

The Effectiveness of Physical Therapy Intervention on Chronic Ankle Instability

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ABSTRACT

Background: Chronic ankle stability (CAI) describes a combination of mechanical and functional instability with sequelae of ankle sprain, such as pain, swelling, weakness, instability, and repeated episodes of giving way. These sequelae can inhibit physical activity, affecting the patient's overall health and quality of life. Physiotherapy interventions for managing chronic ankle instability are quite varied from several exercises. The study aims to determine the effectiveness of physiotherapy intervention on chronic ankle instability (CAI).

Methods: The research method used is a literature study of articles using secondary data in the form of a study of several journal articles regarding the effectiveness of physiotherapy interventions on chronic ankle instability.

Results: Several studies have shown that physiotherapeutic interventions such as balance training, strengthening, and stabilization exercise related to improving neuromuscular and proprioceptive control are effective in treating chronic ankle instability (CAI).

Conclusion: Physiotherapy interventions such as balance exercise, whole body vibration, hip strengthening exercise, wobble board rehabilitation and hop stabilization exercise are effective in treating injuries, namely chronic ankle instability.

Keywords: physiotherapy intervention, chronic ankle instability.

Received: September 2022. **Accepted:** December 2022.

Type: Literature Review

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Introduction

Ankle sprains are the most common injury in athletes and represent a significant contribution to lost time from sports participation. About 11,000 ankle sprains occur annually in the US in collegiate athletes, and ankle sprains are most common in men's basketball players. Ankle sprain causes loss of neuromuscular control and proprioception. Neuromuscular control helps maintain the functional stability of the ankle, whereas proprioception influences the ankle joint's position and is related to the sense of joint movement. Ankle sprains damage the lateral ankle ligament complex, which can cause sequelae, such as recurrent ankle sprains. A common sequela is a developmental instability of the ankle, for example, chronic ankle instability (CAI).¹

CAI describes the combination of mechanical and functional instability with ankle sprain sequelae, such as pain, swelling, weakness, instability, and recurrent episodes of "giving way". These sequelae can inhibit physical activity, negatively affecting overall health and quality of life by leading to obesity and other common health problems. Chronic ankle instability can be either functional instability or mechanical instability. Functional instability depends on

patient reports or complaints, which can be accompanied by clinical weakness, while mechanical instability can be detected by physical examination. Patients who fail to recover through non-surgical methods are prone to chronic ankle instability. Clinically, the patient's history with CAI shows recurrent ankle sprains and inversion injuries. Surgery is performed when patients with chronic ankle instability fail conservative management and physical therapy. About 40% of people who sustain a lateral ankle sprain will experience a relapse and sequelae, such as pain and instability, that persist for at least 12 months. CAI is associated with a variety of sensorimotor adaptations, including biomechanical changes. Individuals with CAI land in a more plantar-flexed an upside-down position. Kinematic changes have been identified proximal to the ankle joint during dynamic tasks. Altered kinetics, including greater ground reaction forces and loading rates, have also been observed in individuals with CAI during landing tasks. These changes are hypothesized to potentially increase an individual's risk for recurrent injuries and ankle joint degeneration. Several therapeutic interventions have been used to treat CAI-related disorders. Physiotherapy interventions in the treatment of injuries, such as CAI, which

can be applied in clinical settings, are balance exercises, whole body vibration, hop stabilization exercises, wobble board rehabilitation, and hip strengthening exercises which affect neuromuscular and sensorimotor control.²

Methods

The research method used is the study of article literature using secondary data in the form of studies of several journals regarding the effectiveness of interventions related to treating CAI. The literatures were searched with the keywords 'chronic ankle instability, 'exercise for chronic ankle instability', and 'chronic ankle instability and physiotherapy intervention'. The inclusion criteria: 1) published in English and published in 2016-2021, 2) reported about CAI, 3) reported about exercise or home-based exercise for CAI. The exclusion criteria: 1) the result of the study is not reported, and 2) exercises for CAI are not reported.

Results

M Spencer Cain et al. (2020) performed a randomized controlled trial (RCT) study to assess the impact of 3 rehabilitation programs on clinical measures of balance and self-reported function in adolescent patients with CAI. The 43 CAI patients were randomized into four groups for rehabilitation (resistance-band intervention, biomechanical ankle platform system board intervention, combination intervention, and control intervention). The results showed improvement for each rehabilitation group compared to the control group using the time-in-balance test, foot-lift test, Star Excursion Balance Test (SEBT) (medial, posteromedial, and posterolateral directions), and figure-8 hop test ($p < 0.05$). But neither of the intervention groups prospered.³

Chang et al. (2021) evaluated how 6-week balance training and whole-body vibration (WBV) regimens affected female athletes with persistent CAI. Athletes with dominant-leg CAI who were female participated in this randomized controlled research. The participants were randomly split into three groups: Group A received WBV training, Group B received balance training, and Group C received no instruction (control group; Group C). Participants in the two exercise training programs demonstrated improvements in dynamic balancing, active repositioning, and 30 degrees of concentric contraction (CON) and eccentric contraction of the ankle inverter, respectively, compared to the control group in the SEBT, joint position sense test, and isokinetic strength test. Participants in both groups displayed modest effect sizes for CAI in the SEBT, joint position sense test, and isokinetic strength test. There were no differences in the variables between the two exercise training programs.²

Hooman Minoonejad et al. (2019) performed an RCT to evaluate how to hop stabilization training affects collegiate basketball players with CAI's neuromuscular control and self-reported function. The experimental hop stabilization and control groups were randomly allocated to 28 college basketball players with CAI. For six weeks, participants of the experimental group underwent supervised hop stabilization

exercises three times each week. The control group did not receive any treatment. Before and after the 6-week training program, the degrees of preparation and reactionary muscle activation, and the muscle onset time were measured from 8 lower-extremity muscles during a jump-landing exercise. Compared to the control group, the experimental group showed significant increases in muscle onset time, reactive muscle activation, and anticipatory muscle activation across the lower extremities ($p < 0.05$). The experimental group outperformed the control group in terms of self-reported function ($p < 0.05$).⁴

A study by Brent I Smith et al. (2018) performed prospective RCT to investigate whether patients with CAI respond clinically and subjectively after hip strengthening. Participants had either supervised hip strengthening (using resistance bands three times per week) for four weeks or no intervention. A patient-reported measure (the Foot and Ankle Ability Measure activities of daily living and sports subscales) and four clinical measures (the SEBT in the anterior, posteromedial, and posterolateral directions; Balance Error Scoring System; hip external rotation strength; and hip abduction strength) were used to evaluate participants before and after the 4-week training period. The training group outperformed the control group in terms of hip abduction strength, hip external rotation strength, SEBT reaches (anterior, posteromedial, and posterolateral directions), Balance Error Scoring System total errors, and Foot and Ankle Ability Measure-sports score.⁵

Shelley W. Linens et al. (2016) aimed to measure clinical improvements in CAI instability using a wobble board rehabilitation protocol. Thirty-four participants were randomly divided into a rehabilitation group and a control group. The results of the foot lift test, the Time-in-Balance Test (TBT), the SEBT-antromedial, medial, and posteromedial (average reach distance normalized to leg length), the Side Hop Test (fastest time), and the Figure-of-Eight Hop Test (fastest time) were the dependent variables. Except for SEBT-antromedial reach direction, the main effects for groups were not significant ($p > 0.05$) for any measures where time was the primary factor. Except for TBT ($p > 0.05$), significant interactions were discovered for all dependent measures ($p < 0.05$). The rehabilitation group increased performance at the post-test, whereas the control group did not, according to post hoc testing of significant interactions.⁶

Discussion

CAI is a major concern for individuals with a history of ankle sprains. Nonoperative treatment through a multimodal rehabilitation program is generally recommended for CAI. Each intervention focuses on a common task of ankle rehabilitation. Therefore, balance exercises are essential for athletes with CAI in rehabilitation and training programs and can effectively reduce the risk of ankle sprains during sports activities. An athlete who experiences CAI will experience dynamic balance and joint reaction time disturbances due to decreased neuromuscular

and proprioceptive control. Neuromuscular control helps maintain the functional stability of the ankle. At the same time, proprioception influences the ankle joint's position and the movement felt when the joint moves. According to Chang et al., an effective intervention is balance training accompanied by WBV training. Balance training is a progressive exercise performed on an unstable surface, and the resulting efferent output causes changes in motor neuron excitability. Balance training increases muscle excitability in the ankle joint and improves motor control for CAI. WBV is another popular method used in CAI rehabilitation. WBV training is performed on an oscillating vibration platform, which activates the muscle spindles to facilitate the tonic vibration reflex. This training also increases motor neuron excitability and motor unit synchronization to improve motor control in the ankles.^{3,7,8}

In addition, hop stabilization exercises can also be given. According to Minoonejad et al., the effectiveness of a 6-week hopping stabilization program on feedforward and feedback neuromuscular control during jump landing in college-level basketball players with CAI can improve feedforward and feedback neuromuscular control in individuals with CAI. This feedback activity may increase muscle coactivation and stiffness to aid joint stability. Increased activity of the tibialis anterior and peroneus longus will increase the TA/PL force couple, which maintains a neutral ankle position during dynamic activities. The jumping exercise experienced during the intervention may have increased muscle spindle sensitivity and inhibited Golgi tendon organs. Such changes will increase muscle elasticity and promote better neuromuscular coordination, which can shorten the transition between eccentric loads and concentric contractions required to maintain the center of mass within the base of support during the transition from dynamic to static. The intervention might also improve participants' ability to modulate the H-reflex. The amplitude of the H-reflex decreases with the increasing complexity of the postural task, which is thought to represent a shift from control of spinal movements to coordinated control of supraspinal movements. Individuals who have CAI cannot modulate their H-reflex properly, but the therapeutic practice has reduced this inability in those with CAI.²

In addition, hip strengthening exercises can also be given. According to Smith et al., hip strengthening positively impacts neuromuscular control, hip strength, and self-reported functional deficits. Deficits in postural control in individuals with CAI have been suggested due to a reduced ankle strategy for balance maintenance. This response can be attributed to the dysregulated function of the proprioceptive and neuromuscular control components associated with the initial injury. As a result, there is greater reliance on proximal correction and subsequent dependence on the hip for balance. Deviation from the normal movement pattern of using the ankle to maintain posture puts the proximal muscles, specifically the hip, to initiate greater movement and muscle contraction to counteract the instability. Because it has been determined that patients with CAI rely more

heavily on hip contributions during the dynamic balance task, any deficit in hip strength can further reduce postural control. This training protocol increases strength and improves lower extremity neuromuscular control. Ensuring increased muscle and joint stability at the hip enhances performance through adaptive strategies that reduce the mechanical strain on the distal joint musculotendinous structures where inadequate ankle strategy may exist. This intervention reinforces these adaptive strategies, improving self-reported balance, strength, and function. Significant improvement in ankle joint position sense following a six-week ankle strengthening protocol using resistance bands was hypothesized to be due to increased muscle spindle sensitivity or associated changes in the central mechanism. To evaluate the neuromuscular control-related balance components, Blackburn et al. demonstrated improved semi-dynamic and dynamic balance with the ankle strength training group, which was associated with central nervous system adaptation and altered motor control programming.^{4,6}

During rehabilitation, the patient is required to balance on an unstable surface while completing rotational movements. During the rehabilitation program, the dynamics of this aspect of movement most likely enhance the intrinsic muscle strength of the foot and tibialis anterior and peroneus longus, allowing for improved mechanoreceptor function in the lower extremities. These changes lead to increased postural control of the lower extremities, which provides a more stable base and increases paths of postural correction. Exercise on an unstable surface benefits balance on a stable surface because the lower kinetic chain muscles are forced to work harder, allowing for easier stability on a stable surface. With a stronger base, a functional dynamic lower kinetic chain, and a productive pathway of postural correction, patients can reach further anteromedial, medial, and posteromedial movements. BAPS was created to re-educate the ankle joint mechanoreceptor complex, thereby improving balance, proprioception, and neuromuscular coordination.⁵

Dynamic balance exercises can make dynamic stabilizers of the ankle joint. Previous studies have shown a reduction in muscle onset latency of the tibialis anterior and peroneus longus muscles after completion of the sway plank program, thereby increasing mechanoreceptor function. We hypothesize that the ankle-retrained dynamic stabilizers during wobble board rehabilitation also allow more effective use of the muscles further up the kinetic chain, resulting in better dynamic balance. Linens et al. found a significant increase in the rehabilitation group's star excursion balance test (SEBT) compared to the control group. Following the dynamics of systems theory, upon completion of the rehabilitation protocol, patients may have less constraint on the sensorimotor system and, as a result, be afforded more range of motion in their lower extremities. In particular, patients may be more confident in their ability to control the subtalar joint and in their ability to travel through a greater range of motion at the knee and hip while balancing on a firm surface without subsequent injury.⁶

Conclusion

Based on the literature review, it can be concluded that physiotherapy interventions such as balance exercise, whole body vibration, hopping stabilization, hip strengthening, and wobble board rehabilitation are effective in treating CAI injuries.

Conflict of interest

No conflict of interest in this study.

Funding

No funding for this study.

Ethical consideration

This literature review did not require institutional ethical approval because it used information from publicly available records.

Author contributions

IMAPK revised the paper and conducted a literature search while NLAU created the study concept, produced the article, and conducted the literature review.

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