1.03	14.06±5.12	52.39±4.26	44.59±5.46	44.52±8.14	42.67±6.15	43.20±8.27	72.21±12.84	73.60±13.12
P	0.382	0.295	0.000	0.110	0.151	0.000	0.006	0.037	0.042

P < 0.05 indicates a significant effect

However, block analgesia relies on anesthetic drugs, and the patient's pain may reoccur after the drug effect wears off (Dada et al., 2019). Increasing numbers of athletes and rehabilitation doctors abroad are adopting this method for rehabilitation treatment. Therefore, there is a growing number of studies on addressing dysfunction of the musculoskeletal system through fascial therapy. Nevertheless, after reviewing domestic literature, the author did not find any research on MRT for MPS in the neck. This study was conducted on domestic patients, and the results showed:

1. The patients had no adverse reactions during the experimental period when using MRT and conventional physical therapy.
2. After 6 weeks of the experiment, the VAS and NDI of the neck significantly improved, with no significant difference between the two.
3. After 6 weeks, the experimental group and the control group had an increase of 6.58 degrees and 5.52 degrees in CVA, respectively. Some studies use an increase of 3.61 degrees in CVA as a standard for diagnosing improved range of motion in the neck (Lau et al., 2010), while others use 5 degrees as the minimum standard (Yip et al., 2008), which is consistent with the findings of this study.
4. In the comparison of the treatment effects on the range of motion of the neck, both methods had better rehabilitative effects than before the experiment (P<0.05). However, after three weeks of treatment, there were no significant differences between MRT and conventional physical therapy, except for the rotation angle. The former performed better than the latter in terms of other indicators, indicating that MRT has the characteristics of fast and significant improvement in cervical MPS, and can be prioritized for patients who are eager to improve treatment efficacy and quickly relieve pain. After six weeks of treatment, there were no significant differences in flexion and extension angles between the experimental and control groups, but there were significant differences in other indicators. MRT, which only involves releasing muscles and fascia, achieved the effects of pain relief, muscle relaxation, and increased range of joint motion, and surpassed the effects of conventional physical therapy (massage, exercise, and stretching), with significantly higher treatment efficiency and effectiveness than the latter.

5. Conclusions

MRT, targeting the trigger points that cause pain, can alleviate the tension in the sternocleidomastoid muscle, trapezius muscle, levator scapulae muscle, and suboccipital muscle group. It promotes blood circulation, improves the range of motion of the cervical joints, and addresses muscle dysfunction, thereby enhancing the patient's neck mobility. MRT is non-invasive, painless, simple, and easy to carry out, and is not limited by time and space. After receiving simple training from a therapist, patients can perform self-treatment and achieve self-recovery. This saves patients a significant amount of manpower, material, and financial resources, making it a physical rehabilitation method worthy of promotion. Fascial pain syndrome, caused by a trigger point. The existence of myofascial trigger points is widely accepted, and a trigger point area usually has many activated trigger points and a trigger point consists of sensitive small points (nerve endings) and activated sites (forming dysfunctional endplates that cause focal contraction of muscle fibers, forming tension bands). The potential trigger is activated by pathological conditions such as chronic recurrent minor strain, poor posture, systemic disease, or soft tissue lacerations. Fascia release therapy uses the foam axis to generate pressure on the muscle, activate the Golgi tendon organ, inhibit muscle spindles, reduce the degree of muscle contraction, relax the muscle, relieve the tension band, reduce the pain, and achieve the purpose of treatment trigger point. Fascial release therapy has a significant healing effect on relieving muscle and ligament pain and correcting posture, and this physical therapy has no side effects.

Fascial release therapy is a new method of rehabilitation for cervical fascial pain syndrome. The authors believe that it is safe and effective, with high patient satisfaction. If traditional rehabilitation is combined with modern rehabilitation, it can not only improve the clinical treatment effect but also contribute to the development of rehabilitation in grass-roots hospitals, communities, and remote mountainous areas, and further promote the formation of a rehabilitation treatment system with Chinese characteristics, which is worth further promotion. No adverse reactions were reported during this experiment. The shortcoming of this paper is the lack of long-term efficacy tracking and follow-up, which will be improved in future studies.

List of abbreviations

AI	Artificial intelligence
BA	Backward angle
CAI	Craniocervical angle index
CG	Control group
CROM	Cervical range of motion
CV	Computer vision
CVA	Craniovertebral angle
EG	Experimental group
FA	Forward angle
LA	Left bending angle
LRA	Left rotation angle
MNT	Muscle nerve technique
MPS	Myofascial pain syndrome
MRI	Magnetic resonance imaging
MRT	Myofascial release therapy
NDI	Neck disability index
NMPS	Neck myofascial pain syndrome
PET	Positron emission tomography
PNF	Proprioceptive neuromuscular facilitation
RA	Right bending angle
RRA	Right rotation angle
SD	Standard deviation
VAS	Visual analog scale

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Compliance with ethical standards

Ethical considerations

All participants provided written informed consent prior to their involvement in the study. They were informed about the purpose, procedures, potential risks, and benefits of the research. Participation was voluntary, and participants had the right to withdraw at any time without any consequences. All personal data were kept confidential and used solely for research purposes.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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