

Traditional and Modern Rehabilitation Therapies of Ankle Sprains

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Abstract. The ankle joint is one of the main weight-bearing joints of the body. In the joint sprains, ankle sprains are the most familiar type. The ankle sprain is a damage to the ligaments surrounding the ankle joint and is commonly seen in athletes, paratroopers, sports enthusiasts and other groups. In the last few years, many researchers have executed studies on the treatment of ankle sprains, but there are still relatively few studies that summarize the discussion of ankle sprain treatment methods. This article presents the efficacy of traditional and modern rehabilitation therapy in ankle sprains by summarizing previous studies, aiming to promote the development of ankle sprain treatment research. Traditional rehabilitation treatment for ankle sprains includes tuina, acupuncture, fire pot and Chinese herbs-related treatment. Tuina therapy is conducive to peeling off adhesions, regenerating tendons and promoting the repair of damaged muscle tissues. Acupuncture can promote metabolism, accelerate absorption, and relieve the stimulation of various metabolic products on the sprained area. Modern rehabilitation therapies include physiotherapy, exercise, manual, and orthopedic therapy. Physiotherapy is the action of artificially generated or naturally available physical factors on the human body to prevent or treat diseases. Exercise therapy can promote joint fluid flow, facilitate local blood flow, and accelerate the absorption of inflammatory factors and the metabolism of cartilage.

Keywords: Ankle sprain, Traditional rehabilitation therapy, Modern rehabilitation therapy.

1. Introduction

Sports injuries are a common, occurring injury during sports exercise or actions. They can cause by accidents, bad training techniques, excessive use of fixed body parts, insufficient training apparatus. Sports injuries can affect a patient's athletic performance and level of function. With the increase in the level of competitive sports and the widespread development of national fitness and sports and leisure, sports injuries are becoming more and more common. Among sports injuries, acute serious injuries such as fractures and joint dislocations are relatively few, and the two together account for about 3% of sports injuries, while a large number of injuries to ligaments, muscles, tendons, joint capsule and articular cartilage and other chronic soft tissue micro-trauma [1]. After a sports injury, the main goals of the patient's rehabilitation are to achieve the level of function before they injury, return to play safely and prevent recurrence of the injury [2].

The ankle is one of the major weight-bearing joints of the body. In the joint sprains, ankle sprains are the most familiar type. Ankle sprains account for approximately 30% of all sports injuries and are the largest cause of prolonged absence from competition activities [3]. It can have varying degrees of impact on athletes, ranging from minor effects on athletic performance to recurrent swelling and pain in the ankle, resulting in chronic ankle instability, which can affect careers [4].

This article focuses on the efficacy of traditional and modern rehabilitation methods in ankle sprains, with the aim of promoting the development of research in the therapy of ankle sprains.

2. Background

Fibula, tibia and talus are the three main bones of the ankle joint. A downward projection on the distal inner side of the tibia is called the medial ankle, and a projection on the distal side of the fibula is called the external ankle. The four most important ligaments in the ankle (as the picture shows) are the deltoid ligament, anterior talofibular ligament, calcaneal ligament and posterior talofibular

ligament. The deltoid ligament is located in the inner ankle and is tougher than the ligament in the outer ankle, making it relatively less likely to be injured (Fig. 1).

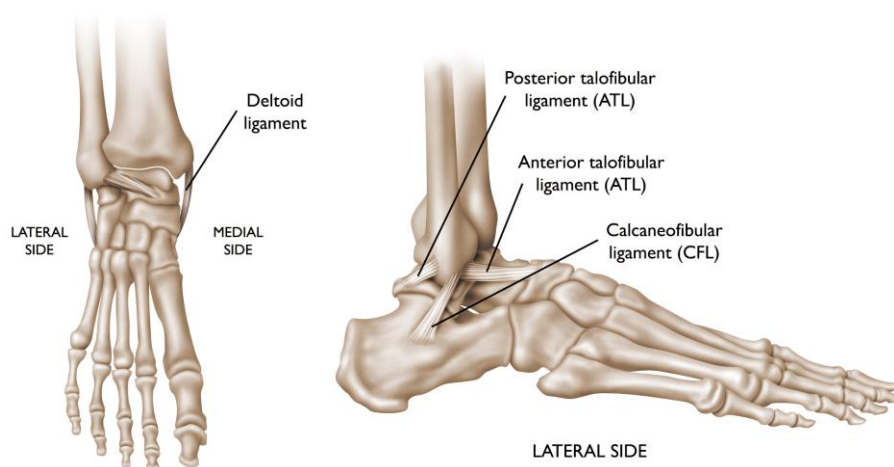


Figure 1. The anatomy of ankle joint

The ankle sprain is a damage to the ligaments surrounding the ankle joint, which are accountable for the stable of the ankle joint. Severity is determined by a combination of the number of ligament injuries and the degree of damage to the ligaments. Ankle sprains are commonly seen in groups such as athletes, airborne soldiers, and sports enthusiasts [5]. It is often accompanied by ligament damage, localized pain, swelling, skin bruising, restricted movement and abnormal walking, which have an impact on people's daily life [6].

There are three types of ankle sprains, namely external ankle sprains, internal ankle sprains and high ankle sprains. External ankle sprains are injuries of the ankle due to inversion stress, internal ankle sprains are damage of the ankle caused by valgus stress, and high ankle sprains are damages due to valgus and dorsiflexion stress. Among them, external ankle sprains occurs most frequently, taking American college athletes as an example [7], from 2005 to 2006, among all athletes with ankle sprains, lateral ligament injuries accounted for 83.4%. Injuries to the lateral ankle ligaments are classified into three grades: degree I (mild), degree II (moderate) and degree III (severe) based on their severity. In degree I, the ligament is loose, no obvious tear, no local swelling and pressure pain, normal or mild loss of function; in degree II, the ligament is partially torn, with swelling, pain, pressure pain and partial loss of function; in degree III, the whole ligament is ruptured, with obvious pain and swelling and unstable of the ankle joint [8].

In addition, depending on the time of the ankle sprain, it can be separated into three periods, they are the acute, intermediate and chronic periods. The acute phase is common within 48 hours of the ankle sprain and common presents with extreme pain and different degrees of swelling, high skin temperature, subcutaneous bruising, and decreased joint motion. The middle stage is usually within 3 days to 2 weeks of the sprain and shows a reduction in pain, swelling and subcutaneous bruising, but the joint movement is still limited. The chronic phase is 2 weeks after the sprain, often showing gradual elimination of pain, most of the swelling and subcutaneous bruising subsided, and most of the ankle function recovered, but a few patients have a long recovery period, long-term local vague pain, instability of the ankle joint and easy to sprain and swelling repeatedly [9-10].

3. Traditional rehabilitation therapy for ankle sprains

In Chinese medicine, ankle sprains are classified as "tendon injuries", mainly due to damage to the arteries in the ankle joint, resulting in swelling and pain, bruising, and poor ankle movement due to blood stasis [11]. Traditional rehabilitation treatment for ankle sprains includes tuina, acupuncture, fire pot, moxibustion, external application of Chinese herbs, external washing of Chinese herbs, internal use of Chinese herbs, and fumigation of Chinese herbs and so on [9]. However, because the

principles and effects of each treatment method are different, the period of time for treating ankle sprains is also different. This study focuses on the efficacy of tuina therapy and acupuncture therapy.

3.1. Tuina therapy

Tuina therapy improves the blood flow in microcirculation, accelerating the transfer and degradation of active substances in the body and promoting the excretion of inflammatory substances. It is conducive to peeling off adhesions, regenerating tendons and promoting the repair of damaged muscle tissues, thus providing fast, functional recovery, short recovery period and reducing after-effects [12].

Many studies have proven that tuina is effective in treating ankle sprains. Huang chose 160 patients with ankle sprains from one university and stochastic separated them into an treatment group and a control group. Among them, the treatment group was used massage combined with functional exercise to treat patients, and the control group was adopted functional exercise only. The American Orthopedic Foot and Ankle Society (AOFAS) score and soft tissue injury efficacy criteria were used to compare the treatment effects. The outcomes indicated that the AOFAS scores of the treatment group were considerably better than the group which only treated with functional exercise, and the excellent soft tissue injury efficacy rate of the treatment group was greatly higher than that of the control group, and the distinction were statistically notable ($P < 0.05$) [12]. Wu recruited a total of 35 persons with ankle sprains and then used Tuina massage techniques to treat them, and the overall effective rate was 94.29% [13]. In an efficacy observation study, 60 patients with ankle sprains were stochastic separated into a conventional group and an intervention group. Moreover, the conventional group was adopted electromagnetic wave combined with acupuncture treatment, and the intervention group was treated with tendon and bone setting manipulation combined with acupuncture treatment. The outcomes indicated that the treatment efficiency of the intervention group was greatly higher than that of the conventional group, and the distinction was statistically marked ($P < 0.05$) [14].

However, in the acute phase of ankle sprains, massage therapy should be used with caution or not, because in this phase, the small blood vessels might rupture and bleed, forming a hematoma, which usually takes about 24 hours to recover. In the acute stage, the main purpose is to activate blood and reduce swelling; in the recovery period, stronger stimulation techniques can be used [10]. If the sprain is immediately rubbed, hot-packed, and forced to move the ankle joint, it could definitely accelerate the bleeding and exudate of the sprained part, and even aggravate the rupture of blood vessels and form a bigger hematoma, so the overly heavy manipulation could cause secondary injury to the ankle joint.

3.2. Acupuncture therapy

Acupuncture can effectively activate the endogenous analgesic system to increase the content of opioids substances in the body and exert analgesic effects; it can also reduce the blood exudation condition at the injury site through neuro-humoral regulation, promote metabolism, accelerate absorption, and relieve the stimulation of various metabolic products on the sprained area. Acupuncture has obvious advantages in treating ankle sprains, as it can regulate qi and blood and unblock the meridians by stimulating the relevant acupoints, thus promoting the flow of qi and blood in the injured area and restoring the functional activities of the ankle joint [15].

In an efficacy observation study, 80 patients with ankle sprains were stochastic separated into a control group and a treatment group, with forty patients in every groups. The control group was given the conventional acupuncture method of electrothermal acupuncture, and the treatment group was given the Qi-acupuncture method of electrothermal acupuncture. The final outcomes pointed out that the degree of pain in both groups was reduced compared with that before treatment, but the treatment group was better; the ankle joint ability scores of the two groups were compared, and the treatment group was well than the control group, and the distinction was statistically marked ($P < 0.05$) [16]. In a clinical effectiveness study by Zhang, he performed acupuncture therapy on 68 patients with ankle sprains. The results showed that 60 patients were healed, with a healing rate of 88.23%, 8 patients

with a significant rate of 11.76%, and 0 patients with no effect, for a total effective rate of 100% [17]. Jiang et al. applied the method of penetrating pricking plus electroacupuncture sparse wave to treat 27 cases of old ankle sprain, and argued that the healing rate was 62.96% and the improvement rate was 37.04%, with good efficacy [18].

However, acupuncture treatment should be performed with great caution in patients with ankle sprains in the acute phase, when there is a possibility of internal bleeding from the ankle joint. It is unsuitable for patients who are afraid of needles and are sensitive to pain.

4. Modern rehabilitation therapy for ankle sprains

Modern rehabilitation medicine believes that most simple acute ankle ligament injuries tend to be treated with non-surgical methods. In the acute phase, the main focus is on anti-inflammation, analgesia and prevention of secondary ligament injury, while in the repair and remodeling phase, the main focus is on increasing range of motion (ROM), strengthening muscle strength, accelerating healing and improving proprioception and ankle function [19]. Most modern rehabilitation therapies are based on the "PRICE" principles (P: protection, R: rest, I: ice, C: compression, E: elevation), reinforcement of external fixation dressings and improvement of joint function.

However, in terms of specific treatment, different scholars have different advocates. One part of scholars emphasizes the importance of ligament protection and advocates early fixation. Another group of scholars believes that for ankle injuries, early joint movement is more important than joint bracing, and that functional treatment is better than external fixation in terms of restoring ankle function and excellent rate [20]. Modern rehabilitation therapies include physiotherapy, exercise therapy, manual therapy, and orthopedic therapy. This study focuses on physiotherapy and exercise therapy in modern rehabilitation therapy.

4.1. Physiotherapy

Physiotherapy is the abbreviation of physical factor therapy, which is the action of artificially generated or naturally available physical factors on the human body to prevent or treat diseases. Physiotherapy is divided into two main categories, one is the therapy based on various physical factors, including water, heat, sound, light, electricity, magnetism and so on, and the other is the therapy based on functional training and manual therapy. Because the properties of each physical factor are different, each physiotherapy method has its own function and usage, and even the same physiotherapy method can have different effects depending on its parameter values.

Today's physiotherapy treatments are varied and include Cryotherapy, thermal therapy, electrical therapy, Kinesio Taping and joint mobilization. Although there is a wide variety of physiotherapy treatments, not all of them are suitable for ankle sprains. For example, thermal therapy is unsuitable for ankle sprains in the acute stage because it can speed up blood flow and accelerate bleeding and hematoma formation in the affected area [10].

In the study by Cruz-Díaz et al., they achieved significant improvement in patients' dorsiflexion range of motion with chronic ankle sprains through 3 weeks of joint mobilization intervention, and the effect was maintained during the subsequent 6 months of follow-up [21]. Shu et al. argued that Kinesio Taping technique treatment could improve the balance control ability and the function of the corresponding muscle groups in patients with lateral ankle ligament injury and accelerate the recovery of the injured. A total of 90 people with ankle sprain were selected and separated into an experimental group (group A), placebo group (group B), and control group (group C) according to the random number table method, with 30 cases in each group. Group C received conventional rehabilitation exercise training, while groups A and B were given Kinesio Taping technique treatment and tension-free white patching treatment, in addition to conventional rehabilitation training [22]. Yin holds that the Kinesio taping did not have a significant immediate effect on kinesthetic, sensory integration and voluntary dynamic postural control in patients with chronic ankle instability, but the Kinesio taping

and motor white taping provided effective support in response to sudden perturbations of the support surface [23].

4.2. Exercise therapy

Exercise therapy can promote the flow of joint fluid, facilitate local blood flow, accelerate the absorption of inflammatory factors and the metabolism of cartilage [24], thus relieving the pain caused by ankle sprains and improving the ROM of the ankle joint. Exercise therapy can improve the prognosis of ankle injuries by evaluating and treating the impairment of movement caused by the injury. In addition, exercise therapy is more beneficial to the elderly for rehabilitation and prevention of osteoporosis.

Exercise therapy can be divided into active, passive, and resistance exercise according to the source of power, and functional ankle training includes ankle muscle strength training, endurance training, balance training, proprioceptive training, etc. [25]. Sekir et al. tested 24 amateur athletes with functional ankle instability and found that isometric plyometric training contributed to the recovery of muscle strength and proprioception in the peri-ankle muscle groups in patients with ankle unstable [26]. In a randomized clinical trial, 27 patients were randomly separated into treatment and control groups, with the treatment group receiving proprioceptive training combined with trigger point dry needling and the control group receiving proprioceptive training alone. The results showed that the degree of postural deviation and joint position awareness improved, and proprioceptive training combined with trigger point dry needling could help patients with chronic ankle instability to improve proprioceptive function and prevent re-torsion of the ankle joint [27]. Zhao treated 50 patients with ankle inversion injuries with resistance training rehabilitation therapy. The results showed a significant reduction in pain, significant improvement in ankle mobility and a significant growth in muscle strength of the ankle flexors and extensors in the patients [28].

Currently, numerous traditional rehabilitation methods for treating ankle sprains have definite efficacy and low adverse effects. However, inconsistent intervention methods, inconsistent assessment criteria, and too much reliance on personal experience are still shortcomings. At the same time, although modern rehabilitation methods have been proven to be effective by many studies, the related treatment methods have been somewhat contradictory in similar studies. Therefore, future research on ankle sprains should focus on developing systematic intervention methods and assessment criteria and finding more effective treatment methods. In addition, in recent years, sports injuries are increasingly common with the improvement of the level of competitive sports and the widespread development of national fitness, sports and leisure. Therefore, it is essential to vigorously perform publicity and education on sports injuries and prevention, so that people know how to effectively prevent the occurrence of sports injuries and how to seek medical attention and avoid secondary injuries after the happening of injuries, to decrease the happening of sports injuries and reduce the impact of sports injuries on people's daily lives.

5. Conclusions

The ankle is one of the major weight-bearing joints of the body. In the joint sprains, ankle sprains are the most familiar type. Ankle sprains account for approximately 30% of all sports injuries and are the biggest cause of prolonged absence from competition activities. Ankle sprains are common among athletes, paratroopers, and sports enthusiasts, and are often accompanied by ligament damage, local pain, swelling, skin bruising, restricted movement, and abnormal walking, which affects people's daily life. If the initial ankle sprain is not treated in a suitable way or in a timely manner, it will delay the treatment and worsen the injury. If scientific care is not carried out after treatment, the treatment effect could be reduced, and there might even be long-term ankle swelling, pain, restricted joint activities and easy to sprain repeatedly. With the development of rehabilitation medicine, the treatment of ankle sprains has become diverse, but there are differences between each treatment method. Each method has its suitable stage, suitable people and its contraindications. This article

focuses on the efficacy and positive impact of traditional and modern rehabilitation methods in ankle sprains, with the aim of promoting the development of research in the treatment of ankle sprains.

Traditional rehabilitation treatment for ankle sprains includes tuina, acupuncture, fire pot, moxibustion, external application of Chinese herbs, external washing of Chinese herbs, internal use of Chinese herbs, and fumigation of Chinese herbs and so on. Among them, tuina therapy is conducive to peeling off adhesions, regenerating tendons and promoting the repair of damaged muscle tissues, thus providing fast functional recovery, short recovery period and reducing after-effects. However, in the acute phase of ankle sprains, massage therapy should be used with caution or not, because, in this phase, the small blood vessels might rupture and bleed, forming a hematoma, which usually takes about 24 hours to recover. Acupuncture can reduce the blood exudation condition at the injury site through neuro-humoral regulation, promote metabolism, accelerate absorption, and relieve the stimulation of various metabolic products on the sprained area. However, it is unsuitable for patients who are afraid of needles and are sensitive to pain.

Modern rehabilitation therapies include physiotherapy, exercise, manual, and orthopedic therapy. Physiotherapy is the action of artificially generated or naturally available physical factors on the human body to prevent or treat diseases. Although there is a wide variety of physiotherapy treatments, not all of them are suitable for ankle sprains. For example, thermal therapy is unsuitable for ankle sprains in the acute stage because it can speed up blood flow and accelerate bleeding and hematoma formation in the affected area. Exercise therapy can promote joint fluid flow, facilitate local blood flow, and accelerate the absorption of inflammatory factors and the metabolism of cartilage, thus relieving the pain caused by ankle sprains and improving the ROM of the ankle joint.

References

- [1] Zhou Mouwang. The history and prospect of sports trauma rehabilitation in China [J]. Chinese Journal of Rehabilitation Medicine, 2019: 885-887.
- [2] Ni Guoxin. Issues related to sports injury rehabilitation practice [J]. Chinese Journal of Trauma. 2022, (06): 487-491.
- [3] Dizon JM, Reyes JJ. A systematic review on the effectiveness of external ankle supports in the prevention of inversion ankle sprains among elite and recreational players [J]. Journal of Science and Medicine in Sport, 2010, 13(3): 309-317.
- [4] Fong, Daniel Tik-Pui, et al. A systematic review on ankle injury and ankle sprain in sports [J]. Sports medicine, 2007, 37: 73-94.
- [5] Waterman BR, Belmont Jr PJ, Cameron KL, et al. Epidemiology of ankle sprain at the United States Military Academy [J]. American Journal of Sports Medicine, 2010, 38(4): 797-803.
- [6] Huang Zhiping. Understanding and treatment of ankle sprain in Orthopedics Department of traditional Chinese Medicine [J]. World's latest medical information Digest, 2018, 60: 2.
- [7] Nelson AJ, Collins CL, Yard EE, et al. Ankle injuries among United States high school sports athletes, 2005-2006 [J]. Journal of Athletic Training, 2007, 42(3): 381-387.
- [8] Guan Guoping, Meng Qiang, Niu Wenxin, et al. Research progress on protection and rehabilitation of ankle sprain [J]. Journal of Medical Biomechanics, 2016: 82-86.
- [9] Xie Dongming, Li Yinghe, He Zhenquan. Brief analysis of the diagnosis and treatment of ankle sprain by acupuncture and massage [J]. Clinical Journal of Chinese Medicine, 2016: 42-43.
- [10] Xie Yan. Rehabilitation of ankle sprain [J]. Modern Distance education of Chinese Medicine, 2008: 53-54.
- [11] Wang Yingyun. Clinical study on the treatment of acute ankle sprain with three ankle needles combined with puncture cupping [D]. Guangzhou University of Chinese Medicine, 2018.
- [12] Huang Yawen. Clinical observation of massage combined with functional exercise in the treatment of III degree acute lateral ankle collateral ligament injury caused by exercise [J]. Modern Preventive Medicine. 2012: 269-271.

- [13] Wu Fengming. Treatment of 35 cases of ankle sprain by manipulation [J]. Journal of External Treatment of Traditional Chinese medicine. 2007, 16: 1.
- [14] Liang Guofu. Observation on the effect of acupuncture combined with strengthening and bone-setting manipulation on old ankle sprain [J]. Journal of Clinical Medicine Literature, 2019: 27-28.
- [15] Li Ke, Wu Lei. A brief discussion on the experience of acupuncture treatment of ankle sprain [J]. Chinese Journal of Folk Therapy, 2019: 108-109.
- [16] Chen Zhuangna, Xiong Jun, Huang Shilong. Observation on the effect of different acupuncture therapy on old ankle sprain [J]. Inner Mongolia Traditional Chinese Medicine, 2020: 91-92.
- [17] Zhang Zuan. Clinical effect of acupuncture therapy on ankle sprain [J]. China Health Standard Management, 2015: 103-104.
- [18] Jiang Yinghua, Lu Yu. Treatment of 27 cases of old ankle sprain by penetrating acupuncture and electroacupuncture with dense wave [J]. Journal of Practical Chinese Medicine, 2019, (08): 1020-1021.
- [19] Dubin, Joshua C., et al. Lateral and syndesmotric ankle sprain injuries: a narrative literature review [J]. Journal of chiropractic medicine, 2011, 10: 204-219.
- [20] Yang Jianrong. Progress in rehabilitation treatment of acute ankle sprain [J]. Foreign Medical Science (Medical Geography), 2016.
- [21] Cruz-Díaz D, Lomas Vega R, Osuna-Pérez MC, et al. Effects of joint mobilization on chronic ankle instability: a randomized controlled trial [J]. Disabil Rehabil, 2015, 37(7): 601-610.
- [22] Shu Zhendi, Jin Yun, Su Tingting, et al. Effect of sports taping technique on early rehabilitation of patients with acute lateral ankle ligament injury [J]. Chinese Journal of Rehabilitation Medicine, 2021, (06): 686-691.
- [23] Yin Lulu. Effects of intramuscular taping on proprioception and postural control in patients with chronic ankle instability [D]. Shanghai University of Sport, 2020, (01).
- [24] Ma Zhuoli, Lu Qimei, Ci Yan. ROM treatment in exercise therapy after knee injury [J]. Theory and Practice of rehabilitation in China, 2002, 8(4): 226.
- [25] Chen Xin, Shi Shaoyun, Chen Xiuqing, et al. Application of exercise therapy in rehabilitation treatment of ankle joint injury [J]. Chinese Journal of Bone and Joint Injuries. 2018: 892-893.
- [26] Sekir U, Yildiz Y, Hazneci B, et al. Effect of isokinetic training on strength, functionality and proprioception in athletes with functional ankle instability [J]. Knee Surg Sports Traumatol Arthrosc, 2007, 15(5): 654-64.
- [27] Salom-Moreno J, Ayuso-Casado B, Tamaral-Costa B, et al. Trigger Point Dry Needling and Proprioceptive Exercises for the Management of Chronic Ankle Instability: A Randomized Clinical Trial [J]. Evid Based Complement Alternat Med., 2015, 790209.
- [28] Zhao Xiangyu, Shi Shusheng. Elastic band resistance exercise therapy: Rehabilitation treatment of ankle varus injury [J]. Journal of Mudanjiang Normal University (Natural Science Edition), 2020, (04): 41-44.