

# A Comparative Study on Balance After Conservative and Reconstructive ACL Rehabilitation in Young Adults: A Survey Study

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## ABSTRACT

**Background:** ACL injury is said to affect the balance of an individual. ACL injury can be treated either by conservative treatment or by reconstructive treatment. However, there is difference in opinion, which treatment has best results. Therefore, the primary aim is to compare the balance after conservative and reconstructive ACL rehabilitation in young adults.

**Methodology:** Total 25 patients were allocated into two groups; group A was ACL reconstructive group (12 subjects) and group B was ACL conservative group (13 subjects). Duration of injury was between 5 months- 1 year. The outcome measures include Pain (VAS), Balance (Star Excursion Balance Test), Functional tests, Girth, Range of Motion (Goniometer), Strength (Strain gauge dynamometer) and Stability of joints (Special tests) respectively.

**Result and conclusion:** The analysis of recorded data revealed that the balance remains same in both the groups after assessment. And there is no significant difference between both the treatment methods. To conclude this study, it can be stated that after both conservative and reconstructive rehabilitation, balance is equally hindered among young adults.

**Keywords:** Anterior cruciate ligament, (ACL), Balance, Conservative group, Reconstructive group, Rehabilitation, Proprioception, Star Excursion Balance Test.

## INTRODUCTION

Balance or postural stability is a generic term used to describe the dynamic process by which the body's position is maintained in equilibrium [15]. Balance is the process of maintaining the body's center of gravity (CoG) vertically over the base of the support and it relies on rapid and continuous feedback from visual, vestibular and somatosensory structures for the subsequent execution of smooth and coordinated neuromuscular actions [13-14]. Balance is of two types: Static balance and Dynamic balance. Balance impairment can be caused by injury or disease to any structures involved in the three stages of information

processing (i.e. sensory input, sensorimotor integration and motor output generation).

Receptors located in the muscles, tendons, skin and joint structures such as in the cruciate ligaments, provide the central nervous system with information regarding the joints and body position, speed and direction of the movement. Neurophysiological experiments show that the afferent information from the ACL affects the gamma motor neurons and therefore they will contribute to functional stabilization of the knee joint [1].

This sensory information, as well as information from the visual and vestibular systems, contributes to the maintenance and

control of posture and balance in a particular position or during a movement. Dysfunction in any part of the system will result to impaired postural control [1].

Balance usually gets impaired in knee conditions like Anterior Cruciate Ligament (ACL) tear [1], Posterior Cruciate Ligament (PCL) [2], osteoarthritis [68] and other conditions. Rupturing of anterior cruciate ligament may result in antero-lateral instability of the knee. This will manifest as a feeling of instability and repetitive episodes of 'giving way' in which the knee will fail under conditions of rotational stress [3].

Anterior cruciate ligament (ACL) injury is one of the most extensively studied orthopaedic conditions in the literature. ACL injury has been associated with a decrease in proprioceptive performance and specifically postural control [8]. Proprioceptive deficits have been implicated as contributing to balance impairments following knee ligamentous injuries.

ACL injuries are treated surgically and in these cases, as well as in non-surgically managed ACL injuries, it has been suggested that the patient's ability to balance on the ACL injured leg may be decreased [4]. Many people with ruptured ACL require ACL-reconstruction to restore functional and anatomical knee joint stability [5].

After injury, returning to the previous activity level can be hampered by knee instability, altered neuromuscular control, [6] proprioception and muscle strength deficiency {[7]; [8] and [9]}.

Clinicians often use postural-control assessments to evaluate the risk of injury, initial deficits resulting from injury and the level of improvement after intervention for an injury. Dynamic postural control has gained popularity in clinical and research settings as an assessment of function. It involves some level of expected movement around a base of support. One measurement of dynamic postural control that has increased in frequency of use is the Star Excursion Balance Test (SEBT) [10].

The modified star excursion balance test is a functional screening tool to assess lower extremity dynamic stability and neuromuscular control encompassing lower extremity strength, coordination, balance, and flexibility [11]. In the SEBT, neuromuscular control is explored by keeping balance on one foot while the other foot is reached in specific direction [12]. It is found to be a reliable assessment tool with high test-retest reliability and has been shown to discriminate dynamic balance and neuromuscular control strategies between limbs following unilateral lower extremity injury.

## **METHODOLOGY**

We designed a study to compare balance after conservative and reconstructive ACL rehabilitation in young adults.

From Dec 2019 to March 2021, 25 patients (13 conservative subjects and 12 operative patients) with clinical and magnetic resonance imaging confirmed ACL rupture was included in this study. There are 24 Males and 1 Female, with a mean age of 14 years (range 18-34 years). The criteria for selecting were- both males and females are included, duration of injury- 5 months to 1 year, MRI showing ACL tears (All grades), participants with age group 18-32 years, with or without association of meniscal injury and subjects with ACL injury corrected conservatively or surgically. Subjects with fracture of patella. Patients with tibia and femur fracture, with an avulsion fracture, contracture in lower limbs or patients using any assistive aids were excluded for the purpose to evaluate knee proprioception following ACL injury.

All the patients were taken from institutional OPD's and nearby clinics. After being informed about the methodology and the objectives of the study, the patients gave written informed consent and assured compliance for participation in this study. The study has been approved by the Institutional Ethical Committee.

Evaluation of the proprioception was done in only the ACL injured knee using the balancing tests like One leg standing, Vertical jump test, Romberg test, Tendam standing, Semi-tendam standing, Toe standing and Heel standing, Vrikshasana

and SEBT. Assessment of range of motion of knee and hip joint was done by goniometer. Assessments of strength of muscles of hip and knee joints were done by strain gauge dynamometer.

## RESULT

Table 1: Comparison of mean values for balancing variables between conservative and operative groups:

Variable	Operative		Conservative		t value	P value
	Mean	SD	Mean	SD		
One leg squat	18.83	10.641	13.69	3.902	0.1372	P > 0.05
Vertical jump test	56.60	22.712	47.97	13.789	0.2702	P > 0.05

No statistical difference was found between ACL conservative and operative groups during one leg standing and vertical jump test as presented in Table 1.

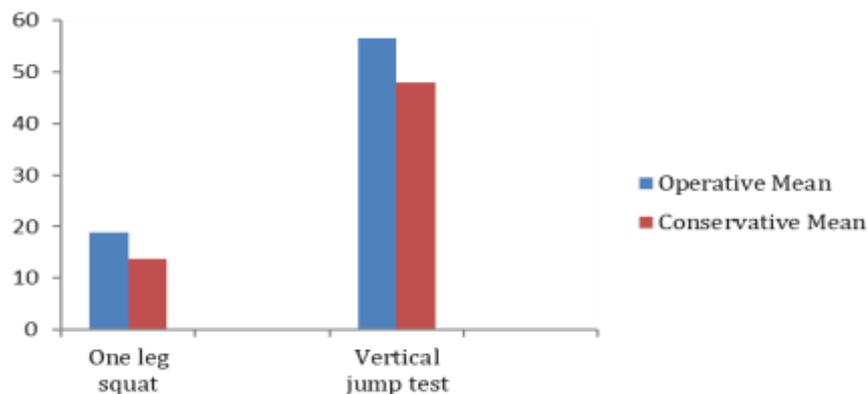
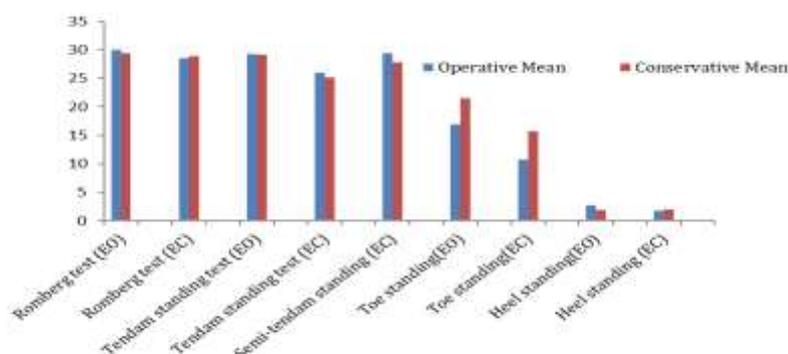


Table 2: Comparison of mean values in balance tests with eyes open and eyes close between ACL conservative and operative groups:

Variable	Operative		Conservative		t value	P value
	Mean	SD	Mean	SD		
Romberg test (EO)	29.98	0.0577	29.37	2.249	0.3497	P > 0.05
Romberg test (EC)	28.51	3.2203	28.92	1.813	0.0001	P < 0.05
Tendam standing test (EO)	29.26	2.5634	29.14	2.534	0.9080	P > 0.05
Tendam standing test (EC)	25.98	5.6490	25.09	5.351	0.6912	P > 0.05
Semi-tendam standing (EO)	29.25	2.586	29.83	0.610	0.4651	P > 0.05
Semi-tendam standing (EC)	29.37	1.940	27.87	4.270	0.2659	P > 0.05
Toe standing (EO)	16.96	9.355	21.55	5.498	0.1565	P > 0.05
Toe standing (EC)	10.73	7.524	15.65	6.966	0.1108	P > 0.05
Heel standing (EO)	2.685	1.213	1.915	1.213	0.1621	P > 0.05
Heel standing (EC)	1.757	0.655	2.043	1.105	0.4360	P > 0.05

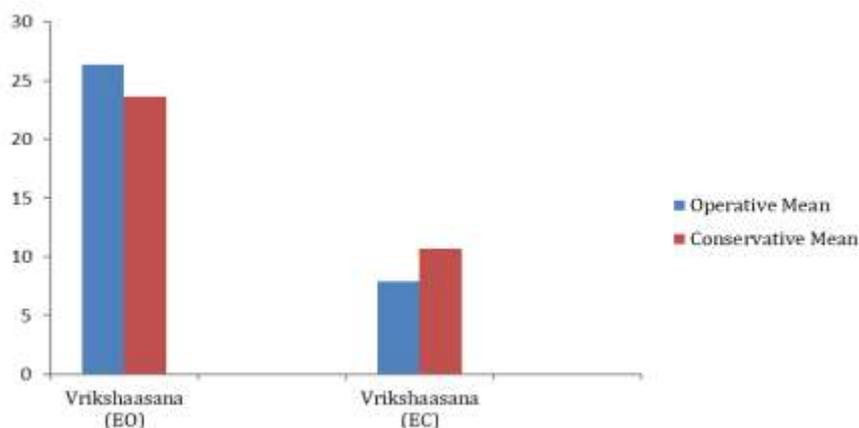
No statistical difference was found between the balance tests when compared with eyes open and eyes closed within ACL operated and conservative groups presented in Table 2.



**Table 3: Comparison of mean values of vrikshaasna between ACL conservative and reconstructive group:**

Vrikshaasana Variables	Operative		Conservative		t' value	P value
	Mean	SD	Mean	SD		
Vrikshaasana (EO) (in secs)	26.35	3.126	23.68	6.193	0.1868	P > 0.05
Vrikshaasana (EC) (in secs)	7.887	4.543	10.73	3.837	0.1066	P > 0.05

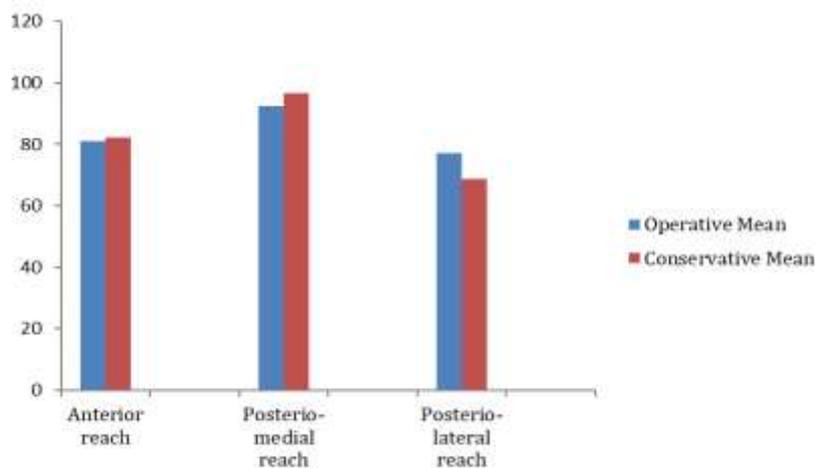
No statistical difference was seen between mean values of vrikshaasna between ACL conservative and reconstructive group as presented in Table 3.



**Table 4: Comparison of mean values SEBT between ACL conservative and reconstructive group:**

Variable	Operative		Conservative		t value	P value
	Mean	SD	Mean	SD		
Anterior reach	80.9	11.750	82.16	12.390	0.7950	P > 0.05
Postero-medial reach	92.39	13.702	96.57	16.815	0.5006	P > 0.05
Postero-lateral reach	77.01	24.93	68.83	18.254	0.3638	P > 0.05

No statistical difference was seen between mean values of SEBT variables between ACL conservative and reconstructive group as presented in Table 4.



## DISCUSSION

The quantification of balance deficits and their rehabilitation can be valuable to a number of populations. Balance measuring systems have been used clinically to measure how balance is affected between ACL conservative group and ACL reconstructive group. Proprioceptive deficit is probably the result of loss of ligamentous

mechanoreceptors and consequent loss of proprioceptive feedback.

In this study, one leg standing, vertical jump test, Romberg test, tandem standing, semi-tandem standing, toe standing, heel standing, vrikshaasna and Star Excursion Balance Test were used as an outcome measure to assess the proprioceptive performance and specifically postural control after ACL injury. The measurement

was taken after warm up and 6 trials of the test. It was one time study. The data was analysed using SPSS version 20.0.

In this study, the mean difference between the ACL reconstructive group and conservative while performing one leg squat and vertical jump test is non-significant as the value of  $p > 0.05$ . Aglietti *et al* suggested that in young adults which desire to return to pre-injury activity, operative management of an ACL tear is considered the 'gold standard' of care. The non-operative management of ACL-deficient knees has been proposed in the past as a substitute, but has been associated with poor functional outcome.

Romberg test, tandem standing, semi-tandem standing, toe standing, heel standing and vrikshaasna have no significant mean difference when compared between ACL conservative group and reconstructive group as the  $p > 0.05$ .

Star Excursion Balance Test (SEBT) was also checked in this study. It was observed that, conservative group and operative group had non-significant difference in the mean values of SEBT variables with  $p > 0.05$ .

## CONCLUSION AND LIMITATION

The analysis of recorded data revealed that the balance remains same in both the groups after assessment. And there is no significant difference between both the treatment methods. Thus, the alternate hypothesis is rejected and null hypothesis is accepted for this study. To conclude this study, it can be stated that after both conservative and reconstructive rehabilitation, balance is equally hindered among young adults.

The main limitation was COVID-19 outbreak and lockdown. It was difficult to contact and reach out to subjects. The population size used was relatively small in comparison to many of before mentioned studies. There is an extensive age gap between 18-32 years. Gender based comparison could not be made owing to relatively lesser number of female

participants. Study was conducted in very limited time.

## List of abbreviations:

ACL- Anterior Cruciate Ligament, PCL- Posterior Cruciate Ligament, SEBT- Star Excursion Balance Test. SD- Standard Deviation, EO- Eyes Open, EC- Eyes Closed

## Author's contributions:

Osheen Bhandari- Data collection, research design, research process, reviews of literature, research analysis and manuscript drafting.

Narinder Kaur Multani- Editing and manuscript drafting.

## Declaration by Authors

**Ethical Approval:** Approved

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**Conflict of Interest:** The authors declare no conflict of interest.

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