

1 **An Observational Study on Correlation Between Y Balance Test And Calf Muscle Isometric**
2 **Endurance and Agility among Athletes with Chronic Ankle Instability.**

4 **ABSTRACT**

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

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

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

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

23 **Keywords:** Balance, calf endurance, T agility, chronic ankle instability

24 INTRODUCTION

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

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

38 Dynamic balance is essential for postural stability during movements. It also plays a
39 significant role in lower limb neuromuscular control and, thus essential for prevention of
40 injuries [12]. Studies have reported that commonly used dynamic balance tests, the Star
41 Excursion Balance Test (SEBT) and the Y-Balance Test (YBT), have good inter- and intra-
42 rater reliability in both athletes and healthy individuals [13-15]. The Y Balance Lower
43 Quadrant Test has gained recognition as credible and valid indicator of dynamic equilibrium
44 in a single stance.

45 Proprioception depends on feedback from muscle, tendon, and joint receptors signalling limb
46 position and movement to the brain. In CAI, disruptions to this loop can stem from ligament
47 damage, muscle weakness, or altered joint mechanics [6]. Lower active joint-position sense

48 in CAI indicates reduced ability to perceive ankle joint position accurately, contributing to
49 movement coordination difficulties, instability, and heightened injury risk [16,17].

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

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

62

63 **METHODOLOGY**

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

72 like balance and co-ordination issues were excluded from the study. The study was conducted
73 between May 2025 to March 2026.

74 **Procedure**

75 Upon approval from Ethics committee, the participants were screened for inclusion criteria.
76 Subjects who met the criteria were given information regarding the study. A written,
77 informed consent was procured from each participant. Then demographic information, calf
78 muscle isometric duration, Y Balance test and T Agility Test were performed for calf
79 endurance, dynamic balance, and agility respectively.

80 **Procedure for Y balance Test**

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

93 **Procedure for calf muscle endurance**

94 To conduct the test, each subject was asked to maintain a single leg on a firm object with his
95 foot and asked the subject to heel off from the firm object, the hand should be held on a bar

96 for the support, go for a squat and one leg off while squatting, maintain the position as long
97 as possible and same procedure was repeated for contralateral leg. The total duration
98 measured in seconds.

99 **Procedure for T agility test**

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

106 **Sample Size and Sampling**

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

112 **Data Analysis**

113 The data was analysed using statistical package SPSS 26.0. Normality was estimated by
114 Kolmogorov-Smirnov test, all the demographic data and descriptive characteristics of the
115 outcome measures following normal distribution was represented as Mean and standard
116 deviation except for calf endurance (represented in Median and IQR). To assess the
117 correlation, Karl Pearsons Correlation Coefficient (r) was applied between Y balance
118 composite score and agility, whereas for Y balance composite score and calf endurance

119 Spearman's Correlation Coefficient (ρ) was used for right and left side respectively. P
120 value less than 0.05 was considered statistically significant.

121 RESULTS

122 Seventy-two people were screened for selection of subjects to meet the criteria at Outpatient
123 Department, Mangala College of Physiotherapy. The study included 50 participants, where
124 the descriptive data has been expressed in Mean \pm SD for age, height, weight, and BMI, the
125 composite scores of Y balance test and T agility. Calf endurance has been expressed in
126 Median (IQR) in Table 1. The Karl Pearson correlation Coefficient (r) analysis had been
127 performed between Y balance composite score, calf endurance, and T agility tests shows no
128 correlation between any parameters and is represented in Table 2.

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

Descriptive variables n=50		Mean \pm SD / Median (IQR)
Age (in years)		21.62 \pm 1.52
Height (in cm)		166.24 \pm 9.77
Weight (in Kg)		60.24 \pm 11.20
BMI (in Kg/m ²)		21.27 \pm 3.26
Y Balance test Composite score	Right	97.45 \pm 14.89
	Left	98.35 \pm 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 \pm 3.11

131

132 Table 2: Karl Pearson Correlation Coefficient between outcome measure for left and right
 133 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	--	--

134 p<0.05 statistically significant

135 **DISCUSSION**

136 Athletes with CAI, often show repetitive giving away sensations due to lack of proprioceptive
 137 feedback resulting in musculoskeletal injuries. Through literature it is found that agility and
 138 balance are two major concerns in athletes, preventing injuries and athletes' skilful
 139 performance [20]. With an objective to find the correlation between Y balance, calf muscle
 140 isometric endurance and T agility drills, 50 participants included in the study after screening
 141 and meeting the criteria.

142

143 **Y Balance Test and T agility test**

144 In our study, we found there is no correlation between Y balance distance and T agility drills
 145 on either side when analysed using Karl Pearson's Correlation test. Through earlier literature,
 146 cross-sectional study [20] had contrast results to our study, showing that YBT-LQ is a prime
 147 variable to assess dynamic balance and Modified Agility T Test to consider the agility skill.
 148 Another study concludes with implementing balance is a key factor to improve the kinetic

149 balance and enhance athletic ability [18]. This lower active joint-position sense indicates a
150 reduced ability to accurately perceive the position of the ankle joint in individuals with CAI,
151 thus increasing the fear of reinjury which would have reduced the speed in agility. Supporting
152 to our assumption a study has shown high posteromedial asymmetry increased injury risk in
153 highly agile adolescent athletes [21].

154 **Y balance test and calf endurance**

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

164 **Calf endurance and T agility test**

165 Like other results, in our study calf isometric endurance does not show any dependency over
166 agility. This clearly shows isometric training tends to build more stability in the joints through
167 foot stabilization, whereas T agility test is one of the dynamic tests which requires more
168 acceleration, deceleration and mostly reaction time to change the direction rapidly. It can be
169 taken into consideration that training isometric exercises will stabilize joints with the
170 ligament laxity as in CAI that needs more precise control during dynamic movements.

171 **Limitations**

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

177 **CONCLUSION**

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

181 **Conflicts of Interest**

182 There are no reported conflicts of interest.

183 **Acknowledgement**

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