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Diagnosis and Non-Pharmacological Treatment of Ankle Sprains

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Abstract. Ankle injuries are among the most common sports-related injuries. If not treated properly or if it occurs repeatedly, it may lead to a series of short-term and long-term harmful consequences.This article discusses the relevant characteristics of ankle stability and introduces four commonly used clinical examination methods: the Ottawa Criteria, the Bern Criteria, the anterior drawer test, and the varus stress test. The article focuses on the application of two non-pharmacological treatment approaches for acute ankle injuries—acupuncture combined with the POLICE Emergency Treatment Principles and ultrasound physiotherapy. Based on existing research, these two therapies can alleviate patient pain, reduce swelling, suppress persistent inflammation, balance the muscle tone around the ankle joint, and promote cellular and collagen regeneration, thereby effectively preventing the sequelae of recurrent ankle sprains. However, both treatment regimens currently face the widespread issue of inconsistent clinical practice guidelines, limited high-quality clinical evidence, and cannot fully replace rehabilitation-based muscle strengthening exercises.

Keywords: Diagnosis, Ankle Sprains, Non-Pharmacological Treatment, Sports musculoskeletal injury

1. Introduction

Ankle joint stability is crucial for maintaining body balance and lower limb motor function. While neuromuscular control plays a vital role, ankle stability is largely determined by the structural integrity of the joint itself. Ankle sprains can cause varying degrees of ligamentous injury and may also lead to chronic ankle instability. Ankle sprains are among the most common sports-related injuries encountered by athletes across a wide range of athletic activities. They account for a significant proportion of all sports-related injuries, with lateral ligament injuries representing the largest category. Among basketball players, ankle sprains constitute the majority of their foot-related injuries; in soccer matches, this proportion reaches nearly 20%; and among professional handball players, ankle injuries also represent a high incidence rate. During basketball activities—such as landing after a jump, sudden stops and changes of direction, or when the ankle is in a plantar flexion and varus unstable position—any imbalance in force distribution can easily strain the lateral ligaments, resulting in an ankle sprain. This article introduces four commonly used clinical examination methods, as well as non-pharmacological treatment approaches for patients with ankle sprains.

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2. Clinical examination methods

2.1. Ottawa Ankle Rule

In terms of the diagnostic strategies of ankle sprains, the most commonly used method so far is the Ottawa Ankle Rule. This method of diagnosis uses a series of quick screening tests (including applying pressure to the lateral (outside) 6 cm of the ankle and medial (inside) 6 cm and seeing if the patient can walk 4 consecutive steps without a problem) to determine if an X-ray is needed to rule out a fracture and make the correct diagnosis. This screening method shows 100% sensitivity in adolescents younger than 16 years of age and it can decrease the need for radiographic examination by 43.8% according to data shown in peer-reviewed journals included in the database of the 2022 PMC [1]. The Ottawa Ankle Rule has been validated in center-based studies for over ten years and has been shown to be nearly 100% sensitive– its standardisation can save up to 30% of unnecessary ankle X-rays, reducing radiation exposure to patients and wait times in ED [2]. This study also reported that although there was strong evidence to support this approach, adherence to this diagnostic rule is still relatively low globally.

2.2. Bernese Ankle Rules

The Bernese Ankle Rule (BAR) is refined and optimized from the Ottawa Rule and further reduces the screening area to palpation. This is done by indirectly compressing a 10 cm section of the distal lateral ankle rather than the entire 6 cm distance as per the Ottawa Rule. This method has the same sensitivity for fracture detection, as the Ottawa Rule, and reduces secondary discomfort due to the examination by avoiding direct palpation of the most swollen part. This is an indirect stress testing technique which means that the injured site is not directly palpated. The pooled positive LR was 3.54 and the pooled negative LR was 0.39 [3]. Thus, this examination also has moderate value to exclude fracture.

2.3. Anterior Drawer Test

The Anterior Drawer Test (ADT) is not only used to identify if there is a fracture present but is also used to check for ligamentous laxity and/or tears and, therefore, can be used to identify soft tissue injuries. This test is frequently combined with other tests in clinical use: firstly, to rule out fractures and second, to determine if there is ligamentous damage. The ADT should be done after swelling has reduced which is typically 4-5 days after the injury, and should be avoided in case of possible secondary injury due to ligamentous overstretching. The patient is supine with the knee flexed and the distal part of the lower leg is fixed in place with one hand, the other hand is used to pull the heel forward during the test. Normally the anterior displacement is about 4–5 mm; if the patient has an excessive anterior displacement this indicates an anterior talofibular ligament injury. The Anterior Drawer Test (ADT) in 45 studies had good to excellent intra-rater reliability, but relatively poor inter-rater reliability. Although the study populations, examiners, and experimental conditions may vary, the intraclass correlation coefficient (ICC) and Kappa values suggest that the intra-rater reliability for different kinds of ADT is mostly at an acceptable level [4, 5]. However, most of the studies that reported interrater reliability indicated poor to moderate interrater reliability, with only 1–2 studies reporting high interrater reliability [6, 7]. Factors such as the experience of examiners can affect the inter-rater reliability; this underscores the need to develop rigorous assessment protocols. Three research studies showed relatively low reliability, mostly as a result of small

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number samples and atypical test position (e.g. supine position) [8-10]. The overall reliability of the ankle drawer test (ADT) and its derived tests (ALDT, RADT, IADT) can be considered between moderate and excellent.

2.4. Varus Stress Test

Varus Stress Test, or Varus Stress Test / Talar Tilt Test, is a clinical exam to determine if there is any injury or tear to the outside (lateral) ankle ligaments. In the test the doctor holds the distal end of the lower leg with one hand and applies a varus force with the other hand to the ankle and compares the amount of talar tilt on each side of the ankle. When viewing the test, if there is a tilt angle of more than 10° or if lateral pain is noted, then there may be some injury to the peroneal tendon or the anterior talofibular ligament. This test has a specificity of ~87% (Sports Health 2021) [11].

3. Non-pharmacological treatments

3.1. Acupuncture

Acupuncture, one of the conservative treatments for ankle sprains is especially popular in China. Based on the existing clinical experience from emergency departments and on the results of animal studies, treatment by acupuncture therapy can result in a relatively quick alleviation of symptoms in patients suffering from ankle sprains. Acupuncture has great potential for use in ankle sprain treatment. It is particularly effective for the condition that complains local pain, swelling and limited mobility after sprain, but acupuncture can't take the place of the basic measures of treatment, such as urgent immobilisation, ice application, and it is not suitable for all patients, should be used according to the patient's degree of injury and physical condition. Acupuncture stimulation on specific acupoints JieXi, KunLun and TaiXi can help to regulate the local qi and blood circulation, inhibit inflammatory reactions, and thus relieve pain and swelling during the acute phase (24 to 72 hours after the sprain). But, in this stage, those regions of the highest swelling should not be needled directly, as this may aggravate the bleeding. Acupuncture can be used as a complementary treatment for ankle sprain, but the use of acupuncture should be decided after a thorough evaluation of the stage and severity of the ankle sprain. In the acute phase (24-72 hours after injury), the main treatment strategy will be cold compression and immobilization (POLICE - Protection, Optimal loading, Ice, Compression, Elevation, and acupuncture can be used to ease pain and aid in healing the tissue [12]. In the subacute stage, the amount of icy treatment can be reduced, the proportion of acupuncture can be raised and the deep needling method can be used, usually at distal points ZUOLI (ST36) and YANGLINGQUAN (GB34) to unblock the Foot-Shaoyang meridian and promote the absorption of stagnant blood, relax the muscles and break the tissue adhesion, generally by qualified physician. In the recovery phase (14 days after the sprain) the primary emphasis should be on rehabilitation exercises; acupuncture can only be used to help relieve any residual local discomfort or soreness and to relax any muscles or ligaments that may be tight.

In terms of effectiveness of acupuncture as an adjunctive treatment method to the ankle sprain, the meta-analysis of 17 RCTs showed that the overall effectiveness rate of the POLICE intervention alone was about 74.1% while the overall effectiveness rate for the combined intervention with acupuncture was about 89.2% [13]. What's more, there was a significant decrease in chronic ankle instability, from 25.0% to 9.4%, with the combined therapy. In addition, this combination resulted in better outcomes for pain relief, swelling reduction and functional recovery than the POLICE protocol alone.

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3.2. Ultrasonic physical therapy

A second frequently used non-pharmaceutical method of therapy is ultrasonic therapy. Initially, the therapist will coat the area of the ankle sprain (lateral malleolus) and the area of the ligament injury and the area surrounding the swollen soft tissue with a thick layer of the coupling agent (transparent gel) and cover the painful and ecchymotic region. Coupling agent is used to remove air, so that the ultrasonic waves can be transmitted into the body. Then the equipment is adjusted to fit the equipment parameters (Intensity: 0.5-1.5W/cm2; duration: 5-10 min.). A circular ultrasonic probe is then gently rolled over the skin in a circular and oscillating manner (back and forth) over the damaged ligament, fascia and soft tissue without hitting the bony area/bony prominence (for example the lateral malleolar bony prominence). The probe glides over the skin as it progresses and may make a slight sizzling sound at times. Each treatment session takes about 5-10 minutes.

3.2.1. Mechanism of action

High frequency sound waves are used in ultrasonic physiotherapy to create thermal and mechanical energy which is delivered to the injured area, increases blood flow and encourages the regeneration of cells in the ankle sprain and therefore reduces pain and speeds up recovery. This therapy reaches into the deep layers of subcutaneous tissue, helps to decrease the inflammation on the inside, relieve swelling and stiffness and at the same time stimulate the activity of the cells, thereby speeding up the rehabilitation period. Its effectiveness is, however, not guaranteed in all people and it is advisable to use it in conjunction with other methods of treatment, including rest and cold compresses. The principles of this complementary healing technique to repair tissue can be divided into three categories: 1. Thermal Effect: Ultrasonic waves have a thermal effect. Patients report a significant increase in temperature around the ankle during treatment. This heat is produced on one hand by the friction between the tissues caused by the vibrations and on the other hand, by the conversion of the acoustic energy into heat by the tissues themselves. This thermal effect produces a gentle, but profound thermal response that increases local blood flow, interstitial fluid flow and, consequently, the effective removal of metabolic waste products and the effective delivery of nutrients to the injured area. In addition, this heat can also help relieve muscle spasms and stiffness, and stimulate the metabolic rate to help remove blood stasis and inflammatory factors. 2. Mechanical Effect: As ultrasonic waves pass through the subcutaneous tissue they generate micro-vibrations which the subcutaneous tissue is continually tensioned and relaxed. This produces differences in tissue pressure, thus providing a gentle massage action to the tissue cells, the basis of ultrasonic therapy for the treatment of many conditions. The micro-massage effect on cells can change their volume and, because the permeability of the cell membranes changes, the transport of nutrient substances is enhanced and the removal of metabolic waste increased. In addition, the effect can aid in loosening stuck tissues and minimize scar tissue. 3. Biological Effects: Ultrasonic waves may be able to regulate the expression of cyclins which will favor the progression of cells from G1 to S phase and promote DNA synthesis. They promote repair of damaged ligaments or tendons, promote the regeneration of collagen and stimulate fibroblasts. Also, these waves can trigger certain signaling pathways (such as TGF-β) which can further shorten healing time.

3.2.2. Clinical manifestation

A Cochrane systematic review on "Therapeutic ultrasound for acute ankle sprains" included five placebo-controlled randomized trials that had a total of 572 patients with acute ankle sprains; and

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the main conclusion was in patients with acute ankle sprains, there is insufficient evidence to support the routine use of ultrasound physiotherapy, there were no statistically significant difference between real ultrasound and sham placebo ultrasound in terms of pain, swelling, or ankle joint function outcomes over 7–14 days, and the overall therapeutic effect of ultrasound was minimal and its clinical value is limited [14]. But with this small sample size in this trial, and the varying ultrasound intensities/durations, it's unclear whether there would be any benefit to a set ultrasound dose. In another clinical guideline published in BJSM, the flagship sports medicine journal of the BMJ group, "Diagnosis, treatment and prevention of ankle sprains: an evidence-based clinical guideline" concluded that therapeutic ultrasound should not be recommended for the treatment of acute ankle sprains and there is currently insufficient evidence that ultrasound is useful for improving recovery outcomes of acute ankle sprains [15]. However, there was one RCT that was reported in Chinese literature that included 86 acute ankle sprain patients [16]. The average time to resolution of swelling in the intervention (ultrasound + rehabilitation) group was reduced by 3.2 days compared to simple rehabilitation control group, the overall effective rate was 93.02% compared to 76.74%, after 2 weeks of treatment.

4. Clinical challenge-

The POLICE principle combined with acupuncture for managing acute ankle sprains has shown promising short-term results with a higher overall clinical response rate (74.1% to 89.2%) and lower chronic ankle instability rate (25.0% to 9.4%), but still has many limitations in clinical practice [13]. Firstly, there is little standardisation in acupuncture treatment; in existing literature up to 103 acupoints are cited; no literature exists on the selection of acupoints, the depth of the needles and the standards of the procedures, and hence there are significant differences between the acupuncture treatment given by different practitioners and low clinical reproducibility. Secondly, available evidence-based data are of poor quality, most studies are small, have poor double blind controlled design and there is a lack of high quality international multicenter clinical trials, making it hard for these interventions to be accepted by mainstream international medical guidelines. Furthermore, there are some safety concerns associated with acupuncture; the overall incidence rate of adverse events in acupuncture has been reported to be 9.31% and the most frequent adverse events include subcutaneous hematoma and local hemorrhage [17]. A great amount of exudation and micro-vasculature are observed in the ankle joint in the acute phase of ankle sprain; inadequate acupuncture manipulation will aggravate swelling and bleeding in the ankle joint. Moreover, acupuncture can only offer auxiliary effects such as alleviation of pain, decrease of swelling and enhancement of the circulation of meridian, but cannot compensate the muscle strength or proprioception training exercise in ankle joint injury. Long-term follow-up data are lacking to support the long-term effectiveness of acupuncture for the prevention of recurrent ankle sprain.

There are also many limitations when using ultrasonic therapy practically in the clinic. Firstly, there is no standard of clinical use for such treatment modality; some trials use continuous ultrasonic mode, while others use pulsed mode, and there are considerable differences between the parameters used. A meta-analysis found just 31% of the trials to be in accordance with consistent ultrasonic therapy standards [14]. Secondly, in the treatment of acute ankle sprains, the efficacy rate for the use of ultrasonic therapy alone is only about 66.8%, which is much lower than the efficacy rate of 89.2 % for acupuncture combined with POLICE therapy, and immobilisation and compression, and rehabilitation training cannot effectively reduce the risk of sequelae after ankle sprain treatment, the incidence of chronic ankle instability may reach 21.3% when treating with ultrasonic therapy alone. This when taken together with POLICE principle, the efficacy rate rises to 81.4% and the chronic

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ankle instability rate drops to 14.6%. Third, how it is administered can make a big difference in the results of treatment. If the procedure is performed incorrectly, studies have demonstrated that the energy delivered to the area of the injured ligament through ultrasound may be less. This directly results in treatment failure in 40%–60% of cases and, at least in the physiotherapy clinical practice, the probe is kept stationary on the bony prominences (about 28% of cases), leading to the occurrence of periosteal tenderness or even to the risk of minor tissue injury. Fourth, limitations apply to the patient population and when it is best to apply it. If the sprain is in the acute phase (48 hours or less) of the injury, and the hemorrhage and swelling are severe, ultrasound may be contraindicated because it may cause thermal effects which could lead to increased local exudation and swelling (only pulsed low intensity ultrasound is recommended). Patients with a coagulation disorder, skin breakdown or decreased local sensation are at risk of adverse reactions, which may require adjusting the treatment protocol, or even contraindication of the therapy.

5. Conclusion

To conclude, ankle sprains are one of the most frequent injuries in sports injuries, and thus a scientifically valid and standardized initial assessment and diagnosis is important as a prerequisite for subsequent treatment. The Bern Criteria and Ottawa Guidelines can be utilized for rapid screening and exclusion of ankle fracture, while anterior drawer test and valgus stress test are used to evaluate soft tissue and ligamentous injuries of the lateral ankle; a "one-stop" diagnostic algorithm can be achieved by using both the anterior drawer test and valgus stress test. Acupuncture can be added to the management of acute ankle injuries following the POLICE basic emergency care principles, which may improve the effectiveness of acute treatment, prevent chronic ankle instability and minimize the risk of re-injury. But there is still no uniformity in the selection of acupoints and treatment methods in current acupuncture treatments, and the application of various acupoints and treatments varies greatly from person to person, with few high-quality and large-sample clinical data available. Although ultrasound therapy has a theoretical basis for its use in soft tissue repair, evidence for its effectiveness is controversial, treatment parameters and procedural protocols are not standardized and therefore stand-alone applications are limited and should only be used as an adjunctive therapy. Further research is needed to conduct multicenter large-sample RCTs to standardize the parameters, therapeutic indications and methods of acupuncture and ultrasound therapy; at the same time, a wearable monitoring device should be embedded to dynamically monitor the swelling of the ankle and the proprioception, so as to explore the personalized non-drug rehabilitation strategy. The clinical diagnosis and treatment paradigm can be further enhanced to improve the short-term rehabilitation outcomes of acute ankle sprains and minimise the risk of long-term complications (chronic instability).

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