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RESEARCH ARTICLE

AN OBSERVATIONAL STUDY ON CORRELATION BETWEEN Y BALANCE TEST AND CALF MUSCLE ISOMETRIC ENDURANCE AND AGILITY AMONG ATHLETES WITH CHRONIC ANKLE INSTABILITY

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Abstract

Background: Agility and balance in functional variants are the requirements for optimal sport performance. Balance is being one of the factors which maintains the body in a certain position and prevents injury, thus agility to decide a return to sports. Existing literature finds a numerous variable of balance and agility among athletes. The aim of the present study is to find the gap between Y balance test (YBT), dynamic distance, calf muscle isometric endurance and agility among athletes with chronic ankle instability (CAI).

Methodology: In this cross-sectional study, 50 subjects with CAI were selected via convenience sampling method with an age between 18 to 28 years. Dynamic balance was assessed through Y Balance Test for lower limb. T agility test was done to measure agility skill. Calf isometric endurance was taken in sec. The association between the variables was estimated using the Karl Pearson Correlation Coefficient.

Results: The demographic data and outcome measures followed normal distribution and expressed in Mean and Standard deviation. The Karl Pearson's correlation test for outcome of the Y balance and agility, calf endurance of left and right sides did not show any correlation with YBT composite scores for left and right side.

Conclusion: The utilization of proper testing and training methods enhances balance and agility performance among CAI, and thus prevents reinjuries reducing disability impact among athletes.

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Introduction:-

Lower limb injuries in sports population are an area of global concern as they comprise almost 50% of all athletic injuries. High incidence rates have been reposted in soccer (19.7%) and basketball (14.0%) amongst young athletes [1,2]. Amongst lower limb injuries most prevalent is lateral ankle sprain [3,4]. Recurrent lateral ankle sprains can cause chronic ankle instability (CAI), where the ankle feels unstable or gives way during weight-bearing activities due to weakened ligaments and muscles from previous sprains [4-7]. They can have a long-term impact on sports performance and career longevity [8,9].

Chronic ankle instability and recurrent injuries are prevalent among those aged 15 to 35 years, active in sports like running, jumping, cutting, and pivoting, which heighten injury risks due to factors such as high-intensity activities, poor warm-up, insufficient conditioning, inadequate protective gear, and uneven surfaces [4-6]. Effective movement patterns training relies on integrating sensory inputs, including visual cues and proprioceptive feedback about body position and movement [10,11].

Balance being one of the factors which maintains the body in a certain position and prevents injury, where the dynamic balance is very essential for postural stability during movements. It also plays a significant role in lower limb neuromuscular control and, thus essential for prevention of injuries [12]. Studies have reported that commonly used dynamic balance tests, the Star Excursion Balance Test (SEBT) and the Y-Balance Test (YBT), have good inter- and intra-rater reliability in both athletes and healthy individuals [13-15]. The Y Balance Lower Quadrant Test has gained recognition as credible and valid indicator of dynamic equilibrium in a single stance.

Balance having one of the key components as proprioception, depends on feedback from muscle, tendon, and joint receptors signalling limb position and movement to the brain. In CAI, disruptions to this loop can stem from ligament damage, muscle weakness, or altered joint mechanics [6]. Lower active joint-position sense in specially from intrinsic foot muscles and calf muscles strength and endurance in CAI indicates reduced ability to perceive ankle joint position accurately, contributing to movement coordination difficulties, instability, and heightened injury risk [16,17].

Alongside of balance, Agility is a crucial parameter for return to sports, which is defined as ability of athletes to enhance their manoeuvre, react, accelerate, or decelerate rapidly to any stimulus coming up without any loss of balance. Previously, authors suggested improved posture and equilibrium training which have shown benefits for agility, also found there is a strong connection between static and dynamic balance over agility [18]. The T test determines the speed along with four directional changes, where the subject sprints in forward direction to reach point A, moves into left point B, followed by towards right point C and comes back to point A and then backwards sprint to starting point [18].

Existing literature discovered the relationship between the balance and agility in various sports population, but there is dearth among chronic injured athletes on their return to sports. Hence our study focuses on finding the correlation among y balance dynamic distance, calf muscle isometric endurance and agility among athletes with chronic ankle instability.

Methodology:-

This cross-sectional study aimed to establish the correlation among y balance dynamic distance, soleus calf muscle isometric endurance and T agility among athletes with chronic ankle instability. A group of 50 participants were sought out for the study aged between18 to 28 years. The study was conducted at Mangala College of Physiotherapy, Mangalore over a duration of 12 months from April 2025. The inclusion criteria included were gender with chronic ankle instability for more than three months, aged between 18-28 years who are ready to participate in the research. The individuals who are unwilling to participate, any history of lower limb surgery, meniscal injuries, structural flat feet, with neurological deficits like balance and co-ordination issues were excluded from the study. The study was conducted between May 2025 to March 2026.

Procedure:-

Upon approval from Ethics committee, the participants were screened for inclusion criteria. Subjects who met the criteria were given information regarding the study. A written, informed consent was procured from each

participant. Then demographic information, calf muscle isometric duration, Y Balance test and T Agility Test were performed for calf endurance, dynamic balance, and agility respectively.

Procedure for Y balance Test:-
To conduct the test, create a Y-shaped pattern on the ground using three strips of tape. The angles between the anterior stripe and both posterior stripes should be 135°, with 45° between the two posterior stripes. Y Balance Test was assessed in three directions (anterior, posteromedial, and posterolateral), distance in barefoot were notified, for three repetitions. The subject ticking the maximum distance out of each direction were noted and considered for the evaluation. During the test both the arms placed over both the iliac crest. The test performed for both the feet. The participant performed one leg in stance phase, while the other foot was reaching for maximum distance in three directions without losing balance and come back to standing position. Same repeated for other leg. The true limb length was taken, which is measurement from the anterior superior iliac spine to the medial malleolus and recorded in cm to calculate the composite value for each leg. The distance is measured using Inch tape

Procedure for calf muscle endurance:-
To conduct the test, each subject was asked to maintain a single leg stanceon a firm platform with knee kept in slightly bent position, the support was taken if the subject losing balance.The subject is then asked to maintain the held position long as possible and same procedure was repeated for opposite leg. The total duration of isometric measured in seconds.

Procedure for T agility test:-
The T test determines the speed along with four directional changes, where the subject sprints in forward direction to reach point A, moves into left point B followed by right point C and comes back to point A and then backwards sprint to starting point. At each point subject should touch the cones placed by reaching arms. The subject who crossed one foot in front of the other failed to touch the base of the cone and/or failed to face forward throughout, the test was repeated [18].

Sample Size and Sampling:-
The correlation Karl Pearson's coefficient (r) value was retrieved from Maduripu et al., [18] which was -0.275 with 95% confidence level and 80% power used to compute the population size to 45, assuming 10% dropout total sample size as 50 would be the appropriate sample size for the study. Following the subjects who met the inclusion and exclusion criteria the research participants were selected using convenience sampling.

Data Analysis:-
The data was analysed using statistical package SPSS 26.0. Normality was estimated by Kolmogorov-Smirnov test, all the demographic data and descriptive characteristics of the outcome measures following normal distribution was represented as Mean and standard deviation except for calf endurance (represented in Median and IQR). To assess the correlation, Karl Pearsons Correlation Coefficient (r) was applied between Y balance composite score and agility, whereas for Y balance composite score and calf endurance Spearman's rank Correlation Coefficient (rho) was used for right and left side respectively. p-value less than 0.05 was considered statistically significant.

Results:-
Seventy-two people were screened for selection of subjects to meet the criteria at Outpatient Department, Mangala College of Physiotherapy. The study included 50 participants, where the descriptive data has been expressed in Mean ± SD for age, height, weight, and BMI, the composite scores of Y balance test and T agility. Calf endurance has been expressed in Median (IQR) in Table 1.

Table 1: Descriptive statistics details of subjects and outcome measures expressed in Mean ± SD / Median (IQR)

Descriptive variables n=50	Mean ±SD / Median (IQR)
Age (in years)	21.62±1.52

Height (in cm)		166.24±9.77
Weight (in Kg)		60.24±11.20
BMI (in Kg/m^2)		21.27±3.26
Y Balance test Composite score	Right	97.45±14.89
	Left	98.35±14.07
Calf Isometric endurance (in sec)	Right	15.68 (10.18, 18.19)*
	Left	15.75 (9.80,19.34)*
T agility test		17.64±3.11

The Karl Pearson correlation Coefficient (r) analysis had been performed between Y balance composite score and T agility. Whereas Spearman's rank Correlation Coefficient (rho) was used between Y balance composite score and calf endurance tests. Here both the tests show no correlation between any parameters and is represented in Table 2.

Table 2: Karl Pearson Correlation Coefficient between outcome measure for left and right side.

Outcome Measures		T agility test		Calf Endurance	
		r value	p value	r value	p value
Y balance Test (Composite score)	Right	0.018	0.9	-0.063	0.666
	Left Side	-0.029	0.84	-0.037	0.799
Calf Endurance	Right	-0.053	0.717	--	--
	Left Side	0.195	0.175	--	--

p<0.05 statistically significant

Discussion:-

Athletes with CAI, often show repetitive giving away sensations due to lack of proprioceptive feedback resulting in musculoskeletal injuries. Through literature it is found that agility and balance are two major concerns in athletes, preventing injuries and athletes' skilful performance [20]. Hence with an aim to clinically evaluate the relation between dynamic Y balance, soleus calf muscle isometric endurance and T agility drills, 50 participants included in the study after screening and meeting the criteria.

Y Balance Test and T agility test:-

In our study, we found there is no correlation between Y balance distance and T agility drills on either side when analysed using Karl Pearson's Correlation test. Through earlier literature, cross-sectional study [20] had contrast results to our study, showing that YBT-LQ is a prime variable to assess dynamic balance and Modified Agility T Test to consider the agility skill. Another study concludes with implementing balance is a key factor to improve the kinetic balance and enhance athletic ability [18]. Hence it can be assumed that in our study, lower active joint-position sense reduced ability to accurately perceive the position of the ankle joint in individuals with CAI, thus

increasing the fear of reinjury which would have reduced the speed in agility. Supporting to our assumption a study has shown high posteromedial asymmetry increased injury risk in highly agile adolescent athletes [21].

Y balance test and calf endurance:-

The Y balance test and Calf isometric endurance did not display any correlation between the outcome variables analysed. This shows that the joint undergoing isometric endurance has similar or no change in stretch shortening cycle as the length remains the same and the joint maintained at a fixed angle whereas in Y balance test, the stance foot has a pivotal role in maintaining of foot load and muscle balance to attain maximum distance for dynamic leg. Hence forth we conclude CAI which has laxity of ligaments, lacks with optimal proprioception, balance and have weak muscle. A systematic review [22] showed neuromuscular and strength training improved balance, ankle flexibility, and overall function compared to the no-training group among CAI.

Calf endurance and T agility test:-

Like other results, in our study calf isometric endurance does not show any dependency over agility. This clearly shows isometric training tends to build more stability in the joints through foot stabilization, whereas T agility test is one of the dynamic tests which requires more acceleration, deceleration and mostly reaction time to change the direction rapidly. It can be taken into consideration that training isometric exercises will stabilize joints with the ligament laxity as in CAI that needs more precise control during dynamic movements. Hence training for intrinsic foot muscle for stability is a key predictor to improve dynamic control , thus improving agility among athletes with CAI.

Limitations:-

This study has a few limitations that need to be considered. Subjects with CAI did not play the same sports. Hence more studies required to analyse each sport separately. Secondly the outcome was analysed manually using inch tape, stopwatch. Simulated centres with real-time analysis would give more accurate readings for the outcome. Thirdly the sample is checked only at a small cluster and so cannot predict the changes compared to rest of the geography.

Conclusion:-

It is recommended to have sports specific subjects with chronic ankle instability to have better results. Implementing isometric training and motor control, enhancing Y balance test distance and agility can be done with an experimental study design.

Conflicts of Interest:-

There are no reported conflicts of interest.

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