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A Literature Review on Effectiveness of Available Physiotherapy Interventions for Chronic Ankle Instability

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Abstract:

Objective: To explore the effectiveness of various physiotherapy interventions for chronic ankle instability.

Methods: Searches were conducted in google scholar, Pubmed, etc. A literature review conducted of only randomized control trial that reported extractable data relevant to the study. The search included studies published between 2015 to 2025. Out of many articles only total of 12 randomized control trial studies were included.

Results: After the segregation process, a total of eleven randomized controlled trial (RCT) articles were identified and presented in tabular form. The search process and selection criteria are illustrated in the accompanying flowchart.

Conclusion: The reviewed studies show that balance-focused and multimodal rehabilitation programs effectively improve proprioception, neuromuscular control, and functional stability in individuals with chronic ankle instability. Interventions such as wobble-board training, device-based balance training, neuromuscular strengthening, and combined therapeutic approaches consistently yield positive short-term outcomes.

Keywords: Chronic ankle instability (CAI); Functional ankle instability (FAI); Rehabilitation; Sports rehabilitation.

INTRODUCTION:

Ankle sprains are the most common musculoskeletal injuries among physically active individuals, with the **lateral collateral ligament complex** being most frequently affected. These injuries range from mild ligament stretching to complete rupture, and more than half involve a tear or rupture of the **anterior talofibular ligament (ATFL)**.[1] the most frequent complication experienced by athletes following an ankle sprain is **chronic ankle instability (CAI)**.[2]

Ankle sprains occur in approximately 8% of the general population, with recurrence rates reaching up to 80% among individuals engaged in high-risk sports.[3] Studies indicate that 40–55% of individuals continue to report residual symptoms such as pain and instability even six months after the initial injury.[4] The lateral ligament complex–consisting of the anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), and posterior talofibular ligament (PTFL) –is particularly vulnerable, with the ATFL affected in up to 85%, the CFL in 50–75%, and the PTFL in less than 10% of cases.[5]

Among the mechanisms of injury, inversion sprains are the most frequent, typically occurring when the foot inverts while plantar flexed, leading to lateral ligament damage.[6] These injuries account for nearly 25% of all musculoskeletal injuries, with almost half occurring during sports that involve running, jumping, or sudden directional changes.[7] If not managed properly, ankle sprains may result in recurrent instability, chronic pain, and long-term functional impairment.[8]

Chronic Ankle Instability (CAI) is characterized by repeated episodes of the ankle "giving way," often accompanied by weakness, pain, and impaired postural control.[9,10] It negatively affects mechanical, sensorimotor, and neurocognitive aspects of balance, underscoring the need for effective rehabilitation

strategies.[11] Improving postural stability and neuromuscular coordination is therefore considered essential in CAI management.[5,7]

Although surgical interventions may restore ligament integrity, they are invasive and involve lengthy recovery periods.[11] In contrast, non-surgical physiotherapy-based interventions, such as wobble board exercises, dynamic neuromuscular stabilization, blood flow restriction training, manual therapy, balance device training, and Kinesio taping, have shown promising outcomes in enhancing balance, proprioception, and functional stability.[1–9] Current research supports a multimodal rehabilitation approach that combines balance and strength training to improve neuromuscular control and prevent recurrence.[7–11]

As research into chronic ankle instability (CAI) treatments evolves, a variety of approaches have emerged, including neuromuscular exercises, taping, and novel device-based interventions. This review critically evaluates current evidence on both balance-oriented and multimodal rehabilitation strategies. The synthesis highlights the outcomes, efficacy, and limitations of these therapeutic approaches, aiming to discern their comparative value and pinpoint crucial areas for future investigation.

Need of the study:

Despite the availability of numerous rehabilitation methods, recovery outcomes for chronic ankle instability remain inconsistent, and there is no clear consensus on the most effective approach. Given the uncertainty surrounding long-term outcomes and the comparative effectiveness of existing interventions, further research is required to identify rehabilitation strategies that provide consistent and lasting improvements in ankle stability and function.

Objective of the study:

This literature review will specifically examine the existing evidence regarding the effectiveness of physiotherapy interventions on chronic ankle instability.

MATERIALS AND METHODS

Inclusion Criteria

1. This study included randomized controlled trial publications that specifically investigate the effects of different kinds of physiotherapy interventions with chronic ankle instability.
2. Only articles published in the English language will be considered.
3. The articles were published between 2015 and 2025.
4. The age range is from 18 to 60 years.
5. Both sexes are encompassed.

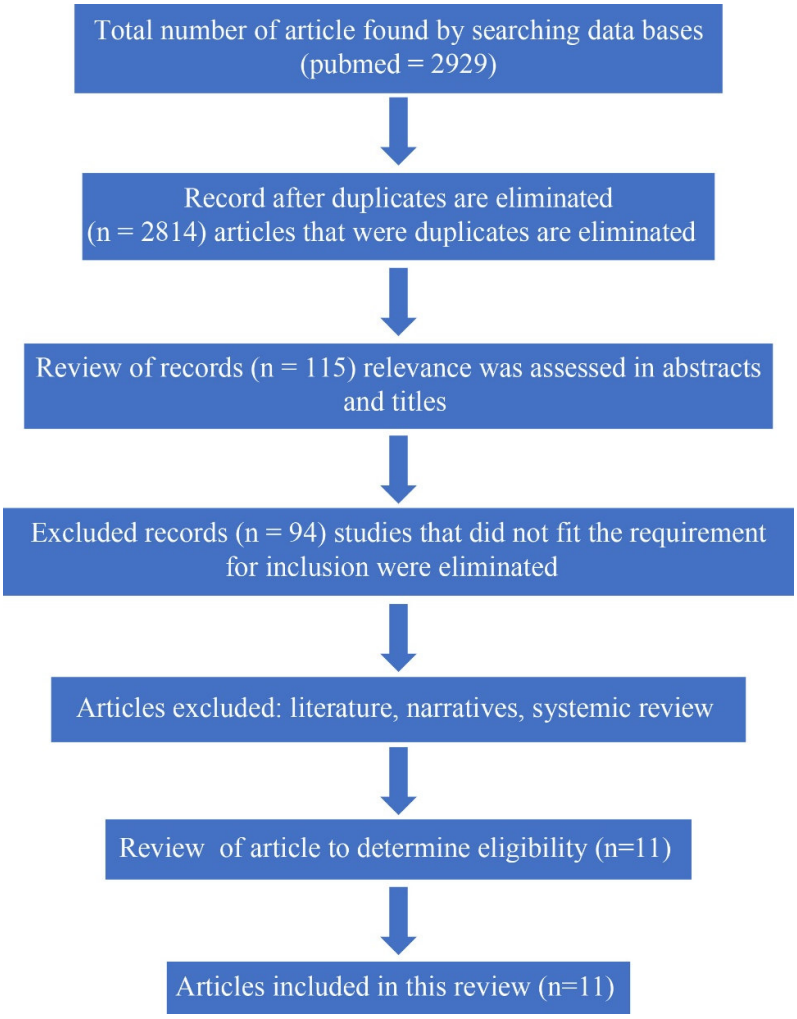
Exclusion Criteria

1. Articles published in languages other than the regional language were omitted.
2. Narrative review, literature other than randomized control trial articles were excluded.
3. Articles published prior to 2015were excluded.
4. Studies those are not relevant to the specified keyword

METHODOLOGY:

The evidence for the present study was systematically gathered from reputable online databases and search engines, including Google Scholar and PubMed. A comprehensive search strategy was employed using specific keywords such as “chronic ankle instability” and “physiotherapy intervention” to identify relevant scholarly publications. The search was limited to studies published between 2015 and 2025 to ensure the inclusion of recent and high- quality evidence from the past decade. Based on the predefined inclusion and exclusion criteria, a total of nine articles were identified as suitable for analysis. All selected studies were obtained in full text and critically reviewed. The extracted data were systematically analysed, and the results have been organised and presented in a tabular format to enhance clarity and facilitate comparative interpretation.

Flow chart:



REVIEW OF LITERATURE

Author, Year	Total No. of Samples	Duration	Intervention	Outcome Measures	Significant Findings
Bermúdez-Egidos et al., 2025	26 (22 completed)	3 weeks (2×/wk)	Flossing + Kaltenborn manual sliding vs placebo flossing/manual without sliding	Loaded dorsiflexion (Leg Motion), goniometer ROM, PPT, RsScan stability	Experimental group improved loaded dorsiflexion, unloaded PF ROM, ellipse area, and bilateral stability vs control.
Yesilkir & Ergezen Sahin, 2025	40 amateur athletes (DNS=13, BT=14, CT=13)	6 weeks (3×/wk)	DNS training; Balance training; Conventional training	YBT, CAIT, FAAM, BESS, FLT, Blaze Pod RT, Side Hop	DNS & Balance training > Conventional across outcomes ($p<0.001$); DNS best for postural control; balance training best for reaction time.

He, Chang & Liu, 2025	49 university students (25 experimental, 24 control)	8 weeks (3×/wk)	Strength training + acupuncture + WBVT vs Strength + acupuncture	CAIT, FAAM, isokinetic strength, proprioception, balance (COP measures)	Adding WBVT improved FAAM-ADL, peak plantarflexion torque, and AP balance more than control; large within-group gains.
Wang et al., 2025	40 (21 controls) CAI, 19	Cross-sectional	Stair riser manipulation (15, 17.5, 20 cm) with AIDASD apparatus	Ankle inversion proprioception (discrimination accuracy)	CAI group performed worse across heights; proprioception decreased with increased riser height; riser height effect significant.
Yu 2025 et al.,	31 (16 CAI, 15 non-CAI)	Acute lab experiment (immediate effects)	KT short, lengths mid, long	Y-Balance Test (anterior, PM, PL)	Longer KT reduced CAI vs non-CAI difference; CAI group improved dynamic balance (esp. PM, PL) with longer taping.
Chai et al., 2024	24 patients (12 dual-task, 12 single-task)	6 weeks (3×/wk)	Dual-task balance (cognitive load) vs single-task progressive balance	EEG (theta/alpha/beta), JPS, PL/TA onset, SEBT	Both groups improved; dual-task increased cortical theta/alpha, better JPS (PF), and faster PL onset.
Mahmoud et al., 2023	39 female CAI (3 groups)	4 weeks (3×/wk)	BFR alone; BFR + rehab; Rehab only	Isokinetic strength, dynamic balance (OASI/APSI/MLSI), FADI	BFR alone: no significant improvement. BFR + rehab and Rehab: significant strength and balance gains; FADI improved only in combined/rehab groups.
Hou et al., 2022	20 young adults	3 months + 1-year follow-up	Supervised balance training (24 sessions, 2×/wk 60 min) incl. wobble board, hops, band work	FAAM, CAIT, TTB, COP, plantar pressure, isokinetic strength	Significant improvements in function, balance, and strength after 3 months; some declines by 6–12 months; 80% no recurrent sprain.
Cruz-Díaz et	70 recreational athletes (25 self- mob+CrossFit,	12 weeks (CrossFit	Ankle self-mobilization +	WBLT (DFROM),	Both interventions

al., 2020	24 CrossFit, 21 control)	2×/wk)	CrossFit vs CrossFit alone	CAIT, SEBT	improved vs control; self-mobilization + CrossFit superior to CrossFit alone for DFROM and posterolateral/posteromedial SEBT reaches.
Wright,	8 athletes	8 weeks	Wobble-board training	GRF, Perceived Stability,	Majority improved perceived stability;
Nauman & Bosh, 2020		(measured 0, 4, 8, 12)	(5×40s sets; progressive)	Pain, recurrent sprains	Pain decreased in symptomatic athletes; zero re-sprains during intervention.
Linens, Ross & Arnold, 2016	34 (17 rehab, 17 control)	4 weeks	Wobble board rehab (3×/wk; progressive levels)	Foot Lift Test, Time-in-Balance, SEBT, hop tests	Significant improvements in static (Foot Lift) and dynamic balance (SEBT, hop tests); control no change.

DISCUSSIONS:

The aim of this literature review was to gather and categorize papers focused on reducing or treating the chronic ankle instability by physiotherapy interventions. This review was conducted to identify effective physiotherapy techniques to gain more exposure of what more techniques are there related to physiotherapy to treat chronic ankle instability.

We identified several relevant articles in a variety of reputable journals that correspond to our keywords. After examining the inclusion and exclusion criteria, we were able to gather 11 articles in the form of randomized controlled trials (RCTs) from the years 2015 to 2025. These articles will be further analysed. Randomized controlled trials (RCTs) were selected due to their inclusion of exercise protocols and the author's perspectives or findings, as compared to review articles.

All 11 articles had a distinct outcome measures to confirm diagnosis and all interventions routine tailored to fit the individual needs were there in their respective test groups.

After analysing 11papers, all studies demonstrated positive outcomes. Furthermore, the impact is optimized when participants receive a combination intervention rather than a single intervention.

The research duration ranged from 3 weeks to 1 year, which is considered sufficient for improving chronic ankle instability. It is evident that a longer training period would yield even better results for the participants

The studies included in this review used several outcome measures to evaluate improvements in chronic ankle instability. Common assessments included functional questionnaires such as the CAIT and FAAM, as well as balance tests like the Star Excursion Balance Test, Y-Balance Test, and Foot Lift Test. Researchers also measured proprioception through joint position sense, muscle reaction time using EMG, and ankle strength with isokinetic testing. Some studies added functional performance tests such a shop tests and reaction-time tasks. Together, these measures helped determine changes instability, strength, and overall ankle function after rehabilitation.

Linens et al. (2016) conducted a randomized controlled trial titled *"Wobble Board Rehabilitation for Improving Balance in Ankles with Chronic Instability."* The study included 34 physically active adults with chronic ankle instability, randomly assigned to either a wobble-board rehabilitation group or a control group. Participants in the rehabilitation group completed four weeks of wobble-board training, performed three times per week. Balance outcomes were measured pre- and post-intervention using the Foot Lift Test, Time-in-Balance Test, SEBT, Side Hop Test, and Figure-of-Eight Hop Test.Wobble-board training stimulates ankle proprioceptors by continuously challenging balance and joint position sense, enhancing afferent feedback to the central nervous

system. This leads to improved neuromuscular control, postural stability, and coordination. Repeated perturbations retrain the peroneal muscles to respond more rapidly to inversion stresses, thereby reducing recurrent sprains. Results showed significant improvements in nearly all static and dynamic balance measures in the rehabilitation group, while the control group demonstrated no meaningful changes. The authors concluded that a simple, single-exercise wobble-board program is effective for improving balance deficits in individuals with chronic ankle instability.

Wright et al. (2020) conducted an exploratory case series titled *"Wobble-Board Balance Intervention to Decrease Symptoms and Prevent Reinjure in Athletes with Chronic Ankle Instability."* The study examined eight intercollegiate athletes with chronic ankle instability who completed an eight-week wobble-board training program performed three times per week in a realistic athletic training environment. The intervention resulted in meaningful improvements in self-reported ankle stability for most participants and moderate improvements in pain, although global function changes were limited. Athletes with greater baseline deficits showed the largest benefits, and no ankle sprain reinjures occurred during the intervention period. The authors concluded that this simple, single-exercise wobble-board protocol is feasible in real-world sports environments and can effectively enhance stability and reduce symptoms in athletes with chronic ankle instability.

Hou et al. (2022) conducted a one-year prospective study titled "The Effectiveness and Sustainability of Supervised Balance Training in Chronic Ankle Instability with Grade III Ligament Injury." The study involved 20 young adults with chronic ankle instability who completed a three-month supervised balance-training program and were followed up at 3, 6, and 12 months. Participants showed significant improvements in self-reported function, plantar pressure distribution, postural stability, and isokinetic muscle strength immediately after training. However, some gains—particularly in dorsiflexion and eversion strength and certain postural control measures—partially declined at six months and one year. During follow-up, 80% of participants returned to normal activity without reinjure, while 20% experienced recurrent sprains; those with higher Beighton scores and weaker baseline inversion strength were more likely to reinjure. Structured balance and proprioceptive exercises retrain sensorimotor control pathways impaired after ligament injury. The repeated dynamic postural challenges enhance integration between visual, vestibular, and somatosensory systems, improving joint stability and movement efficiency. The authors concluded that supervised balance training is effective for improving function and stability in individuals with severe ligament injury, though long-term maintenance may require additional strength training from six months onward.

Chai et al. (2024) compared six weeks of dual-task balance training—combining balance exercises with a cognitive task—to traditional single-task balance training in adults with chronic ankle instability. Both groups improved proprioception, postural control, and peroneus longus muscle response, but the dual-task group demonstrated greater gains in joint position sense, faster muscle activation, and higher cortical activity. Incorporating a cognitive load (e.g., counting or memory tasks) during balance exercises activates cortical regions responsible for attention and motor planning. This dual activation enhances cortical plasticity and motor control efficiency, improving joint position sense, muscle reaction timing, and balance under real-life multitasking conditions. Overall, adding a cognitive challenge made balance training more effective than balance exercises alone.

Mahmoud et al. (2023) examined whether blood flow restriction (BFR) used alone could improve muscle strength, dynamic balance, and physical function in women with chronic ankle instability. Thirty-nine participants were assigned to BFR alone, rehabilitation alone, or rehabilitation combined with BFR for four weeks. Results showed that only the rehabilitation and combined BFR + rehabilitation groups improved muscle strength, balance, and function, while the BFR-only group showed no meaningful improvements. BFR partially restricts venous return while maintaining arterial inflow, creating a hypoxic environment that induces early fatigue and recruits fast-twitch muscle fibers even with low loads, thereby stimulating hypertrophy and strength gains. When combined with rehabilitation, it accelerates neuromuscular adaptation and enhances strength and dynamic stability in CAI. The study concluded that BFR alone is not effective, but when combined with traditional rehabilitation, it enhances outcomes.

Bermúdez Egidos et al. (2025) tested whether a three-week physiotherapy program combining flossing bands with manual therapy could improve ankle function in adults with a history of recurrent ankle sprains. Twenty-six participants were randomly assigned to either an experimental group receiving flossing with real compression and joint-sliding techniques or a placebo group receiving the same procedures without tension or real mobilization. The experimental group showed greater improvements in dorsiflexion under load, plantar flexion, and selected stability measures, while both groups improved in pain thresholds. The elastic compression bands temporarily restrict blood flow and create shearing between soft tissues during movement, enhancing fascial gliding and joint mobility. When combined with Kaltenborn joint mobilization, it improves capsular extensibility, dorsiflexion range, and proprioceptive input, leading to better ankle kinematics and postural stability. The study concluded that flossing combined with manual therapy can enhance ankle mobility and stability measures in individuals with previous ankle sprains.

Yesilkir and Ergezen Sahin (2025) compared three rehabilitation methods–Dynamic Neuromuscular Stabilization (DNS), balance training, and conventional physiotherapy–in 40 amateur athletes with chronic ankle instability. After six weeks of training, both the DNS and balance-training groups showed greater improvements in neuromuscular control, balance, functional performance, and self-reported ability than the conventional physiotherapy group. DNS produced the most substantial gains in postural control, while balance training improved reaction time the most. DNS retrains motor control patterns based on developmental kinesiology principles by activating deep core and stabilizing muscles, optimizing intra-abdominal pressure, and restoring central stabilization between the trunk and extremities. This enhances postural control, balance, and coordinated functional movement in CAI patients. All groups improved over time, and no adverse events occurred. The authors concluded that DNS and balance training are more effective than conventional physiotherapy for improving function in athletes with chronic ankle instability.

He, Chang, and Liu (2025) compared two rehabilitation approaches in 49 university students with chronic ankle instability: strength training combined with acupuncture, and the same program supplemented with whole-body vibration training (WBVT). After eight weeks, both groups improved in ankle function, strength, balance, and proprioception, but the WBVT group demonstrated greater improvements, especially in daily activity function, plantar-flexion strength, and anterior–posterior balance control. WBVT induces rapid, low-amplitude muscle contractions through stretch reflex activation, enhancing muscle spindle sensitivity and proprioceptive feedback. When combined with strength training and acupuncture—which improve local circulation and neuromuscular function—this results in superior gains in balance, strength, and functional stability. No major adverse events were reported. The study concluded that adding WBVT made the rehabilitation program more effective than strength training and acupuncture alone for improving chronic ankle instability.

Wang et al. (2025) investigated how stair riser height affects ankle proprioception in individuals with chronic ankle instability compared to healthy participants. Forty university students descended custom-built stairs with three different riser heights (15 cm, 17.5 cm, and 20 cm), while ankle inversion proprioception was measured using a specialized testing device. Results showed that individuals with CAI consistently exhibited poorer proprioceptive ability than healthy participants, and proprioception decreased in both groups as riser height increased—especially beyond 15 cm. The study demonstrates that increased riser height challenges ankle joint position sense. In CAI, impaired mechanoreceptor feedback from ligaments reduces proprioceptive accuracy, which worsens under higher mechanical demands. The authors highlighted that higher steps may increase the risk of ankle sprains and emphasized the need for proprioceptive retraining and safer stair design for individuals with CAI.

Yu et al. (2025) examined how different kinesiology taping lengths—short, mid, and long strips—affect dynamic balance in 31 individuals with and without chronic ankle instability. All participants completed Y-Balance Test assessments under four conditions, and results indicated that taping improved balance only in those with CAI. Elastic tape microscopically lifts the skin, reducing pressure on subcutaneous mechanoreceptors and enhancing sensory input from the ankle joint. This improves proprioceptive awareness and dynamic balance by facilitating more accurate muscle activation and joint alignment during movement. Long taping produced the greatest improvements, significantly increasing composite, posteromedial, and posterolateral reach scores, while short and mid taping improved only posteromedial reach. Participants without CAI showed no meaningful changes under any taping condition. The study concluded that longer kinesiology taping is most effective for enhancing dynamic balance in individuals with chronic ankle instability.

López-Valenciano et al. (2025) compared the effects of a 12-week CrossFit training program with and without added ankle self-mobilization in 70 recreational athletes with chronic ankle instability. Both intervention groups improved ankle dorsiflexion, dynamic balance, and self-reported function compared to the control group, but the group performing self-mobilization alongside CrossFit demonstrated the greatest gains—particularly in dorsiflexion mobility and posteromedial/posterolateral balance reach. The combined approach also produced larger improvements in perceived ankle stability. The authors concluded that adding ankle self-mobilization enhances the effectiveness of a CrossFit-based rehabilitation program for improving chronic ankle instability.

LIMITATION AND RECOMMENDATION:

Most of the included randomized controlled trials had small sample sizes and short intervention durations, limiting the generalizability and long-term applicability of their findings. Lastly, while combined and advanced physiotherapy techniques showed promising effects, evidence remains limited to determine their long-term superiority over conventional rehabilitation methods. Further research should also compare multimodal and advanced techniques to identify the most effective approaches for chronic ankle instability

CONCLUSION:

This review concludes that balance-focused and multimodal physiotherapy interventions effectively enhance proprioception, neuromuscular control, and functional stability in individuals with chronic ankle instability.

Combining multiple rehabilitation methods yields more consistent improvements than single-modality approaches.

DECLARATIONS:

Ethics approval and consent to participate: NA

Availability of data and material: Data openly available in a public repository that issues datasets with DOIs.

Competing interest:

None Funding:

NA

Author's contribution:

Vijay.T- Conceptualization, design, data collection, implementation, monitoring, data analysis, interpretation and manuscript writing.

R Sedhunivas - Title formation and final manuscript review. Arnold Nikhilesh - Title formation and final manuscript review.

ABBREVIATION:

1. **CAI** – Chronic Ankle Instability
2. **FAI** – Functional Ankle Instability
3. **RCT** – Randomized Controlled Trial
4. **CAIT** – Cumberland Ankle Instability Tool
5. **FAAM** – Foot and Ankle Ability Measure
6. **SEBT** – Star Excursion Balance Test
7. **YBT** – Y-Balance Test
8. **BFR** – Blood Flow Restriction
9. **WBVT** – Whole-Body Vibration Training
10. **DNS** – Dynamic Neuromuscular Stabilization
11. **EMG** – Electromyography
12. **ROM** – Range of Motion
13. **COP** – Center of Pressure
14. **DFROM** – Dorsiflexion Range of Motion
15. **PL/TA** – Peroneus Longus / Tibialis Anterior
16. **GRF** – Ground Reaction Force

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