ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may397

Evaluating the Therapeutic Impact of Agility Training Verus Ankle Proprioceptrion Exercise for Runners with Chronic Ankle Instabilty

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Publication Date: 2025/05/24

Abstract:

- ***Background:***

Chronic ankle instability typically arises subsequent to an ankle sprain that has nevertheless not sufficiently healed or underwent comprehensive rehabilitation. The capacity to maintain balance is frequently influenced, typically manifesting during ambulation or other actions, but it can also occur while standing still. A multitude of sportsmen and others experience persistent ankle instability. Agility training activities enhance speed, explosive power, coordination, and particular athletic skills; athletes at all levels, from high school students to professional teams, can benefit from these exercises. Integrate these activities many times weekly into your training regimen to enhance your foot speed and refine your athletic technique. Proprioception is defined as the awareness of the position of a bodily component in space at any given moment. Proprioceptive exercises can instruct your body to regulate the positioning of an injured joint. The primary intent of this investigation is to quantify the efficacy of agility training compared to ankle proprioception exercises for runners with chronic ankle instability.

- ***Methodology:***

This experimental pre- and post-interventional study was conducted at the Faculty of Physiotherapy, A.C.S. Medical College and Hospital, with 30 participants (aged 18–25 years, both genders) who had sustained ankle sprains 2–3 months prior. Participants with recent surgery, fractures, skin infections, bone malalignment, or hypersensitivity at the ankle were excluded. They were divided into two groups: Group A (15 subjects) underwent agility training, and Group B (15 subjects) received ankle proprioception training, both for four weeks (5 sessions/week, 30 minutes/session). Ankle strengthening exercises were provided post-session for both groups. Outcomes were assessed pre- and post-intervention using BESS and IDFAI scales.

- ***Result:***

Contrasting the mean values of agility training and ankle proprioception exercises on the balance error scoring system reveals a significant difference, with a decrease in post-test mean values. Agility training demonstrates a mean value of (33.9 ± 13.4), indicating greater effectiveness than ankle proprioception exercises, which show a mean value of (34.2 ± 23.8), at ($P \leq 0.0001$).

- ***Conclusion:***

The research investigation concluded that a short term intervention of agility training and ankle proprioception training were effective in improving balance and functional performancein subject chronic ankle instability. when the two groups were compared, agility training showed better improvement in balance and functional performance in runners with chronic ankle instability.

Keyword: *Ankle Instability, Agility Training, Ankle Proprioception, BESS (Balance Error Scoring System), IDFA (Identification of Functional AnkleInstability).*

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may397

How to Cite: Pavithra D.; Vijayaraj V. (2025). Evaluating the Therapeutic Impact of Agility Training Verus Ankle Proprioceptrion Exercise for Runners with Chronic Ankle Instabilty. *International Journal of Innovative Science and Research Technology*, 10(5), 1367-1375. https://doi.org/10.38124/ijisrt/25may397.

I. INTRODUCTION

The ankle joint is responsible for stability and absorbing impacts and it is one of themost important joints in the lower body, it is the most commonly injured joints, both by athletes and non-athletes. Ankle sprains are among the many prevalent injuries incurred during athletic activities. Seventy-five percent of ankle injuries pertain to the lateral ligament complex [1]. Published statistics indicate that 10% to 30% of all sporting injuries are ankle injuries, with ankle sprains constituting upwards of 70% of all reported ankle injuries in several sports [2,3]. The incidence of recurrent ankle sprains exceeds 40%, and repeated sprains might subsequently result in chronic ankle instability (CAI) and ankle osteoarthritis [4].

The primary issue following an ankle sprain is the subsequent instability of the joint. Research indicates that over 30% of athletes with a lateral ankle injury subsequently develop chronic ankle instability [5,6]. CAI is defined by a spectrum of deficiencies that can be assessed by various sensory metrics. It is sensory. Somatosensory input, reflex responses, and efferent motor control deficiencies are associated with ankle instability, originating either from the ankle ligaments or from spinal or supraspinal motor control levels [7]. It is evident that both feedback and feedforward systems of motor control are modified by ankle instability. Physiotherapy professionals can gauge the severity of lateral ligament injury at the ankle and grade it based on the presentation into 3 categories. Grade 1 indicates the absence of abnormal ligament laxity or looseness. Grade 2 injuries exhibit a degree of laxity, although there is a detectable endpoint. Grade 3 injuries demonstrate significant ligament laxity without a recognizable endpoint during testing. All three cases were originally associated with pain and soreness [8,9].

Proprioception is defined as the result of sensory information transmitted to the central nervous system via mechanoreceptors found in the capsules of joints, ligaments, muscles, tendons, and skin. Injury to ligamentous tissues that encompasses Mechanoreceptors may result in incomplete differentiation, potentially leading to proprioceptive deficiencies that subsequently contribute to chronic ankle instability (CAI) [10]. Proprioception is the body's capacity to perceive its position in space. It is a crucial element of human locomotion, as it enables movement without the necessity to consciously considering the forces, such as gravity, exerted on the body [11]. Following an injury, your proprioceptive system may malfunction, necessitating targeted proprioceptive exercises to recalibrate your body's awareness, which can aid in preventing ankle sprains and other lower extremity problems [12].

Agility is the capacity to swiftly and effectively alter the direction and posture of the body while maintaining control. It necessitates rapid reactions, coordination, balance, velocity, and appropriate responses to evolving circumstances [13]. Agility is a fundamental aspect of fitness and is essential in various sports and physical activities. Consider the sports that require agility [14]. In competitive sports especially football, soccer, basketball, hockey, volleyball, and rugby, one must rapidly react to the movements of both fellow players and the ball. Agility denotes the capacity to initiate, halt, and alter direction swiftly while preserving correct posture [15]. Agility training is a form of exercise that incorporates brief intervals of movement requiring changes in direction. Agility training typically includes exercises like cone drills and ladder drills, where the participant must execute various movement or foot patterns as quickly as possible [16].

Chronic ankle instability significantly impacts functional performance and increases the risk of recurrent injuries, necessitating effective rehabilitation strategies. Despite the availability of various interventions, there is no consensus on the most effective approach, creating a gap in clinical practice [17]. This study addresses this gap by directly comparing the efficacy of agility training and proprioceptive exercises in runners with chronic ankle instability. By utilizing standardized outcome measures such as BESS and IDFAI, it aims to provide evidence-based insights to guide rehabilitation protocols, improve balance and functional performance, and enhance clinical decision-making for this population.

II. MATERIALS AND METHODS

The study was structured as an experimental investigation employing a pre- and post-interventional design to evaluate the effectiveness of the intervention. It was conducted over a duration of four weeks at the Physiotherapy OPD, A.C.S Medical College and Hospital, with sessions held five days a week. The study included a total of 30 participants aged between 18 to 25 years, comprising both male and female students who had experienced ankle sprains two to three months prior to the commencement of the study. Participants were selected based on specific inclusion and exclusion criteria to ensure uniformity and reliability of the results. The inclusion criteria required participants to fall within the specified age range and have a post-injury duration consistent with the study requirements. Exclusion criteria ruled out individuals with recent surgeries or fractures, skin infections, hypersensitive skin, or any form of bone malalignment to avoid confounding factors that could influence outcomes.

The intervention employed various tools and equipment, including a stopwatch for precise timing, tape and cones for measuring distances and setting up exercises, and wobble boards and ropes to facilitate the therapeutic activities. Standard documentation tools, such as pen and paper, were used to record participant data and observations systematically. This rigorous methodology ensured a structured approach to assessing the efficacy of the intervention in addressing ankle sprain-related impairments.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may397

III. MEASUREMENTS TOOLS

A. *Identification of Functional Ankle Instability (Questionnaire)*

The Identification of Functional Ankle Instability (IDFAI) is a more recently formulated questionnaire designed to ascertain if individuals fulfill the minimum criteria for inclusion in a Functional Ankle Instability (FAI) cohort. It consists of inquiries regarding the duration since an ankle sprain and the presence of instability during daily activities. A cumulative score of 10 or below suggests that the participant is improbable to exhibit ankle instability, while a score of 11 or above indicates a likelihood of ankle instability [18,19].

B. *Balance error scoring system*

The BESS test provides a balance evaluation methodology designed primarily for the assessment of sports-related concussions. The test protocol instructs patients to execute the following twist while barefoot, with hands on hips and eyes closed, for a duration of twenty seconds each. Each of the twenty-second trials is evaluated on a scale from one to ten, based on the number of faults or deviations from the correct stance made by the participant; a greater score signifies inferior performance. The highest possible total score is 60, comprising ten faults from each of the six assessments [20,21].

IV. PROCEDURE

The study included 30 runners with chronic ankle instability, selected based on the inclusion criteria. A warm-up consisting of stretching exercises around the ankle joint was performed for 5 minutes by both groups before training, and a cool-down comprising standing wall pushes and stretching was done for 5 minutes after each session. Group A underwent agility training for 30 minutes, 5 days per week for 4 weeks, which included lateral plyometric jumps, forward running with high knee drills, dot drills, L drills, and lateral lunges [Figure 1]. Group B participated in ankle proprioception training for the same duration and frequency, consisting of single-leg balancing with clapping, single-leg balancing with throwing and catching a ball, single-leg hops, heel-toe balance, and single-leg squats [Figure 2]. Both groups also performed ankle strengthening exercises using TheraBand (level III and IV, red colour) for dorsiflexion, plantar flexion, inversion, and eversion [Figure 3]. Each strengthening exercise was performed for 5 repetitions with a 1-minute rest interval between exercises, totalling 20 minutes per session for 4 weeks. Post-intervention assessments were conducted using standardized measurement tools.

- *Group A-Agility Training Exercise Protocol*

Table 1: Group A - Agility Training Exercises Protocol

EXERCISE	DESCRIPTION	SETS/DURATION	REST PERIOD
Lateral Plyometric Jump	Participants stood with feet no more than hip-width apart, squatted down, and pushed upward and sideways over a line. They landed softly and absorbed the impact by squatting deeply, repeating back and forth for 30-60 seconds.	30-60 seconds per set	60-90 seconds
Forward Running, High Knee Drills	Participants maintained an erect posture with their core engaged and arms bent at 90 degrees, mimicking a sprinting motion. They performed high knees by lifting their knees alternately toward their chest, aiming to raise them to at least hip height.	3 sets (15 seconds/set)	30 seconds between sets
Dots Drills	Five dots in the shape of an "X" were marked on the ground. Participants stood on the affected ankle, started at the central dot, hopped to each corner dot, and returned to the central dot.	3 sets	30 seconds between sets
L Drills	Participants started at the first cone with one hand on the ground, ran to the middle cone, touched it, reversed direction, and ran around the far cone, returning to the start position.	2 sets	30 seconds between sets
Lateral Lunge	Participants stood facing the right ladder rail, jumped into a lunge with one foot in the first square and the other outside, then switched legs midair, jumping forward to the next square, repeating until the end of the ladder.	2 sets	30 seconds between sets

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may397

➢ *Group B: Ankle Proprioception Training Protocol*

Table 2: Group B: Ankle Proprioception Training Protocol

EXERCISE	DESCRIPTION	SETS/DURATION	REST PERIOD
Single Leg Balancing, Clapping	Participants balanced on the affected leg with the opposite leg raised and bent at a 90-degree angle. They clapped overhead and under the raised leg 12 times.	12 repetitions per leg / 3 sets	30 seconds between sets
Single Leg Balancing, Throwing and Catching a Ball	Participants balanced on the affected leg while throwing and catching a ball, bending the knee slightly with each catch.	20 catches	-
Single Leg Hops	Participants balanced on the affected leg with hands on hips and performed 10 slow hops forward, backward, and to each side.	3 sets	30 seconds between sets
Heel Toe Balance	Participants walked in a straight line using tandem gait, where the toes of the back foot touched the heel of the front foot with each step.	100 meters	30 seconds between sets
Single Leg Squats	Participants balanced on the affected leg with hands on hips and performed mini squats, bending the knee to 45 degrees and returning to the start position.	Variable, as tolerated	30 seconds between sets

➢ *Combined Protocol for Group A & Group B – Ankle Strengthening Exercise*

Table 3: Combined Protocol for Group A & Group B - Ankle Strengthening Exercises

EXERCISE	DESCRIPTION	DURATION/REPETITIONS	REST PERIOD
Ankle Dorsiflexion	Participants looped one end of the Theraband over a sturdy table leg and the other around the top of their foot. They pulled their toes up toward their head, feeling the band pull, and returned slowly.	5 repetitions per session	1 minute
Ankle Plantar Flexion	Participants looped the band around the ball of their foot and held the other end in both hands. They pointed their toes, pressing down against the band, then returned to the start position.	5 repetitions per session	1 minute
Ankle Inversion	Participants looped the band around the ball of their foot, crossed their other leg over at the ankle, and turned their foot inward against the band's resistance, then returned slowly.	5 repetitions per session	1 minute
Ankle Eversion	Participants looped the band around the ball of their foot and turned their foot outward against the band's resistance, then returned slowly.	5 repetitions per session	1 minute

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may397

V. RESULT

The gathered data were organized and examined utilizing statistical techniques that are both descriptive and inferential. All factors were evaluated utilizing the Statistical Package for the Social Sciences (SPSS) version 24. The paired t-test was utilized to determine the statistical difference within groups, while the independent t-test (Student's t-test) was employed to assess the statistical difference between groups. Upon comparison of the mean values of group A and group B on the IDFAI (Identification Functional Ankle Instability), a significant reduction in post-test mean values is observed. However, group B (ankle proprioception exercise) exhibits a mean value of 7.8, which is lower and more effective than group A (agility training), which shows a mean value of 7.7, at $P \leq 0.001$ [Table 1 & 2][Graph 1&2]. Consequently, the null hypothesis is rejected. Upon comparing the mean values of Group A and Group B on the Balance Error Scoring System (BESS). There is a notable reduction in the post-test mean values; nevertheless, Group B (ankle proprioception) exhibits a mean value of 23.8, which is lower and more effective than Group A's mean of 13.4 at ($P \leq 0.001$). Therefore, the null hypothesis is rejected. Comparative analysis of Pre-test and Post-test results between groups A and B on IDFAI and BESS reveals a significantly significant difference in mean values at $P \leq 0.001$ [Table 3][Graph 3].

VI. DISCUSSION

Repetitive ankle sprain or red mage and complaint of patient feelings such as ankle giving way in daily living activities. Among ankle damage patients 20% to 40% progress into chronic ankle instability. Only limits studies have previously reported improvement in postural control and balance ability through agility training and ankle proprioception training.

This present investigation primarily aimed to evaluate the effectiveness of agility training and ankle proprioception exercise in runners with chronic ankle instability was conducted on 30 runners with chronic ankle instability. the FAI was measured using the identification functional ankle instability (IDFAI). The IDFAI is a simple, valid and reliable tool to measure severity of ankle instability. the selected subjects were divided into two groups. Group A received agility training on stable surface and Group b received ankle proprioception exercise on a stable surface for 4 weeks 5 days per week. Both groups were performed 4 sets of strengthening exercise, because muscle strength is vital to perform physical activity of daily living, requirement of strength is more in case ofactivity as to bring about competitive performance. The ankle strengthening exercise are also an important component of ankle strengthening ankle rehabilitation and should ideally be combined with the ankle exercises for optimal results. The pre and post- test values were recorded and there was regular follow up at the fifth day every week. The outcome measure was recorded using balance error scoring system for balance. IDFAI for performance. This study reported that training on obstacles can improve postural control, balance, ankle stability, and functional performance in subjects with ankle instability. the agility training subjects perform exercise task and cognitive task at the same time and the cognitive task was related to their sports activity, has more in improvement of postural control ability than ankle proprioception exercise. The present study says that agility training is more effective intervention method to improve balance and functional performance of CAI patients

A study conducted by Eadric Bressel et al. indicates that balance training enhances neuromuscular coordination, while joint strength and range of motion are also probable mechanisms contributing to improved balance [22]. KM Rowley reported effectiveness in decreasing postural fluctuation and trunk stiffness in healthy individuals. Numerous studies indicate that CAI correlates with deficiencies in both static and dynamic stability, which subsequently leads to recurrent ankle injuries [23]. The current study assessed stability by BESS to evaluate static balance prior to and during the intervention. Reductions in BESS indicate enhancements in balance capability. Jia han et al. examine the significance of ankle proprioception in balance control concerning sports performance and injury prevention [24].

It was determined that agility training and ankle proprioception exercises are beneficial for patients with chronic ankle instability, as evidenced by the pre-test mean value IDFAI of group A (16.9) and group B (15.4), which did not reveal a significant difference between group A (3.2) and group B (4.1). The pre-test mean value of BESS for group A (33.9) and group B (34.2) did not demonstrate a significant difference, but the treatment session's post-test mean value of IDFAI for group A (7.8) and group B (7.7) indicated a significant difference. The post-test results of BESS indicate a modest significant difference between group A (13.4) and group B (23.8), suggesting that patients in group A, who underwent agility training, performed better than those in group B. Agility training is superior than ankle proprioception exercises. Group A exhibited a notable enhancement from pre-test to post-test, with a minor distinction compared to Group B. Agility enhances flexibility, balance, and control. It assists the body in sustaining optimal alignment and posture during action. Furthermore, it promoted the acquisition of skills necessary for maintaining proper body positioning. The subjects who participated in agility training demonstrated superior results when assessed over an extended duration. Due to its ease of administration and lack of requirement for continual monitoring. These workouts are easy to execute. Both agility and ankle proprioception exercises demonstrated stabilization of ankle instability, enhancing strength for all activities. This study indicated that agility training positively affects patients with chronic ankle instability.

VII. CONCLUSION

The present study concluded that a short term intervention of agility training and ankle proprioception training were effective in improving balance and functional performancein subject chronic ankle instability. In this study with the statistical analysis from data collecting using IDFAI & BESS for chronic ankle instability. when the two groups were compared, agility training showed better improvement

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may397

in balance and functional performance in runners with chronic ankleinstability. The current study determined that a brief intervention of agility training and ankle proprioception training effectively enhanced balance and functional performance in subjects with chronic ankle instability. This study employs statistical analysis derived from data collected using IDFAI and BESS for chronic ankle instability. Comparative analysis revealed that agility training significantly enhanced balance and functional performance in runners with chronic ankle instability. Agility training enhances flexibility, balance, and coordination. It assists the body in sustaining appropriate alignment and posture throughout action. Furthermore, it promoted the body to acquire the ability to sustain proper alignment. It enhances the skills pertinent to the sport you engage in, as speed and agility are crucial for elevating athletic performance to the next tier.

RESEARCH LIMITATIONS

The study exhibited various limitations, such as a limited sample size and a brief duration, potentially constraining the generalizability of the results. The lack of long-term follow-up hindered the evaluation of the intervention's enduring effects. The study was limited to participants aged 16 to 25 years and concentrated solely on those with chronic ankle instability, hence constraining the relevance of the findings to wider populations or varying age demographics.

FUTURE SCOPE

The study recommends conducting future research with a larger sample size to enhance the reliability and generalizability of the findings. Longer study durations and extended follow-up periods are suggested to evaluate the sustained effects of the intervention. Additionally, similar studies could be conducted on athletes and individuals from other sports disciplines to explore the broader applicability of the findings across diverse populations.

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ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may397

TABLES

Table 4: Effectiveness of Agility Training to Runners with ChronicInstability for Ankle Joint Within Group A

Group A	MEAN		SD		T-test	Sign
	Pre	Post	Pre	Post		
IDFAI	16.9	7.8	3.2	1.76	9.46	000**
BESS	33.9	13.4	3.3	2.4	19.1	000**

(*- P ≤ 0.001). *** - Highly Significant**

Table 5: Effectiveness of Ankle Proprioception Training for Runners with Chronic Instability Within Group B.

Group B	MEAN		SD		T-test	Sign
	Pre	Post	Pre	Post		
IDFAI	15.4	7.7	4.1	1.66	-13.6	000**
BESS	34.2	23.8	3.2	2.13	-24.02	000**

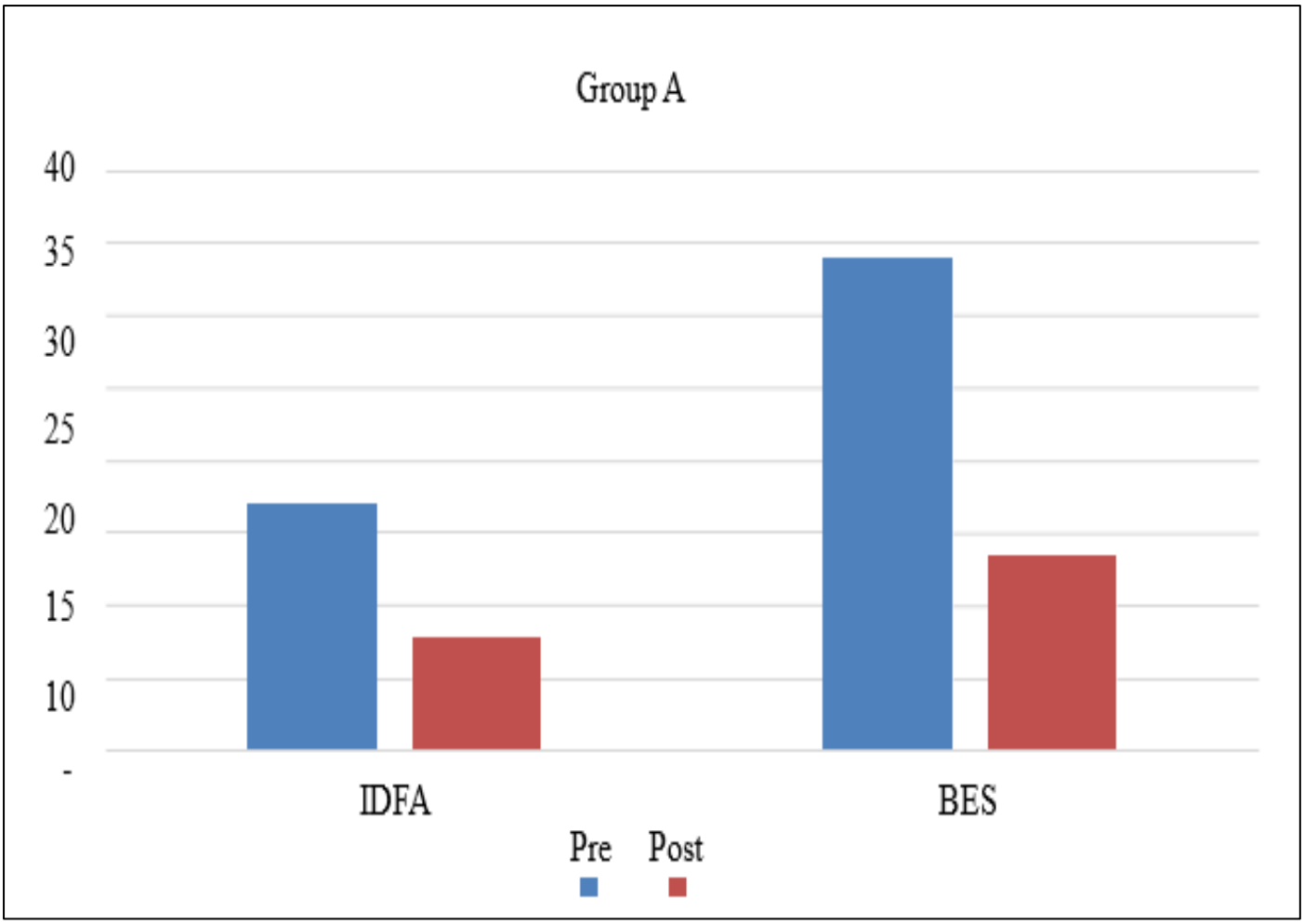
(*- P ≤ 0.001). *** - Highly Significant**

Table 6: Effectiveness of Agility Training Versus Ankle Proprioception Training for Runners with Chronic Instability Between Group – A and Group - B in Post Test.

Group a &b	IDFAI		BESS		T-test	Sign
	Mean	SD	Mean	SD		
Group A	7.8	1.7	13.4	2.4	-7.1	000**
Group B	7.7	1.66	23.8	2.1	-24.02	000**

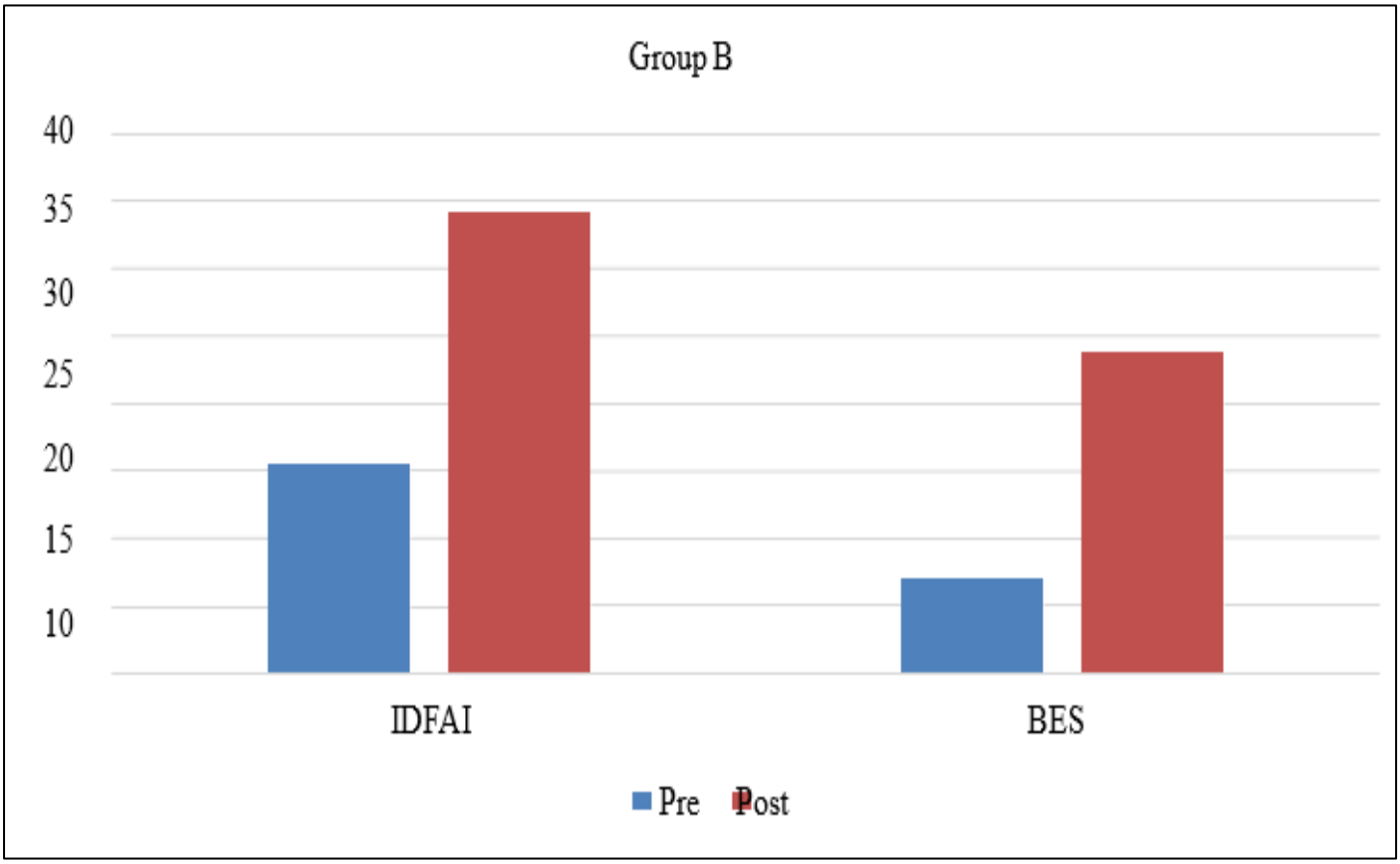
(*- P ≤ 0.001). *** - Highly Significant**

GRAPHS

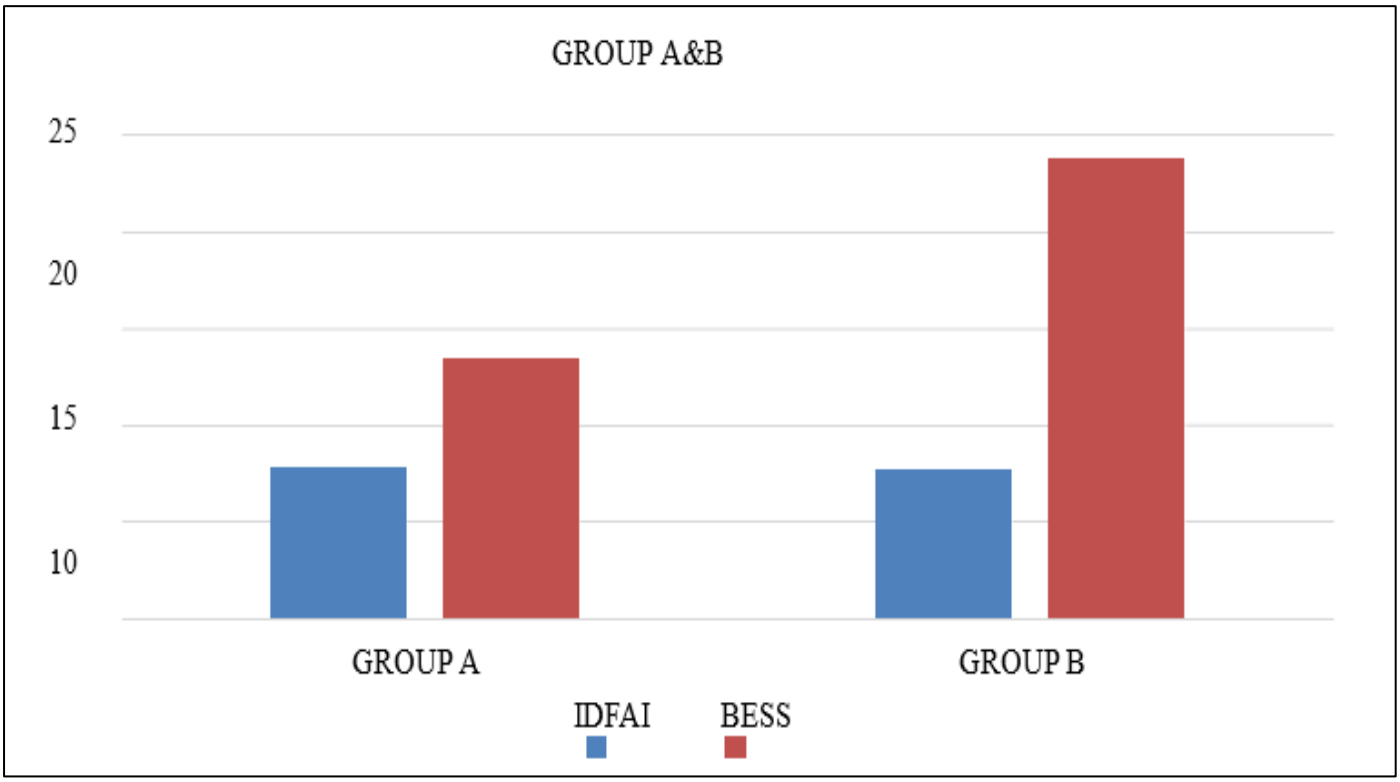


Graph 1: Effectiveness of Agility Training to Runners with ChronicInstability for Ankle Joint within Group A.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may397



Graph 2: Effectiveness of Ankle Proprioception Training for Runners with Chronic Instability Within Group B



Graph 3: Effectiveness of Agility Training Versus Ankle Proprioception Training for Runners with Chronic Instability between Group – A and Group - B in Post Test