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Analysis of Treatment and Rehabilitation of Medial Tibial Stress Syndrome

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Abstract. Medial tibial stress syndrome(MTSS) is a wide range of pain in the medial tibial region, caused by frequent stress on the tibia. It is commonly seen in athletic populations that are overtrained, the symptoms worsen during exercise, and can interfere with daily life in severe cases. Thus, treatment and rehabilitation are very important for recovery to normal sport and daily life, and appropriate methods can promote recovery and prevent recurrence. This paper mainly explores the treatment method of traditional Chinese medicine and the traditional, common and latest treatment and rehabilitation of Western medicine. The results show that rest, ice, nonsteroidal anti-inflammatory medicines and compression are still the main treatments. The effect of Chinese medicine may be better than Western medicine. In the rehabilitation period, strengthening muscle strength and providing a functional support can improve biomechanics and promote patients' recovery. This paper may be able to provide a reference for research on the various treatment and rehabilitation methods in the future. It has great significance in the recovery of patients with MTSS.

Keywords: Medial tibial stress syndrome, treatment, rehabilitation.

1. Introduction

MTSS is the most common overuse injury, caused by frequent pressure on the muscles and bones surrounding the tibia, which constantly tightens the connective tissue connecting the muscles, bones, and tibia, resulting in pain in the posterior medial margin of two-thirds of the distal tibia [1,2]. MTSS is common in the early stages of exercise due to the sudden increase in training intensity or the long-term and high-load training of athletes. Patients with mild symptoms can be relieved after rest, but patients have severe symptoms still feel pain at rest, which can affect daily activities.

The main treatment methods for MTSS in China are external treatment with traditional Chinese medicine and local multi-point injection therapy with platelet-rich plasma. External treatment of Chinese medicine includes acupuncture and moxibustion, massage, cupping, fumigation and bloodletting, and the external treatment of Chinese medicine is cheap and convenient [3]. Due to being able to solve the MTSS radically, it has a better effect than other methods and can reduce the rate of recurrence. Local multi-point injection therapy of platelet-rich plasma also has a better effect in relieving the pain. Compared with foreign countries, the research on the treatment in China is still few and single, and lacks research into the rehabilitation methods of MTSS.

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The treatment of MTSS abroad is divided into two parts: non-surgical treatment and surgical treatment. Non-surgical treatment includes conservative treatment methods, Graston technique, extracorporeal shock wave therapy (ESWT), prolotherapy and New Physical Therapy. Surgical treatment mainly includes deep posterior fascial compartment incision and periosteal release. But surgical treatment is not a common method to treat MTSS. The rehabilitation of MTSS includes functional exercise and functional support. Functional exercise includes hip abductor training and lower-leg exercises. Functional support includes elastic foot orthosis and kinesiology taping (KT). Functional exercise is used to strengthen muscles strength and functional support is used to improve biomechanics. These methods can both solve the problem in a radical way, which involves body structure to relieve the symptoms and prevent recurrence. All in all, the treatment and rehabilitation are different in foreign and more mature countries. But in the research progress at home and abroad, MTSS always uses non-surgical methods to treat. Just consider the surgical treatment when patients have severe, repeated symptoms or the non-surgical treatment is not very effective [4].

MTSS is the most prevalent exercise-related injury. This injury is very common in running, football and basketball. It can affect many people's daily exercise for a year. So early diagnosis and treatment of this injury are very important. Otherwise, it will limit patients' daily exercise and increase the recurrence rate. This injury can influence patients' participation in sports and daily life. So an effective treatment and rehabilitation method is very important. It can relieve the symptoms, promote their recovery, prevent recurrence and let them go back to sports more quickly. Therefore, this article aims to integrate various treatment and rehabilitation methods, providing a reference for exploring comprehensive rehabilitation treatment models, developing personalized treatment and rehabilitation methods, and exploring the most effective treatment frequency and intensity in the future.

2. Treatment methods for medial tibial stress syndrome

2.1. Conservative treatment methods

In the acute phase of medial tibial stress syndrome (MTSS), rest, ice, nonsteroidal anti-inflammatory drugs and compress bandaging are commonly used to alleviate symptoms, with rest and ice and nonsteroidal anti-inflammatory drugs accounting for 40.1% of all treatment methods [5]. Multiple studies have shown that rest is the preferred option, as repeated stress caused by overtraining is one of the causes of MTSS, and rest can alleviate this stress. Therefore, when patients feel hurt, the duration of rest can be determined by recording the degree of pain [2]. After exercise, apply ice to the affected limb several times a day for 20 minutes each time, but avoid direct contact with the skin to prevent frostbite [2]. Nonsteroidal anti-inflammatory drugs can alleviate pain symptoms, while compression bandaging prevents sustained swelling of the affected limb by securing it with a bandage [2].

2.2. Graston technique

The Graston technique has significant benefits for the treatment and rehabilitation of athletes and ordinary patients with long-term, repeated injuries. This technique is one of the methods of instrument-assisted soft tissue mobilization (IASTM), which improves tissue blood circulation and enhances fascial mobility through specific instruments to solve tissue adhesion problems [6,7]. Overtraining can cause MTSS and soft tissue damage, and during the process of soft tissue recovery, fibrosis and scar tissue can be produced, leading to reduced local blood supply [6]. Glaustone

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technology applies pressure to the affected limb through instruments, which can increase blood supply, remove scar tissue and adhesions, thereby reducing pain, promoting tissue regeneration, and restoring normal range of joint movement. But its effectiveness in relieving pain and improving limb function is not as good as cupping therapy [8].

2.3. External treatment of traditional Chinese medicine

The conventional Western medicine treatment for MTSS mainly involves rest, ice packs, nonsteroidal anti-inflammatory drugs and pressure bandaging. Although these methods can temporarily alleviate pain symptoms, they are difficult to fundamentally treat inflammatory lesions of muscles and periosteum, resulting in a higher recurrence rate for patients after resuming exercise. In contrast, traditional Chinese medicine external treatment methods are based on the etiology and pathogenesis of diseases, and have significant advantages such as convenient operation, low cost, precise efficacy, and low recurrence rate. They have demonstrated unique value in the clinical intervention of MTSS. In the theoretical system of traditional Chinese medicine, MTSS belongs to the category of "muscle injury". The core pathogenesis of this disease is a deficiency of positive qi and invasion of external pathogens, resulting in blockage of the meridians and obstruction of qi and blood circulation [3]. The pathological basis of its main clinical manifestations is "pain when blocked"[3]. Based on this, the external treatment of traditional Chinese medicine focuses on strengthening vital energy, dredging muscles and collaterals, and promoting qi to relieve pain [3].

2.3.1. Acupuncture

Acupuncture and moxibustion therapy can dredge muscles and collaterals, promote qi circulation and relieve pain through acupuncture at specific points related to MTSS lesions. The clinical research of (without specifying the year) aimed at young runners. The intervention program of acupuncture at Yanglingquan, Yangjiao, Juegu and other acupoints was compared with conventional treatment. The results showed that the acupuncture and moxibustion group was significantly better than the control group in terms of pain degree, MRI grading, quality of life score, pain-free running mileage and other indicators [3]. A study combined the classic acupoints of Chinese medicine with the acupuncture and moxibustion technology of the interosseous membrane, and confirmed that the analgesic effect of the combined scheme was better than that of the single therapy[9]. To sum up, acupuncture and moxibustion can not only effectively improve pain symptoms, promote the recovery of limb functions and improve the quality of life, but also have a lasting effect [3].

2.3.2. Massage

Tuina therapy uses various techniques to act on specific parts and acupoints of the body surface, achieving the treatment goals of regulating tendons, unblocking collaterals, reducing swelling, and relieving pain, demonstrating unique advantages in the treatment of motor system diseases. Related studies have shown that guasha therapy in tuina has a high cure rate for MTSS [3]. When massage and acupuncture and moxibustion are combined, the curative effect is significantly better than that of single massage or single acupuncture and moxibustion [3]. Further research has confirmed that the combination of massage and other therapies is more effective in relieving symptoms and improving motor function than monotherapy, and can help MTSS patients reduce pain, restore exercise ability, and accelerate their return to normal life in the short term [3].

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2.3.3. Cupping

Cupping therapy uses cups as tools to create negative pressure through combustion and exhaust, which acts on specific parts of the human body to cause local skin congestion, thereby promoting blood circulation, relieving muscle tension, and reducing pain. The study showed that cupping therapy exhibited superior therapeutic effects in multiple clinical evaluation indicators of MTSS [10]. Multiple studies have confirmed that when cupping is combined with other traditional Chinese medicine external treatment methods, it can further enhance the therapeutic effect [3]. Therefore, cupping therapy can not only effectively alleviate the clinical symptoms of MTSS and accelerate swelling resolution, but its synergistic effect with other therapies can also enhance overall treatment efficacy.

2.3.4. Fuming and washing

The fumigation and washing therapy uses the warm liquid produced by boiling traditional Chinese medicine to expand local blood vessels, promote blood circulation, and effectively penetrate diseased tissues by opening pores, exerting the effects of promoting blood circulation, removing blood stasis, reducing swelling, and relieving pain. The study confirmed that the combination of ultra short wave therapy and traditional Chinese medicine fumigation and washing is significantly more effective than pure ultra short wave therapy, indicating that fumigation and washing therapy has important complementary value in the comprehensive treatment of MTSS [3].

2.3.5. Bloodletting therapy

Bloodletting therapy uses instruments such as triangular needles, thick needles, or small needle knives to act on specific acupoints to unblock tendons, reduce swelling, and relieve pain. Research has shown that when combined with other therapies, bloodletting therapy is more effective in treating MTSS than single bloodletting therapy [3]. In clinical practice, a combination of bloodletting and cupping is often used to enhance the effectiveness of bloodletting [3]. This combination can improve the one-time cure rate and has a positive effect on relieving pain and promoting motor function recovery [3].

2.4. Local multi-point injection therapy of platelet-rich plasma

Platelet-rich plasma comes from patients' blood and is obtained through whole blood centrifugation to obtain platelet concentrate. It contains various growth factors that can alleviate inflammatory reactions, so it will not cause self-rejection and is highly safe. A study compared the pain level, single-leg jumping distance, and recovery of exercise between two groups of patients with PRP and triamcinolone acetonide. The results showed that the PRP group had milder pain, longer jumping distance, and more people resumed exercise within a fixed time [11]. Therefore, multi-point injection of PRP can alleviate pain, promote tissue repair, shorten recovery exercise time, and have fewer complications [11].

2.5. Prolocherapy

Prolotherapy involves injecting a 15% glucose solution under ultrasound guidance, which transmits pain signals to damaged tissues through permeation, reducing pain and providing conditions for early rehabilitation treatment [12]. Patients with persistent MTSS symptoms were treated with

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proliferative therapy, and the comparison of pain severity, subjective recovery, and exercise regression levels showed that its analgesic and symptom relief effects were significantly better than baseline [12]. Among various rehabilitation treatments, this therapy can make patients' symptoms milder during the recovery period of exercise (i.e., the "painless period"), and can help patients recover to preoperative exercise levels in the medium to long term, even exceeding preoperative levels in the long term [12]. Therefore, it is suitable for people who plan to resume exercise or engage in specific sports activities.

2.6. Extracorporeal shock wave therapy (ESWT)

Extracorporeal shock wave therapy is a non-invasive treatment. Thus, it has low side effects and is safe. ESWT can use different types of shock waves, frequencies and intensities to customize different treatment schemes for different patients. ESWT is achieved through the vibration generated by the shock waves acting on the tissue, which have biological effects. Then, it can achieve the purpose of promoting tissue healing and relieving the pain [13]. This method is always used for patients who are ineffective for conservation treatment [13]. This method’s effect is better than invasive treatment for patients who want to continue practicing sports after injury [13]. ESWT combined with other treatment and rehabilitation methods will have a better effect than single methods. This therapy allows patients to continue exercising within their pain tolerance range; it is a safe choice for seasonal athletes and contributes to early functional exercise and limb recovery.

2.7. New physical therapy and surgical treatment

The new physical therapy integrates multiple intervention measures, including non-load bearing foot contact mode adjustment, cupping, stretching training, cryotherapy, transcutaneous electrical nerve stimulation (TENS) and muscle strength enhancement training [10]. The research results indicate that cryotherapy, TENS and muscle strengthening training have significant effects on pain improvement; Non non-weight-bearing foot contact adjustment, cupping, and stretching training can effectively alleviate discomfort symptoms in the affected limb, thereby enhancing the intervention effectiveness of overall rehabilitation training. Clinical practice has confirmed that this new physical therapy can not only improve the functional status and athletic performance of athletes' affected limbs, but also effectively curb the progression of MTSS in the acute phase. The study emphasizes the need to develop personalized new physical therapy plans based on individual disease characteristics in order to maximize symptom relief and patient activity and functional abilities [10]. At present, the surgical treatment methods for MTSS mainly include deep posterior fascial compartment incision and periosteal release. Clinical data show that the vast majority of MTSS patients can achieve clinical rehabilitation through non-surgical treatment, and surgical treatment is only used as a second-line intervention, limited to patients with poor non-surgical treatment outcomes or severe symptoms [2].

3. Rehabilitation methods for medial tibial stress syndrome

3.1. Hip abductors training

Weak hip abductors are the main cause of dynamic genu valgus and contralateral pelvic ptosis, which are related to MTSS. If can strengthen the hip abductors through specific training, it will improve the symptoms to achieve long-term therapeutic effects and reduce the recurrence rate. A study compared traditional physical therapy with hip abductor training and physical therapy alone

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[14]. To test the frontal plane projection angle (FPPA), dynamic knee valgus and the contralateral pelvic drop angle during the single-leg /step-down [14]. The result shows that hip abductor training can decrease the frontal plane projection angle (FPPA), dynamic knee valgus and the contralateral pelvic drop angle can be decreased to improve the biomechanics of the affected limb and improve the long-term prognosis. So, through hip abductor training, it can change the potential muscle weakness and motor dysfunction to reduce the risk of recurrence of MTSS.

3.2. Lower-leg exercises

Lower-leg exercise is always recommended to treat MTSS. MTSS is related to excessive foot pronation, reduced lower-leg girth, navicular bone to go down, hip external rotation, height of the spine, iliac and lateral length of the trochanteric tibia. An abnormal foot is one of the reasons for MTSS. But lower-leg exercise can improve foot posture to improve the quality of life. A study compares the effect of using the application of multi-mode training combined with lower-limb training with just using multi-mode training [15]. To evaluate the degree of pain, quality of life, dynamic foot posture, static foot posture and self-perceived at baseline, sixth weeks and twelfth weeks. Low-leg exercise includes short foot sensorimotor exercise, foot invertor muscle strengthening, plantarflexor muscle strengthening, toe curl exercise, gastrocnemius muscle stretching, soleus muscle stretching and calf muscle release [15]. The result shows that using the application of multi-mode training combined with lower-limb training can improve foot posture and quality of life. Because lower-leg training can reduce foot internal rotation, enhance lower leg muscle strength to reduce the influence of daily life and reduce the recurrent rate. So, it is an effective way to treat and prevent MTSS. Meanwhile, the research shows that adding arch support or foot orthosis during lower-leg training can relieve pain and MTSS severity earlier and more effectively to achieve a better therapeutic effect. So this method was encouraged to join the rehabilitation training program [15].

3.3. Elastic foot orthosis

Excessive foot internal rotation, arch collapse and other foot abnormalities are one of the reasons for MTSS. Through customized foot orthosis, the foot condition can be improved, the symptoms can be relieved and patients can be encouraged to return to their daily life. Due to different individuals having different foot conditions, in the period of treatment and prevention, paying more attention to the arch of the foot is very important [16]. A weak arch power will increase the hardness of the muscle in the sport and increase foot load. Then, applying stress to the tibia leads to MTSS. And a weak foot arch will increase the first-time and recurrence rate of MTSS. An elastic foot orthosis can give the arch effective support to improve biomechanics. And reduce the hardness of muscles and stress [16]. However, most research focuses on the effect of elastic foot orthosis on one of the causes of MTSS. This therapy may be a useful and convenient intervention in preventing overuse injuries.

3.4. Kinesiology taping (KT)

In recent years, KT has always been used for the treatment and rehabilitation of sports injuries. KT is accepted because it can improve muscle flexibility, provide effective support and improve sports performance. KT has some elasticity; it can provide certain traction assistance to the tissues at the application site to ensure the flexibility and stability of the affected limb. Meanwhile, these features can also increase the space between each tissue and promote blood circulation and lymph return

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flow [17]. According to the research of Ramteke SU et al., KT can help MTSS recovery by preventing the navicular bone from going down and decreasing the foot pressure during running [17]. This method is very effective in solving the problem in biomechanical aspects. This research also shows that KT can relieve pain, promote proprioception and correct abnormal biomechanics [17]. But currently, the research about justifying the effectiveness of using KT to heal MTSS is a little less.

4. Conclusion

This paper shows that there are various treatment and rehabilitation methods for patients to treat MTSS. The paper shows that rest, ice, nonsteroidal anti-inflammatory medicines and compression are still the main treatments, but with the development of the treatment and rehabilitation of MTSS, researchers have explored many new methods that can reduce the symptoms, improve the recovery and prevent the recurrence these days. According to the research, through comparison, it is found that Chinese medicine has a certain effect in treating MTSS, even better than Western medicine. And compared with the single method, the joint method is more effective. Rehabilitation includes functional exercise and functional support. Patients can strengthen their muscles through functional exercise, use KT to reduce foot pressure and use foot orthosis to reduce muscle stiffness. These are both through changing biomechanics to reduce the frequent stress on patients' legs and reduce the recurrence rate. Combining treatment and rehabilitation has a better effect on recovery. In the rehabilitation period, combining functional exercise and function support has a better rehabilitation effect than just using a single method. This paper researches the treatment and rehabilitation of MTSS in the past five years. To provide a reference for the research related to the treatment and rehabilitation of MTSS. But it still has some limitations. The effect of the combination of more than two methods is not clear. Some methods have not been widely used in the study of patients with MTSS, so the effectiveness remains to be verified. The research object is single. The grouping methods are limited. The sample size is small. The evaluation index is not comprehensive. There are no long-term studies, so the efficacy of long-term treatment can not be verified. In the future, people can explore the model that integrates treatment and rehabilitation for MTSS. Combine with monitoring equipment to explore the model and the effect of personalized treatment and rehabilitation. Explore the best intensity and frequency of intervention of a certain treatment or rehabilitation method.

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