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Effects of Proprioceptive Training on Ankle Stability in Athletes

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Abstract

Background: Ankle sprains are common sports-related injuries and recurrent ankle sprains may contribute to functional ankle instability, impaired proprioception, and reduced neuromuscular control. Proprioceptive training is commonly used to improve balance, joint position sense, and functional ankle stability.

Objective: The objective of the study was to determine the effectiveness of proprioceptive training in improving ankle stability among male athletes aged 12–18 years.

Methods: A pre-experimental study was conducted over 6 months at Tiruppur SDAT Sports Club and On Your Mark Athletic Club, Tiruppur. Twenty male athletes aged 12–18 years were selected by purposive sampling. Participants underwent an 8-week proprioceptive training program, three sessions per week, with each session lasting 45 minutes. Ankle stability was assessed using the Cumberland Ankle Instability Tool (CAIT) before training, during the intervention, and after completion of the program.

Results: The mean CAIT score increased from 17.60 ± 2.58 at pre-test to 22.65 ± 2.03 at post-test 1 and 28.20 ± 0.95 at post-test 2. Repeated-measures analysis demonstrated a statistically significant difference across the assessment points ($F = 240.25$, $p = 0.001$).

Conclusion: The findings of the study indicate that an 8-week proprioceptive training program was associated with improved functional ankle stability in the participating adolescent male athletes.

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INTRODUCTION

Athletes possess specific morphological and physiological characteristics and are continuously exposed to high physical demands depending on their sport. Activities such as acceleration, deceleration, jumping, turning, lateral movements, and rapid changes in direction place considerable stress on the musculoskeletal system and may increase the risk of lower-limb injuries[1]. Regular participation in sports provides several health benefits; however, repetitive stress and high physical demands may also increase the risk of sports-related injuries[2]. Among these, ankle sprains are one of the most common injuries in athletes and may account for a considerable proportion of sports-related injuries. Ankle instability can be classified into lateral, medial, and syndesmotic ligament injuries[3]. Several intrinsic and extrinsic factors contribute to the occurrence of ankle sprains. Intrinsic factors include age, body composition, previous injury, muscle strength, flexibility, proprioception, reaction time, postural stability, foot morphology, and inadequate rehabilitation. Extrinsic factors include the type of sport, level of competition, footwear, playing surface, and use of external supports such as taping and ankle braces[3].Lateral ankle sprains commonly involve the anterior talofibular ligament, calcaneofibular ligament, and posterior talofibular ligament and represent the majority of ankle sprains³. Ankle injuries are also frequently reported among athletes and account for a significant proportion of sports injuries[4].

Recurrent ankle sprains may result in mechanical and functional deficits, leading to chronic ankle instability, chronic pain, degenerative changes, and impaired proprioception[5]. Common preventive strategies include taping, ankle bracing, muscle strengthening, and proprioceptive training. Although taping and bracing can reduce the risk of ankle sprains, exercise-based interventions provide a functional approach by improving neuromuscular control and joint stability. Proprioception is a complex neuromuscular process involving the internal awareness of body position and movement[6]. Proprioceptive training aims to improve the body's ability to detect and respond to changes in position, movement, balance, and joint loading. It includes exercises that improve balance, postural control, joint position sense, muscle activation, and neuromuscular coordination. Research has shown that proprioceptive training can improve balance and postural control in individuals with unstable ankles and may reduce the incidence of ankle sprains[7]. Proprioceptive exercise programmes have also been reported to reduce injury rates and improve athletic performance[8]. Therefore, proprioceptive training is widely used in sports for injury prevention, rehabilitation, improvement of joint stability, and enhancement of motor performance[9].

The Cumberland Ankle Instability Tool (CAIT) was developed to assess functional ankle instability. It is a simple, valid, and reliable 9-item, 30-point questionnaire used to determine the severity of functional ankle instability. A CAIT score of ≤27 indicates the presence of functional ankle instability[10]. Recent studies have reported associations between CAIT scores and objective measures such as muscle strength, proprioception, and dynamic balance. Its reliability across different populations and languages further supports its use in sports and rehabilitation research. Thus, the CAIT can be used as an effective outcome measure for assessing changes in ankle stability before and after proprioceptive training interventions in athletes[11].

MATERIALS AND METHODS

The study was approved by the Institutional Ethics Committee (IEC-RIPT/DT/21/4517).

Study design:

A pre-experimental study design was used.

Study duration:

The study was carried out for 6 months.

Study setting:

The study was conducted at Tiruppur SDAT Sports Club and On Your Mark Athletic Club, Tiruppur.

Sampling and participants:

Twenty male athletes aged 12–18 years were selected using purposive sampling. Participants had been actively participating in sports for at least 8 months and were undergoing regular athletic training.

Inclusion criteria:

- Male athletes aged 12–18 years.
- Active participation in athletics for at least 8 months.
- Sprinters and participants willing to participate in the study.

Exclusion criteria:

- Participants above 18 years of age.
- Those with recurrent injury.
- Recent fracture or illness.
- Non-athletes and participants unwilling to participate.

Variables

The dependent variables were ankle joint stability and joint position sense. The independent variable was the proprioceptive training program.

Materials

Balance/wobble board, BOSU ball, foam pad, resistance band, agility ladder, plyometric soft box, stopwatch, and ball were used.

Intervention procedure

The training protocol was explained to the participants and informed consent was obtained before participation. Baseline ankle stability was assessed using the Cumberland Ankle Instability Tool (CAIT). Participants then underwent an 8-week proprioceptive training program three times per week. Each training session lasted 45 minutes and consisted of 10 minutes of warm-up, 30 minutes of proprioceptive training, and 5 minutes of warm-down. The proprioceptive program included single-leg stance with eyes open, heel-to-toe walking, ankle circles, wobble/balance board training, single-leg hops, resistance-band ankle exercises, single-leg mini squats, BOSU-ball single-leg balance, agility ladder drills, jump-and-land training, and dynamic ball toss. The exercises were progressively advanced by increasing repetitions, duration, sets, or reducing rest according to the protocol. Post-intervention CAIT assessments were conducted to evaluate changes in ankle stability.

Outcome measure

The Cumberland Ankle Instability Tool (CAIT) was used to assess functional ankle instability. It is a 9-item, 30-point questionnaire. Higher scores represent better functional ankle stability, while lower scores indicate greater functional instability. CAIT was administered at pre-test, post-test 1, and post-test 2.

STATISTICAL ANALYSIS

The collected data were tabulated and analyzed using Statistical Package for the Social Sciences (SPSS), version 24. The Shapiro–Wilk test was used to assess normality. The project reported that the data were normally distributed ($p > 0.05$), and parametric analysis was therefore used. Repeated-measures analysis was used to examine differences across the assessment points. Statistical significance was set at $p < 0.05$ with a 95% confidence interval.

Table I

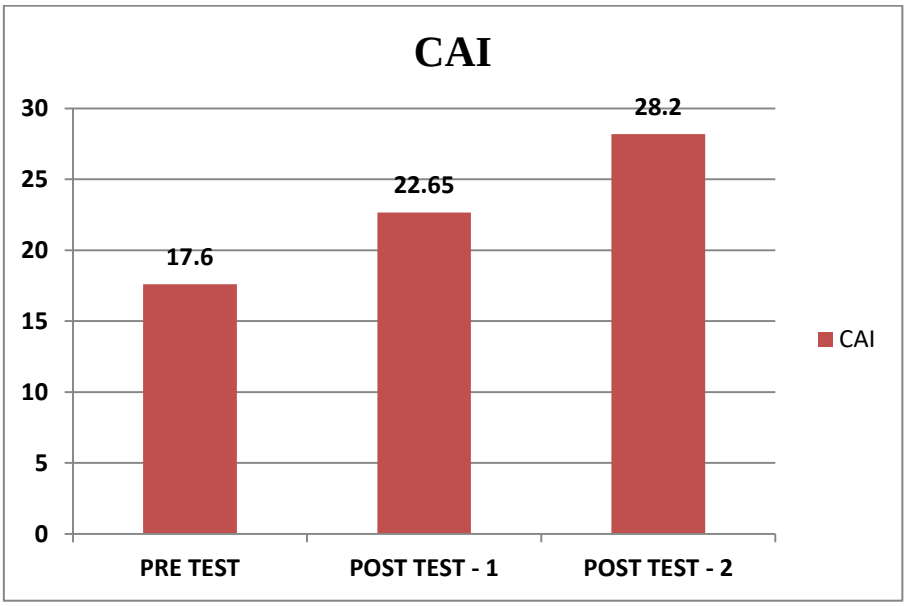
Comparision of cumberland ankle instability tool score within group between pre test and post tests

TEST	PROPRIOCEPTIVE TRAINING	
	MEAN	S.D
Pre Test	17.60	2.58
Post Test - 1	22.65	2.03
Post Test - 2	28.20	.951
F VALUE	240.25	
P VALUE	.001**	

(- P ≤ 0.05 - Significant).**

The above table reveals the Mean, Standard Deviation (S.D), f value and p-value between pre-test and post-tests within Group. There is a statistically significant difference between the pre test and post tests value within Group at $P \leq 0.05$.

Graph – I
Comparison of cumberland ankle instability tool score within group between pre test and post tests



RESULTS

The comparing Pre test and Post test within Group (Proprioceptive Training) on Cumberland Ankle Instability Tool Score shows significant difference in the pre test (17.60 ± 2.58) followed by post test – 1 (22.65 ± 2.03) & post test – 2 (28.20 ± .951) mean values at $P \leq 0.05$. It shows improvement in the post test values compared to pre test.

DISCUSSION

The present pre-experimental study evaluated the effect of proprioceptive training on ankle stability among male athletes aged 12–18 years. The findings demonstrated a progressive improvement in CAIT scores following the 8-week training program performed three times per week. The improvement in CAIT scores may be related to the balance, single-leg control, unstable-surface exercises, hopping, agility activities, and resistance-band exercises included in the training program. These activities were designed to challenge postural control and sensorimotor responses of the lower limb. The pre-test mean CAIT score was 17.60 ± 2.58. This increased to 22.65 ± 2.03 at post-test 1 and 28.20 ± 0.95 at post-test 2. The progressive increase suggests improvement in functional ankle stability over the intervention period. The project reported a statistically significant difference across the assessment points ($F = 240.25$, $p = 0.001$). The findings are consistent with the literature reviewed in the project, which describes improvements in balance, proprioception, postural control, and functional ankle stability following proprioceptive or balance-oriented training. Previous studies cited in the project have also reported benefits of proprioceptive training for athletes with ankle instability and for prevention of recurrent ankle sprains. The present findings should be interpreted within the context of the study design. Because the study was pre-experimental and did not include a separate control group, the observed change cannot be attributed exclusively to proprioceptive training without considering other possible influences.

CONCLUSION

The present study concluded that an 8-week proprioceptive training program was associated with significant improvement in functional ankle stability among the participating male athletes aged 12–18 years. CAIT scores increased progressively from pre-test through post-test 2. The training program included balance, single-leg, unstable-surface, hopping, agility, resistance-band, and dynamic activities. Proprioceptive training may therefore be incorporated as a component of sports training and ankle injury prevention programs for young athletes.

Limitations

- The study included only male athletes.
- The participants were limited to the age group of 12–18 years.
- The sample size was limited to 20 subjects.
- Only ankle stability was assessed as the principal outcome.
- The study duration was 6 months.
- The absence of a separate control group limits interpretation of cause and effect.

Recommendations

- Future studies may include a larger sample size.
- Longer follow-up may be used to evaluate retention of improvements.
- Studies may include different age groups and both male and female athletes.
- Additional outcomes such as dynamic balance, agility, functional performance, postural control, and injury incidence may be assessed.
- Controlled or randomized studies may be conducted to compare proprioceptive training with other training approaches.

Informed consent

Written informed consent was obtained from the participants before enrollment in the study, as described in the project.

Conflict of interest

The authors declare that there is no conflict of interest.

Funding

No external funding was received for this study.

Data availability

The project did not provide a separate data availability statement. The master data were maintained as part of the project records.

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