Experimental Reserch Program

Title: The effect of blood flow restriction training on chronic ankle instability symptoms in sports dance athletes

Experimental period: December：11/20/2023-12/30/2023

Ethics Review Number of Wuhan Sports University School of Medicine:2023102

Project Summary

Chronic Ankle Instability (CAI) is a common sports injury disorder. Athletes also suffer from patellofemoral pain in their daily lives and training. Instrument Assisted Soft Tissue Mobilization (IASTM) is a physical therapy technique that uses specially designed tools such as metal or plastic scraping boards to assist in handling soft tissue problems. Mainly used in rehabilitation medicine, sports medicine, and plastic surgery, it is used to handle tension, adhesion, pain, and motor dysfunction of muscles, fascia, and tendons [25, 26, 27]. Blood Flow Restriction Training (BFRT) is a special training technique aimed at limiting blood flow through the use of cuffs or elastic bands on the limbs, in order to promote muscle growth and improve strength

Therefore, in order to further optimize the rehabilitation process of CAI, this study designed a comprehensive rehabilitation training program that combines blood flow restriction training (BFRT) with ankle balance training, ankle peripheral reinforcement training, and IASTM physical release. BFRT was chosen because it has the adaptability to generate muscle strength at lower loads, providing a relatively low-risk approach for rehabilitation. The combination of ankle balance training and reinforcement training, as well as the physical release of IASTM, is expected to play a synergistic role in promoting the rehabilitation process. By comparing conventional balance training with pure BFRT training, this study aims to evaluate the effect of BFRT assisted rehabilitation on ankle rehabilitation of sports dance athletes, providing new theoretical and empirical support for the rehabilitation field. Through in-depth research, it is expected to provide more effective and comprehensive rehabilitation plans for sports dance athletes, improve their rehabilitation speed and effectiveness, and better safeguard their health and career.

Basic information

Agreement Title:The effect of blood flow restriction training on chronic ankle instability symptoms in sports dance athletes

Acceptance number: 2023102

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Sports dance, also known as international standard dance, is divided into two series: Latin and Modern. In this high-intensity sport, athletes often face the risk of various sports injuries, among which chronic ankle instability (CAI) is a common and significant problem in dance sports [1,2]. Repeated sprains during exercise and long-term ankle joint dysfunction are important factors leading to CAI [3,4]. Its main feature is the reduced stability of the ankle joint, which increases the risk of ankle re sprains for patients during walking, exercise, or other activities [4,5]. For sports dancers, the ankle is one of the joints that bear the greatest pressure during exercise, and its complex structure and frequent exercise requirements make the ankle joint more susceptible to injury. The injury of the ankle joint is highly correlated with the characteristics of sports dance projects. Due to the need for sports dance athletes to perform high-frequency and difficult movements, the ankle is in a constantly changing load state. This sport characteristic puts the ankle at a high risk of injury [6]. Especially in dance events that require frequent changes in direction and jumping movements, ankle sprains, ligament strains, and other forms of injury are very common [7]. Secondly, in addition to the unpredictable demands of dance movements on the ankle, some high demand movements may lead to ankle injuries in unstable states. Continuous high-intensity dance training and performance may increase the risk of ankle muscle fatigue and injury [8]. Ankle joint injury may not only affect the athletic performance of athletes, but also lead to delays in the rehabilitation process, which can have adverse effects on the athlete's career. After the rest symptoms disappear, the muscles around the ankle joint may become weak due to trauma

or inadequate recovery, including the gastrocnemius and tibialis anterior muscles around the ankle. Muscle weakness or incomplete ligament healing can lead to insufficient joint support, resulting in loss of ankle stability, which is also an important factor in inducing CAI [9,10]. Moreover, the ability of nerves to control muscle movement may be affected, leading to inadequate muscle coordination and increasing the risk of ankle instability [11]. Therefore, strengthening training for the strength and stability of the ankle joint after rehabilitation is particularly important.

Blood Flow Restriction Training (BFRT) is a special training technique aimed at limiting blood flow by using cuffs or elastic bands on the limbs to promote muscle growth and improve strength [13]. BFRT was originally designed for rehabilitation injured athletes because it can improve muscle strength while reducing load, helping to avoid further injuries during the rehabilitation process [14]. But as research deepens, it is gradually being applied to a wider range of fitness and training fields [15,16]. One major advantage of BFRT is that it allows for efficient training under relatively light loads, reducing the burden on joints and tendons, making it suitable for people who find it difficult to withstand high-intensity training due to injuries or other reasons [14]. Meanwhile, BFRT also has the characteristic of achieving muscle growth and strength growth in a short period of time, and it is considered a time-saving training method [14]. BFRT can not only be used for strength training, but also for rehabilitation, improving endurance, and improving sports performance, making it have potential applications in various fields [15]. In rehabilitation training, it can be applied to multiple body parts to promote the recovery of injured areas and improve muscle strength, including; Direct effects on limb muscle groups and elbow and knee joints, indirect effects on shoulders, hips, and buttocks [17, 18, 19, 20], among which studies have shown that BFRT has an activating effect on the calf muscle group of CAI athletes. Under low load resistance exercise, the oxygen saturation of the calf muscle group is significantly reduced, and the muscle fatigue perception score is significantly improved, which has an impact on the strength of the lower limbs of CAI patients There is a promoting effect in terms of functionality and other aspects [21, 22, 23].

Instrument Assisted Soft Tissue Mobilization (IASTM) is a physical therapy technique that utilizes specially designed tools (such as metal or plastic scraping boards) to assist in the treatment of soft tissue problems [24]. Mainly used in rehabilitation medicine, sports medicine, and plastic surgery, it is used to handle tension, adhesion, pain, and motor dysfunction of muscles, fascia, and

tendons [25, 26, 27]. The edge design of IASTM special tools can loosen adhesions in tissues, improving their elasticity and plasticity. Regulating pathological areas through neural pathways, reducing pain and improving neurological function [28]. And different types of treatment tools improve the accuracy of treatment, promote blood circulation, accelerate the rehabilitation process, improve tissue elasticity, expand joint range of motion, and have lower risks and complications compared to invasive surgery [29,30,31]. Studies have shown that IASTM can significantly improve lower limb joint function, reduce pain, and increase range of motion [19, 28].

Therefore, in order to further optimize the rehabilitation process of CAI, this study designed a comprehensive rehabilitation training program that combines blood flow restriction training (BFRT) with ankle balance training, ankle peripheral reinforcement training, and IASTM physical release. BFRT was chosen because it has the adaptability to generate muscle strength at lower loads, providing a relatively low-risk approach for rehabilitation. The combination of ankle balance training and reinforcement training, as well as the physical release of IASTM, is expected to play a synergistic role in promoting the rehabilitation process. Through in-depth research, it is expected to provide more effective and comprehensive rehabilitation plans for sports dance athletes, improve their rehabilitation speed and effectiveness, and better safeguard their health and career.

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Research Objective

Through experimental observation of exercise intervention (blood flow restriction training

combined with low load ankle muscle strength training and balance training) combined with instrument tool therapy (Instrument Soft Tissue Release Technique, IASTM), the intervention effect on ankle function, strength, and joint range of motion of sports dance athletes with ankle instability was observed.

Research process and methods

Method; Select 30-45 subjects with unstable, restricted, or uncomfortable ankle joints as observation subjects, and randomly divide them into ankle joint blood flow restriction training combined with IASTM group (n=10-15), ankle joint blood flow restriction training alone (n=10-15), and traditional ankle strength training (n=10-15). The intervention lasted for 4-6 weeks, once a week. Cumberland ankle instability assessment, FAAM ankle function assessment score, and ankle range of motion measurement were performed at three time points before intervention, after the first intervention, and after 4 weeks/6 weeks of intervention for the three groups. The ankle strength test was only compared and analyzed at two time points before and after intervention.

Process: This study is divided into three stages: pre intervention stage, post initial intervention stage, and post intervention stage. In the pre intervention stage, researchers will conduct preliminary evaluations and data statistics on subjects, including Cumberland ankle instability assessment, FAAM ankle function assessment score, and ankle range of motion measurement. During the intervention phase, participants from each group will undergo a 6-week exercise intervention, with a training frequency of 2 sessions per week and each session lasting 20-30 minutes. During BFRT exercise, a cuff will be wrapped around the proximal one-third of the upper limb of the subject to improve muscle strength and endurance by restricting blood flow. In this state, corresponding ankle training movements (stability training, ankle peripheral muscle group training) will be completed.

Research object

Select students majoring in sports dance who have chronic ankle instability and undergo five tests, including balance test, single leg standing, Trendelenburg test, balance test, dynamic balance test, Anterior Drawer test, and Y-Balance test. If two or more tests meet the positive test, it is determined that chronic ankle instability is present, Can be included in the experimental subjects. This experiment has been approved by the Ethics Review Committee of the Medical College of Wuhan Sport University.

Table 1 Inclusion and Exclusion Criteria

Standard	Inclusion Criteria	Exclusion Criteria
Age	118-35 years old	under 18 years old or above 35 years o
Course Of Disease	Suffering from chronic ankle instability symptoms that last for at least 3 months	Acute ankle injury or no joint injury
CAIT score	The CAIT score is 24 points or less.	CAIT score above 24 points
Functional screening	Two or more tests tested positive for ankle joint function screening before the experiment	Failed ankle function screening
Structural inspection	No structural joint lesions or congenital ankle deformities,	Structural lesions or congenital ankle deformities present in the ankle joint
Medical History	Have not undergone ankle surgery or have external injuries	Have undergone ankle surgery or have obvious injuries or wounds
Health Condition	No serious heart, lung, nervous system or other systemic diseases	Serious heart, lung, nervous system or other systemic diseases
Agree to participate in research	Limited athletic ability, unable to complete research tasks	Disagree to participate in the study, or inability to understand and comply with the research protocol

Experimental Group

The experimental group used exercise intervention BFRT combined with physical release ASTM as the main intervention measure. The training programs applied by BFRT include ankle stability training and ankle joint surrounding muscle group strength training. Ankle stability training mainly uses the tool Bosu ball [37] to intervene in four movements: single leg support training, kick balance training, plank support, and deep squat. Ankle muscle group strength training mainly includes heel lifting training and foot dorsiflexion, eversion, and inversion training with the assistance of elastic band resistance. Due to the fact that most CAI patients have limited dorsiflexion and insufficient valgus force, the focus of the exercise intervention plan is to increase the intensity of dorsiflexion and valgus training.

In this experiment, IASTM used a fascial knife as the treatment tool. There are mainly five types of knives, including C-type scanning knife, B-type bat knife, M-type large M-knife, A-type shark knife, and S-type hook knife. According to the special shape of each knife, their functions and uses are also different. The IASTM intervention was completed before BFRT, with the main purpose of releasing the soft tissues around the calf and ankle joints through physical intervention with a fascial knife, in order to improve ankle pain and restore ankle range of motion

Control Group

The control group of this study consisted of traditional ankle joint stability training and ankle joint peripheral muscle group strength training, with the same specific training plan as the experimental group

Research indicators

Cumberland ankle instability questionnaire

The Cumberland Ankle Instability Tool (CAIT) [42] assessed patients' perception of ankle instability, including the frequency, intensity, and impact of symptoms. CAIT typically includes a specific range of questions, each of which may have different scores. The total score is usually between 0 and 30 points

FAAM Ankle Function Assessment Questionnaire

Foot and Ankle Ability Measure (FAAM) is a scale used to evaluate ankle joint function, which includes questions about pain, function, and quality of life, and can be used to assess the overall condition of patients with ankle instability. The functional score includes two types of assessments: the functional level of daily life (FAAM-ADL) and the functional level of physical activity (FAAM-SPORT). The score range is usually from 0 to 100, where 100 represents completely normal ankle joint function, and 0 represents extreme restriction or complete inability to use the ankle joint.

Ankle joint range of motion

This study used a high-precision joint angle measuring ruler to measure the range of motion of different ankle functions in both sitting and supine positions, including measurements of dorsiflexion and plantar flexion of the ankle, as well as measurements of varus and eversion of the foot .

Ankle joint strength test

The experimental strength data was tested using a handheld digital muscle strength tester (model: FM-204M series muscle strength tester). The measurement unit of this muscle strength tester is N, with a measurement unit range of ± 50kgf and a measurement accuracy of ± 0.5% FS (range) ± 1 digital peak. The measured data includes both peak strength and instantaneous strength values. Therefore, this study used a handheld digital muscle strength tester, where participants sat in a suitable position, fixed the bottom of the instrument on the ground, and then applied force in different directions through their ankles. Measure the maximum force in the dorsiflexion and plantarflexion of the ankle joint, as well as in the abduction and adduction directions of the foot. The strength test for each different exercise segment needs to be completed three times, and the average of the maximum strength values from the three tests is taken.

Statistical analysis

This study used SPSS 26.0 statistical software for data reading, testing, and statistical analysis.

The general information of the subjects is analyzed using an independent sample t-test. The measurement data conforms to a normal distribution. Because there are three time points (pre intervention, first intervention, and 6-week intervention) in the experimental data for measuring ankle joint function indicators and range of motion indicators, repeated measures analysis of variance is used for data statistics and analysis. Ankle joint strength was only measured at two time points (before intervention and after 6 weeks of intervention), and the data was only analyzed using paired t-tests. $P<0.05$ is a significant difference with statistical significance.

Quality Assurance

This experiment undergoes strict quality control, including inclusion criteria for experimental subjects, setting of research indicators, assurance during the experimental process, management and analysis of data records after the experiment, all of which are guaranteed by the experimental leader! Quality monitoring is carried out during the research process, and any issues that arise are promptly adjusted and corrected to ensure the normal progress of the study. The implementation of quality assurance measures can improve the reliability and validity of research, making the results more credible, reliable, and scientific.

Expected results of the study

This study is only a rehabilitation plan designed to improve the stability of athletes' ankle joints through physical therapy combined with exercise intervention. It is hoped that this experiment can provide rehabilitation ideas and methods for solving ankle joint function problems in athletes.

Achievement dissemination and publishing policies

Researchers will serve as the lead publisher responsible for the publication of this experiment and paper.

Project Deadline

20/10/2023

Recruitment end date

19/011/2023

Overall test start date

20/11/2023

Overall Trial End Date30/12/2023

Ethics

The intervention of human ankle joint stability involved in this experiment involves physical therapy with external tools, without involving the use of any new drugs or rigorous ethical issues. When incorporating participants, they will be required to sign an informed consent form and submit an ethics review form to the school. Finally, it is confirmed that the informed consent of all subjects and/or their legal guardians has been obtained, and it is confirmed that this experiment has been approved by the ethical review of the human body experiment at Wuhan Sports University. Confirm that all methods are carried out in accordance with relevant guidelines and regulations.

Informed consent form

Prior to the start of the experiment, informed consent forms should be provided, requiring participants to know the specific protocol and risks of the experiment, and to sign informed consent forms after understanding the protocol.

武汉体育学院医学伦理委员会

人体实验伦理审查表

受理编号：2023102

项目名称	血流限制训练辅助体育舞蹈项目运动员慢性踝关节不稳定症状的效果研究		
项目来源		项目号	
项目负责人	刘洋	研究起止时间	2023.11.20-2023.12.30

研究目的

通过实验观察运动干预（血流限制训练配合低负荷的踝肌肉力量训练和平衡训练）联合器械工具治疗（器具软组织松解技术，IASTM），对存在踝关节不稳定的体育舞蹈项目运动员的足踝功能、力量、关节活动度干预效果。

研究过程及方法

方法：选取 30-45 名踝关节不稳定、受限或不适受试者作为观察对象，并随机分为踝关节的血流限制训练联合 IASTM 组（n=10-15）、单纯踝关节的血流限制训练（n=10-15）、传统的踝力量训练（n=10-15）。干预共 4-6 周，每周一次。分别对三个组干预前、首次干预后、4 周/6 周干预后三个时间点进行 Cumberland 踝关节不稳度评估、 FAAM 踝关节功能评估评分、踝关节运动范围测量。而踝关节力量测试只在干预前后两个时间点进行对比分析。

过程：本本研究分为 3 个阶段：干预前阶段，首次干预后、干预后阶段。在干预前阶段，研究人员将对受试者进行初步评估和数据统计，包括 Cumberland 踝关节不稳度评估、 FAAM 踝关节功能评估评分、踝关节运动范围测量。在干预阶段，将对各个组的受试者进行为期 6 周的运动干预，训练频率为 2 次/周，每次训练 20-30 分钟。在 BFRT 运动过程中，受试者的上肢近端 1/3 处将缠上袖带，通过限制血液流动来达到提高肌肉力量和耐力的效果，在此状态下完成相应的踝关节训练动作（稳定训练、踝关节周围肌群训练）。

潜在受益描述

通过实验的运动干预，可能会改善受试者踝关节稳定性，提高其足踝力量与运动活动范围。

潜在风险描述

BFRT 干预可能会造成肌肉的疲劳从而加剧疼痛，但是运动强度可控，可以根据实际情况调整

被试招募描述

选择存在慢性踝关节不稳定问题的在校体育舞蹈专项学生，并经过平衡测试 - 单腿站立（Single Leg Stance）、Trendelenburg 测试、平衡测试 - 动态平衡测试（Dynamic Balance Test）、踝关节前倾测试（Anterior Drawer Test）、Y-Balance 测试五项测试后，2 项或两项以上测试符合阳性测试，判断慢性踝关节不稳定，可以纳入实验对象。

审查意见

武汉体育学院医学伦理委员会

审批日期：2023 年 12 月 13 日