



International Journal of Medical and Exercise Science

(Multidisciplinary, Peer Reviewed and Indexed Journal)

ORIGINAL ARTICLE

COMPARATIVE STUDY OF EFFECTIVENESS OF RESISTANCE VS PROPRIOCEPTIVE TRAINING IN PATIENT WITH CHRONIC ANKLE INSTABILITY

Search engine:
www.ijmaes.org

Jibi Paul^{1*}, V. Sanjay²

Author:

¹BPT Student, Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Vellapanchavadi, Chennai, Tamil Nadu, India

Corresponding Author:

²Professor, Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Vellapanchavadi, Chennai, Tamil Nadu, India, E-Mail- physiojibi@gmail.com

ABSTRACT

Background of the Study: Chronic ankle instability caused by recurrent injuries to the lateral ankle ligament that includes limited mobility perceived instability and recurrent ankle sprain. It affects physical activity especially in individual engaging in repetitive activities. This study is to compare the effect of resistance training VS proprioceptive training in patient with chronic ankle instability. Objectives of the study were to find the comparative effect of resistance training VS proprioceptive training in patient with chronic ankle instability and also to find the effect of resistance training in patient with chronic ankle instability. **Methodology:** The study design was quasi – experimental. The study type was Comparative. The sampling method used was random sampling. The study was conducted in the outpatient department of the Faculty of Physiotherapy at ACS Medical College and Hospital Campus. Sample size was 30 participants; Group A = 15, Group B = 15 and the study duration was 6 months. The treatment duration was 6 weeks, each subject received four treatment sessions per week. Outcome Measure was Ankle function and Balance. Measurement Tool was Y – Balance Test and FAAM – Foot and Ankle Ability Measurement. **Result:** On comparing pre-test and post-test using proprioceptive and resistance training ,30 participants of group A and group B Both groups showed statistically significant improvement in all measured outcomes with p values <0.0001 indicating that both intervention were effective. However, Group A (proprioceptive Training) demonstrated greater mean difference across all variable, with statistically more effective over Group B. **Conclusion:** From the research and statistical analysis, the study concluded that Proprioceptive Training is more effective in improving the functional stability of the CAI.

Keywords: Chronic ankle instability, resistance, proprioceptive training, Ankle function and Balance

Received on 26th July 2025; Revised on 24th August 2025; Accepted on 27th August 2025
DOI:10.36678/IJMAES.2025.V11I03.14

INTRODUCTION

Chronic ankle instability (CAI) is a condition defined by repeated episodes or perceptions of the ankle giving way; ongoing symptoms such as pain, weakness, or reduced ankle range of motion (ROM); decreased self-reported function; and recurrent ankle sprains lasting more than a year after the initial injury^[1]. Symptoms like pain, weakness, or decreased ankle range of motion (ROM), decreased self-reported function, and recurrent ankle sprains that continue for more than a year following the initial injury are all signs of chronic ankle instability (CAI). One of the most causes of CAI is ankle sprains. Ankle sprains are the most common injury reported by competitive athletes and are also among the most prevalent ailments in the general population.

Regardless of patient demographics, the majority of ankle sprains are caused by damage to the ankle's lateral ligaments. Lateral ankle sprains (LASs) and associated after effects are a public health concern due to their incidence, high rates of reinjury, enduring symptoms, and decreased self-reported ankle function. Recurrent episodes or sensations of the ankle giving way, persistent^{1,2}.

The risk of injury is influenced by a complex interaction of internal or intrinsic risk factors such as age, gender, body composition, health (a history of ankle-joint damage), physical fitness (muscle strength, anatomy), skill level (postural balance), and psychological variables³.

The majority of CAI literature has been geared toward adult populations (aged 18-40).¹⁴ Furthermore, research on the incidence and prevalence of CAI have utilized a variety of operational criteria to define CAI, resulting in

nonuniform rates, as shown in a recent meta-analysis by Doherty et al.⁵ In terms of prevalence, more than 25% of adults who participate in sports report having CAI or recurrent sprains^{2,39,45,47}, with dancing having a prevalence of up to 75%.⁴³ Aside from sports, roughly 20% of persons in the general population with a history of lateral ankle sprains report chronic problems with the affected ankle.²⁰ Currently, very little is known about the occurrence and impact of CAI in teenage populations⁴.

The anterior talofibular ligament (ATFL), which is most frequently injured in a lateral ankle sprain, is the weakest ligament with the lowest ultimate stress in terms of anatomical placements and insertions. The calcaneofibular ligament (CFL), which runs obliquely, is larger and stronger than the ATFL. The posterior talofibular ligament (PTL) is a trapezoidal ligament that is thick, strong, and rarely injured. It is located in horizontal plane⁵.

The FAAM is a well-established, extensively translated, and validated measure for assessing physical function in persons with different musculoskeletal problems of the lower extremities, including the leg, ankle, and foot⁶. A tool for assessing physical function and activities of daily living (ADL) from a patient-reported standpoint in people with foot and ankle impairments is the Foot and Ankle Ability Measure (FAAM). Orthopaedic surgeons frequently employ the FAAM, which was first created in 2005 by Martin et al. and has been validated for foot and ankle assessment^{1 to 4}. The 29-item FAAM is divided into 8 sport subscales (Sports) and 21 ADL subscales. Several languages, including Dutch, Turkish, French, Japanese, Chinese, Persian, and

Spanish, have translations and cross-cultural validations of the FAAM (5 To 11). Additionally, the FAAM's Finnish version has been created and approved⁷.

Balance is described as the ability to maintain a posture while doing voluntary tasks and coping with internal and external disturbances.^{13, 14} Many doctors employ postural control exams to estimate the risk of injury and rate of recovery,¹⁵ and one frequent balance assessment used in this approach is the y balance test (YBT)⁸. The Y Balance Test (YBT) is a low-cost clinical assessment of dynamic balance that simulates the demands of exercise requiring unilateral balance. Additionally, it has been used as a clinical outcome measure to measure functional improvement and guide activity progression after injury⁹.

When comparing the effects of strength and balance training protocols on clinical and patient-reported outcomes, a research team found that both are equally effective. However, they were unable to identify which intervention was better than the other. Examining individual outcomes, however, may reveal the distinctiveness of each intervention: While the Balance Error Scoring System scores decreased after the balance-training program, the eccentric strength of eversion increased after the strength-training regimen¹⁰.

The most popular type of rehabilitation therapy was strength and balance training. Strength and balance training therapy aims to address modifiable impairments seen in people with CAI, including decreased muscle strength, poor neuromuscular control, impaired proprioception, changed gait pattern, and limited range of motion¹¹ Strength

training, a type of exercise therapy, has long been used to maintain or increase strength, but its usefulness as a treatment intervention for chronic ankle instability (CAI). The goal of this study was to assess the effects of strength training, no exercise, and neuromuscular control training on balance and self-reported function in adults with CAI¹².

Proprioceptive training is any sort of training that tries to improve balance (static and dynamic) by creating proprioceptive receptors that positively affect the stability of a joint during both static and dynamic functional tasks¹³ Chronic ankle instability can impair the mechanoreceptors of the damaged joints. When standing on one foot, the ankle joint with an ankle sprain requires less maintenance time than the opposite ankle joint with no injury. To measure static and dynamic proprioception, highly competent methods for assessing the impact of musculoskeletal injuries on balance were developed¹⁴.

A common component of the recovery process following lateral ankle sprains (LASs) is strength training. As soon as range of motion is pain-free and resistive forces are tolerable, strength-training exercises are actually frequently started. Restoring the athlete to involvement as soon as feasible is the main objective of rehabilitation. Nevertheless, despite medical interventions to stop recurrent sprains, some athletes nevertheless experience their side effects¹⁵.

Any form of training intended to increase balance (both static and dynamic) by cultivating proprioceptive receptors that enhance joint stability during both static and dynamic functional activities is referred to as proprioceptive training. Dynamic progressive

exercises like hop-to-stabilization drills and single-limb stance exercises on an unstable surface are examples of proprioceptive protocols¹⁶.

Applying effort to overcome resistance is known as resistance training. This improves neuromuscular control and promotes muscle growth by increasing muscle fibre activation and strengthening synchronization. In addition to being less expensive, elastic resistance training can produce strength increases comparable to those of traditional resistance training. Because not all physiotherapy centres can afford pricey equipment, elastic bands are frequently provided to physiotherapists¹⁷.

The majority of the indicators that were examined were spatiotemporal, and changes in gait have been reported in CAI. Those with CAI had a broader base of support but shorter steps, cadence, walking speed, and single limb time. Patients may adopt a modified gait to compensate for their perceived instability, which could explain these alterations in gait [28, 29]. Therefore, these modifications may negatively affect neuromuscular strategies and motor function¹⁸.

The severity of lateral ligament sprains varies. Acutely, this is classified as ligament stretching, partial tear, or total tear. In addition to harming the ligaments, acute sprains interfere with regular brain function. The proximal joints are also impacted by the biomechanical alterations in the lower extremities brought on by chronic ankle instability (CAI), which raises the risk of joint damage¹⁹.

Aim of the Study: This study is to compare the effect of resistance training VS proprioceptive

training in patient with chronic ankle instability.

Need of the study: Chronic Ankle Instability (CAI) affects individuals with a history of repeated ankle sprains, leading to impaired proprioception, neuromuscular control deficits, decreased strength, and functional limitations. Despite its prevalence, there is a lack of effective treatment options for CAI, with many individuals experiencing persistent symptoms and reduced quality of life.

This study aims to investigate the effects of proprioceptive training and resistance training in individuals with CAI. The findings of this study will contribute to the development of effective treatment options for CAI, ultimately improving the quality of life for individuals affected by this condition.

METHODOLOGY

The study design was quasi – experimental. The study type was Comparative. The sampling method used was random sampling. The study was conducted in the outpatient department of the Faculty of Physiotherapy at ACS Medical College and Hospital Campus. Sample size was 30 participants; Group A = 15, Group B = 15 and the study duration was 6 months. The treatment duration was 6 weeks, each subject received four treatment sessions per week. Outcome Measure was Ankle function and Balance. Measurement Tool was Y – Balance Test and FAAM – Foot and Ankle Ability Measurement.

Inclusion Criteria: History of ankle sprain, Functional limitation of activity, Age group 18-35.

Measurement Tools:

Y – Balance Test: The Y-Balance Test (YBT) is a reliable tool to assess dynamic balance, proprioception, and neuromuscular control, especially in individuals with Chronic Ankle Instability (CAI). It helps identify deficits and asymmetries in lower limb function, which can contribute to ankle sprains and instability.

2. FAAM –Foot and Ankle Ability Measure: The Foot and Ankle Ability Measure (FAAM) is a self-reported questionnaire used to assess the functional limitations and overall impact of foot and ankle injuries, including Chronic Ankle Instability (CAI). It is widely used in clinical and research settings to measure progress in rehabilitation. Material Used for the study was Resistance band.

Procedure: The research approval will be obtained from the institutional review board of faculty of physiotherapy, outpatient department, Dr. M.G.R Educational and Research Institute.

A total 30 subjects were selected and divided into two groups who have fulfilled the inclusion criteria were assigned into two groups consisting of 15 subjects each. Both male and female subjects were included age group between 18-35 years. They were provided with informed consent prior the study.

A detailed explanation about the treatment protocol was given to the patient. Demographic data like name, age, sex, chief complaints were collected and they are selected by random sampling method.

Group A:

Proprioceptive Training: Proprioceptive exercises are essential for individuals with Chronic Ankle Instability (CAI) to enhance balance, coordination, and joint stability. Proprioceptive exercises significantly improve the dynamic balance activities such as single-leg stands, balance board exercises and improve postural control. This routine can be done 3-4 times per week to improve strength, ankle stability and function and reduce the risk of further ankle injuries.

Group B: Resistance Training: Resistance training for Chronic Ankle Instability (CAI) focuses on strengthening the muscles around the ankle, improving neuromuscular control, and enhancing stability to prevent further injury. This routine can be done 3-4 times per week to improve strength, stability, and reduce the risk of further ankle injuries.

Intervention Groups:**Group A: Proprioceptive Training:**

1. Single leg stand: Single Leg Stance is a balance exercise where an individual stands on one leg while keeping the other leg lifted off the ground. It helps improve static balance, ankle stability, proprioception, and lower limb strength. The arms are usually placed on the hips, and the eyes focus straight ahead.

Steps: Position: Stand barefoot on one foot on a flat surface, Time: Hold for 30–60 seconds, Format: 3 sets of 10–15 reps, Rest: 30–60 seconds between sets.

2. Tandem Stance: Tandem Stance is a balance exercise where an individual stands with one foot placed directly in front of the other, heel touching toe, as if standing on a tightrope.

Steps: Stand upright with feet together, arms relaxed at sides, Position: Place one foot directly in front of the other (heel-to-toe). Look straight ahead and maintain balance, Time: Hold for 30–60 seconds.

Format: 3 sets of 10–15 reps. Rest: 30–60 seconds between sets.

3. Lateral Hops: Lateral hops are a plyometric and balance exercise where an individual jumps side-to-side over a line or object using one or both feet. This exercise helps improve ankle stability, proprioception, and coordination.

Steps: Stand on one leg (or both feet for beginners) beside a line or cone, knees slightly bent arm at sides.

Position: Hop sideways over the line or object and immediately hop back to the starting side. Keep movements quick and controlled. Land softly with knees slightly bent.

Time: Hold for 30–60 seconds.

Format: 3 sets of 10–15 reps. Rest: 30–60 seconds between sets.

Group B Resistance Training

1. Ankle Dorsiflexion Exercise: Ankle dorsiflexion exercises are movements that strengthen and mobilize the muscles responsible for lifting the foot upward toward the shin.

Steps: Sit on a chair or lie down with legs extended. Keeps the heel resting on the ground and the foot relaxed.

Slowly pull your toes and foot upward toward your shin (dorsiflexion), hold for 2–3 seconds, then slowly return to the starting position.

Keep the movement slow and controlled.

Time: Hold for 30–60 seconds. Format: 3 sets of 10–15 reps.

2. Ankle Plantar flexion Exercise: Ankle plantar flexion exercises involve pointing the foot downward, away from the shin, by engaging the calf muscles—mainly the gastrocnemius and soleus.

Steps: Sit on a chair or lie down with legs extended, heel resting on the floor. For resistance, loop a resistance band around the ball of the foot and hold the ends.

Point your toes downward, pushing against the resistance (plantarflexion). Hold for 2–3 seconds, then slowly return to the starting position.

Time: Hold for 30–60 seconds.

Format: 3 sets of 10–15 reps.

3. Ankle Inversion Exercise: Ankle inversion exercises involve turning the sole of the foot inward toward the midline of the body. These exercises target the tibialis posterior, tibialis anterior and other stabilizing muscles on the inside of the ankle.

STEPS: Sit on the floor or a chair with your legs extended. Loop a resistance band around the forefoot and anchor the other end to a stable object on the outside of the foot.

Slowly pull your foot inward (sole turns toward the midline) against the resistance of the band. Hold for 2–3 seconds, then return slowly to the starting position.

Time: Hold for 30–60 seconds.

Format: 3 sets of 10–15 reps.

1. Ankle Eversion exercise: Ankle eversion exercises involve moving the sole of the foot outward, away from the midline of the body. These exercises primarily target the peroneal muscles (peroneus longus and brevis) and help

improve lateral ankle strength, stability, and proprioception

Steps: Sit on the floor or a chair with your legs extended. Loop a resistance band around the forefoot and anchor the other end to a stable object on the inside of the foot (toward the opposite leg). Pull your foot outward (sole turns away from the midline) against the resistance of the band. Hold for 2–3 seconds, then return slowly to the starting position.

Time: Hold for 30–60 seconds. **Format:** 3 sets of 10–15 reps.

Data Analysis: The collected data were tabulated and analyzed using both descriptive

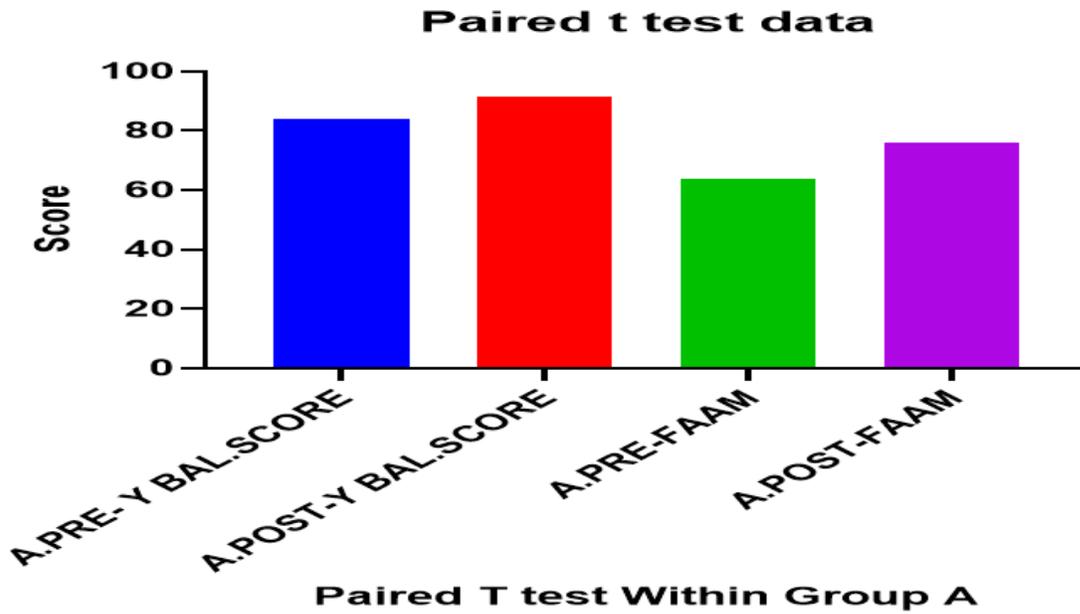
and inferential statistics. All the parameters were assessed using Graph Prism Pad version 8.4.3, with a significance level of p value less than 0.05 and a 95% confidence interval set for all analysis. The Shapiro Wilk test was used to determine the normality of the data. In this study, Shapiro Wilk test showed that the data was normally distributed on the dependent values at $P > 0.05$. Hence parametric test was adopted. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to find statistical difference between the groups.

Group A:

Table 1: Paired t test within Group A on Y-Balance Test Composite Score and FAAM

Group A	Number of Pairs	Mean Diff.	SD, SEM	df	t	P value	Sig.Diff. (P < 0.05)
Y-Balance Test Composite Score	15	7.13	1.30 0.34	14	21.22	<0.0001	****
FAAM	15	12.47	4.96 1.28	14	9.74	<0.0001	****

The above table 1 shows significant difference in Y-Balance Test Composite Score and FAAM within Group A with P value <0.0001



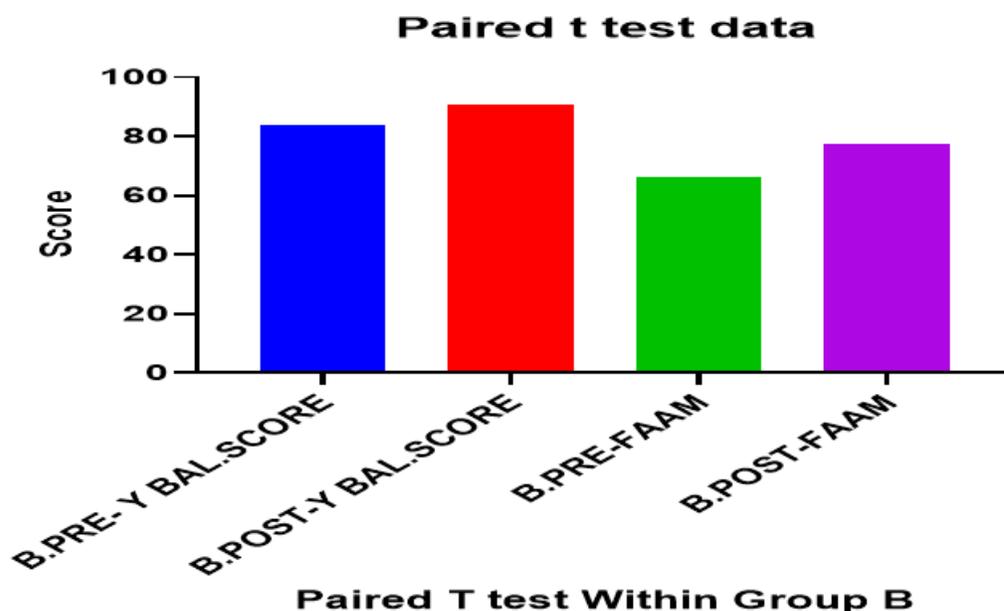
Graph 1: Presentation of Y-Balance Test Composite Score and FAAM within Group A

Group B:

Table 2: Paired t test within Group B on Y-Balance Test Composite Score and FAAM

Group B	Number of Pairs	Mean Diff.	SD, SEM	Df	t	P value	Sig. Diff. (P < 0.05)
Y-Balance Test Composite Score	15	7.00	2.20 0.57	14	12.30	<0.00 01	****
FAAM	15	11.07	2.09 0.54	14	20.54	<0.00 01	****

The above table 2 shows significant difference in Y-Balance Test Composite Score and FAAM within Group B with P value <0.0001



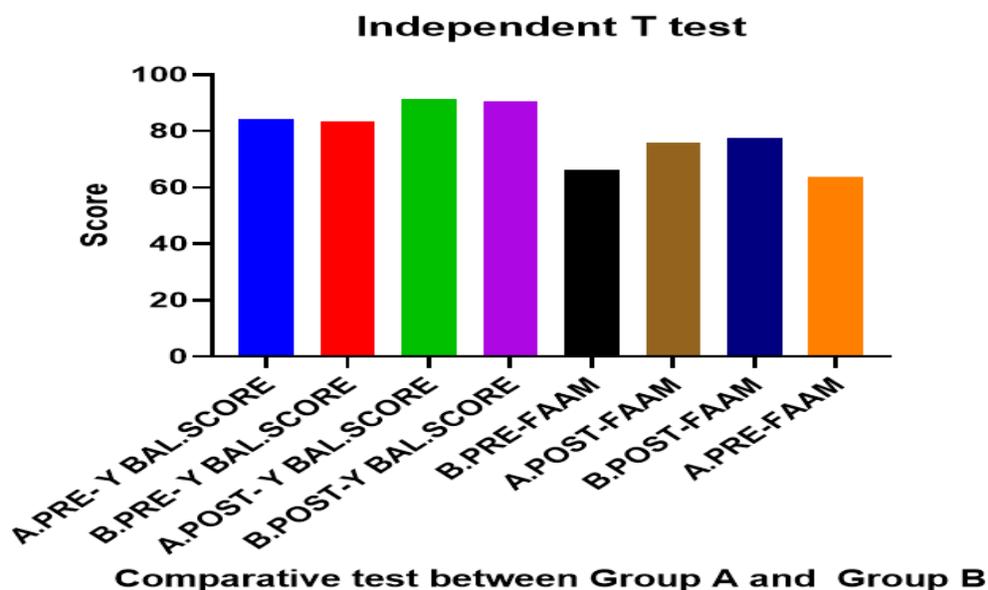
Graph 2: Presentation of Y-Balance Test Composite Score and FAAM within Group B **Comparative Test** between Group A and Group B

Table 3: Independent t test between Group A and Group B

Group A&B		Number of Pairs	Mean Diff. ± SEM	R	DF	t	P value	Sig. Diff. (P < 0.05)
Pre test	Y-Balance Test Compo site Score	30	0.60 0.77	0.02	28	0.78	0.44	NS
	FAAM	30	2.80 1.51	0.11	28	1.86	0.07	NS

Post test	Y-Balance Test	30	0.73	0.02	28	0.78	0.44	NS
	Compo site Score		0.94					
	FAAM	30	1.40	0.07	28	1.45	0.16	NS
			0.97					

The above table 3 shows NO significant difference on Pre Test and Post test of YBalance Test Composite Score and FAAM between Group A and Group B with P value 0.44, 0.07, and 0.44, 0.16 respectively.



Graph 3: Presentation of Y-Balance Test Composite Score and FAAM between Group A and Group B

RESULT

Total 30 participants, 22 male and 8 female subjects were included in the study based on specific selection criteria and divided in to 15 samples in each Group A and Group B. Participants were with age group between 20 and 35 years.

In this study, the comparative effect of Group A over Group B on Y-Balance Test Composite Score and FAAM shows significant difference with P value 0.44 and 0.16 respectively. Group A found effective on Y-Balance Test Composite Score and FAAM with mean score difference of 7.13 and 12.47 with p value <0.0001 respectively

Group B also found effective on Y-Balance Test Composite Score and FAAM with mean score difference of 7.00 and 11.07 with P value <0.0001 respectively. Group A intervention found more effective over Group B intervention on Y-Balance and FAAM with mean score difference of 7.13 and 12.47 over 7.00 and 11.07 respectively.

DISCUSSION

Chronic ankle instability caused by recurrent injuries to the lateral ankle ligament that includes limited mobility, perceived instability and recurrent ankle sprain. It affects physical activity especially in individual engaging in repetitive activities. This study was aimed to compare the effectiveness of proprioception training and resistance training in individual with chronic ankle instability.

In this study 30 subjects were selected and 15 subjects were studied in group A and 15 subjects were studied in group B. Group A and Group B followed a course of training for a period of 8 weeks with 4 sessions per week. On comparing pretest and post- test value of Group A who were treated with proprioceptive training in patients with CAI shows significant improvement in balance and functional stability. Group B who were treated with resistance training also showed significant improvement in balance and stability. Y Balance test and FAAM questionnaire were used as an outcome measuring tool. Proprioceptive training targets the sensory feedback mechanisms that help the body detect changes in joint position and respond appropriately to prevent excessive ankle movement or re-injury. Resistance training enhances the strength of the muscle

surrounding the ankle, particularly the peroneal muscle, which are essential for maintained joint stability during dynamic movement.

The study concluded that participants with increased peroneal muscle echogenicity exhibited poorer outcomes, including peroneal muscle atrophy, diminished eversion strength, and compromised balance functions in patients with CAI. Future rehabilitation programmes should concentrate on enhancing peroneal muscle architecture as a potential therapeutic strategy²⁰.

The pathological limb of CAI patients reported inferior results compared to the non-dominant limb of healthy individuals while performing monopodal CMJs, DJs, and side-hop tests. Concerning between-limbs results, LSI in the patients affected by CAI was significantly lower compared to the uninjured side while performing the side-hop test, but not while executing CMJs and DJs. These findings suggest that the side-hop test could be more accurate than vertical jump tests for detecting functional deficits in patients suffering from CAI²¹.

This study investigated the comparative effects of hopstabilization training (hop training) and traditional balance training on adolescent female basketball players with CAI. Both intervention protocols produced significant improvements in ankle stability, as evidenced by enhanced CAIT scores and favorable changes in static and dynamic balance measures²².

For patients with CAI, Long-term and multifaceted exercise therapy yields superior rehabilitation outcomes, providing critical

clinical evidence for optimizing personalized rehabilitation programs. Clinically, the most suitable exercise therapy can be selected based on SEBT assessment results to develop targeted treatment plans. Specifically, if the SEBT assessment identifies an anterior balance deficit (SEBT-A), joint mobilization is prioritized as the primary intervention. Conversely, in cases of impaired posterolateral stability (SEBT-PL) and diminished posteromedial reach (SEBT-PM), a combined therapeutic approach incorporating strength training and proprioceptive training is recommended²³.

The study on combination of strength and balance training achieves greater benefits for patient reported outcomes and intervention for 6 weeks, more than 3 times a week and more than 30 min each time were the best rehabilitation programs to improve CAI patient reported outcomes. balance training could bring greater benefits to dynamic balance. Strength training should be used cautiously in clinic to improve the dynamic balance in individuals with CAI²⁴.

On comparing the Mean Values of Group A & Group B on Y-Balance Test Score, it shows a significant increase in the post- test mean values in both groups, but (Group A) shows 7.13 ± 1.30 which has the higher mean value, is more effective than (Group B) 7.00 ± 2.20 at $P \leq 0.05$. On comparing the Mean Values of Group A & Group B on FAAM Score, it shows a significant increase in the post- test mean values in both groups, but (Group A) shows 12.47 ± 4.96 which has the higher mean value, is more effective than (Group B) 11.07 ± 2.09 at $P \leq 0.05$. On comparing Pretest and Post test within Group A & Group B on Y-Balance Test Score and FAAM Score, shows significant difference in the mean values at $P \leq 0.05$.

Ethical Clearance: Ethical clearance has obtained from Faculty of Physiotherapy, Dr. MGR. Educational and Research Institute, Chennai, Tamil Nadu, India. Reference number: No: BPT IV Year-B Sec, 68/ PHYSIO/ IRB/ 2024-2025, dated: 16/12/ 2024.

Conflict of interest: There was no conflict of interest to conduct and publish this study.

Fund for the study: It was a self-financed study.

CONCLUSION

The present study aimed to compare the effect of resistance training versus proprioceptive training on patients with Chronic Ankle Instability (CAI). Chronic ankle instability often result in recurrent sprain, functional limitations and altered balance and proprioception based on the outcome assessed through the YBalance Test and the Foot and Ankle Ability Measure (FAAM), both intervention groups demonstrated notable improvements in post-intervention scores, indicating that both training methods were effective in enhancing ankle function and dynamic balance.

However, upon comparative analysis, proprioceptive training appeared to yield slightly better improvements in balance and coordination as indicated by a greater positive change in Y-Balance scores. This suggests that exercise emphasis using joint position awareness, neuromuscular control, and dynamic stability may be more effective in addressing the core deficit associated with CAI. On the other hand, resistance training contributed significantly to strengthening the

musculature surrounding the ankle, which is equally vital for stability and injury prevention.

REFFRECE

1. Delahunt E, Remus A. Risk factors for lateral ankle sprains and chronic ankle instability. *Journal of athletic training*. 2019 Jun 1; 54 (6):611-6.
2. Saarinen AJ, Uimonen MM, Suominen EN, Sandelin H, Repo JP. Structural and construct validity of the Foot and Ankle Ability Measure (FAAM) with an emphasis on pain and functionality after foot surgery: a multicentre study. *The Journal of Foot and Ankle Surgery*. 2022 Jul 1;61(4):872-8.
3. Saarinen AJ, Uimonen MM, Suominen EN, Sandelin H, Repo JP. Structural and construct validity of the Foot and Ankle Ability Measure (FAAM) with an emphasis on pain and functionality after foot surgery: a multicentre study. *The Journal of Foot and Ankle Surgery*. 2022 Jul 1;61 (4):872-8.
4. Mohammadi H, Ghaffari R, Kazemi A, Bennett H, Hosseinzadeh M. Evaluation of the value of the Y-balance test to predict lower limb injuries in professional male footballers. *Journal of Sport Rehabilitation*. 2023 Oct 24; 33(1):33-9.
5. Zheng Y, Feng R, Hu W, Huang P. Investigation of inter-rater and test-retest reliability of Y balance test in college students with flexible flatfoot. *BMC Sports Science, Medicine and Rehabilitation*. 2024 Feb 8; 16(1):40.
6. Su Y, Li W, Pan C, Shi Y. Effects of combination of strength and balance training on postural control and functionality in people with chronic ankle instability: a systematic review and metaanalysis. *BMC Sports Science, Medicine and Rehabilitation*. 2024 Apr 9; 16(1):79.
7. Kaminski TW, Hartsell HD. Factors contributing to chronic ankle instability: a strength perspective. *Journal of athletic training*. 2002 Oct; 37(4):394.
8. Fakontis C, Iakovidis P, Kasimis K, Lytras D, Koutras G, Fetlis A, Algiounidis I. Efficacy of resistance training with elastic bands compared to proprioceptive training on balance and self-report measures in patients with chronic ankle instability: A systematic review and meta-analysis. *Physical Therapy in Sport*. 2023 Nov 1; 64:74-84.
9. Al-Mohrej OA, Al-KenaniNS. Chronic ankle instability: Current perspectives. *Avicenna journal of medicine*. 2016 Oct; 6(04):103-8.
10. Alkhatami KM. Using the Y-balance test as a predictor tool for evaluating noncontact injuries in university league football players: a prospective longitudinal study. *Cureus*. 2023 May 21;15(5).
11. Elabd OM, Elabd AM, El-Azez MS, Taha MM, Mohammed AH. Impact of chronic ankle instability on gait loading strategy in individuals with chronic ankle instability: a comparative study. *Journal of NeuroEngineering and Rehabilitation*. 2024 Dec; 21(1):1-8.
12. Peters JW, Trevino SG, Renstrom PA. Chronic lateral ankle instability. *Foot & ankle*. 1991 Dec; 12(3):182-91.
13. Lin CI, Khajooei M, Engel T, Nair A, Heikkila M, Kaplick H, Mayer F. The effect of chronic ankle instability on muscle activations in lower extremities. *Plos one*. 2021 Feb 22;16(2):e0247581.
14. Tedeschi R, Ricci V, Tarantino D, Tarallo L, Catani F, Donati D. Rebuilding stability: Exploring the best rehabilitation methods

- for chronic ankle instability. *Sports*. 2024 Oct 17;12(10):282.
15. Yin Y, Wang J, Lin Q, Luo Y, Liu Y, Sun J. Effect of proprioceptive neuromuscular facilitation on patients with chronic ankle instability: A systematic review and meta-analysis. *PloS one*. 2025 Jan 9; 20(1):e0311355.
16. Lin CW, Jankaew A, Lin CF. Physical Therapy Intervention Effects on Alteration of Spinal Excitability in Patients with Chronic Ankle Instability: A Systematic Review and Meta-analysis. *Sports Health*. 2025 Mar; 17(2):394-403.
17. Lopes R, Hong CC, Calder J, Kerkhoffs GM. Risk factors for the recurrence of instability after operative treatment of chronic lateral ankle instability: A systematic review. *Journal of Experimental Orthopaedics*. 2025 Jan;12(1):e70214
18. Beyraghi Z, Khanmohammadi R, Hadian MR. Effects of Combining Transcranial Direct Current Stimulation with Balance Training on Anticipatory Postural Adjustments in Persons with Chronic Ankle Instability. *Sports Health*. 2025 Mar; 17(2):383-93.
19. Chang S, Tan Y, Cheng L, Zhou L, Wang B, Liu H. Effect of strength training with additional acupuncture on balance, ankle sensation, and isokinetic muscle strength in chronic ankle instability among college students. *Frontiers in Physiology*. 2024 Apr 5; 15:1324924.
20. Guo Y, Cheng T, Yang Z, Huang Y, Li M, Wang T. A systematic review and metaanalysis of balance training in patients with chronic ankle instability. *Systematic Reviews*. 2024 Feb 12; 13(1):64.
21. Faghihi R, Khanmohammadi R. Comparing virtual reality and balance training effects on postural strategies during ball kicking in soccer players with chronic ankle instability. *Scientific Reports*. 2024 Dec 28; 14(1):31448.
22. Yekdaneh A. Effects of Balance and Strength Training for Ankle Proprioception in People with Chronic Ankle Instability: A Randomized Controlled Study. *Journal of the American Podiatric Medical Association*. 2024 May 1; 114(3).
23. Reyes MC, Suttmiller AM, Chung S, Gruskiewicz VM, Johnson KR, Foreman NN, McCann RS. Cross-education effects of balance training in individuals with chronic ankle instability. *Journal of Bodywork and Movement Therapies*. 2024 Oct 1; 40:1263-8.
24. Reyes MC, Suttmiller AM, Chung S, Gruskiewicz VM, Johnson KR, Foreman NN, McCann RS. Cross-education effects of balance training in individuals with chronic ankle instability. *Journal of Bodywork and Movement Therapies*. 2024 Oct 1; 40: 1263-8.

Jibi Paul, V. Sanjay (2025).Comparative Study Of Effectiveness Of Resistance Vs Proprioceptive Training In Patient With Chronic Ankle Instability, *ijmaes*;11(3);2485-2498.