

## Original Research Article

# Effect of drains on dynamic proprioception after arthroscopically assisted anterior cruciate ligament reconstruction

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### ABSTRACT

**Background:** Decrease in proprioception and kinesthesia occurs after ACL injury. Changes occurring within the joint following injury affect normal recruitment and firing patterns of the surrounding musculature. There are little data in the literature with reference to drain use after arthroscopic procedures on the knee or ACL reconstruction. The objective of the study was to determine the effect of postoperative drain use on proprioception after arthroscopically assisted anterior cruciate ligament (ACL) reconstruction with quadrupled hamstring graft.

**Methods:** In this study, 54 arthroscopic ACL reconstruction patients were randomized for either intra-articular suction drain group or non-drain group. Outcome Assessment was done at 1 month, 3, 6 and 12 months after the surgery in which patients were assessed using Star excursion balance test by measuring excursion distances in each of the 8 directions.

**Results:** Excursion distances in eight directions showed more increment in drainage tube (DT) group compared to no DT group. However it was found to be statistically significant only for posteromedial ( $p = 0.018$ ) and medial directions ( $p < 0.001$ ).

**Conclusions:** Postoperative drain should be used after arthroscopically assisted anterior cruciate ligament (ACL) reconstruction with quadrupled hamstring graft for improving the deficits in dynamic posture control.

**Keywords:** Anterior cruciate ligament, Star excursion balance test, Proprioception, Drains, Hamstring graft

### INTRODUCTION

The anterior cruciate ligament (ACL) plays an important role in the stability of the knee primarily through its passive constraint to anterior tibial translation and tibial rotation. Also it influences the dynamic function of the knee. The variability in dynamic adaptations achieved through alteration in the patterns of muscle firing during a particular activity provides a possible explanation for the differences in outcomes of patients after anterior cruciate ligament injury.<sup>1,2</sup>

A decrease in proprioception and kinesthesia occurs after ACL injury. Changes that occur within the joint affect normal recruitment and timing patterns of the

surrounding musculature. In the ACL deficient (ACL D) knee, movement occurs in a non-physiological axis, creating alterations in gait and movement.<sup>3,4</sup> The sensation of instability and giving way that the ACL D patient describes has been attributed to poor proprioception in addition to the actual functional instability.<sup>5</sup> ACL injury has been associated with a resultant decrease in proprioceptive performance, with this relationship between ACL rupture and decreased proprioception being reported to be due to damage to the mechanoreceptors in the articular structures and ACL.<sup>6</sup>

Drains have been used commonly in orthopedics to evacuate hematomas under the presumption that this will decrease pain and swelling, hasten the return of motion,

shorten the hospital stay, speed rehabilitation, and potentially decrease the risk of infection.<sup>7-9</sup> However, use of drains are not without their problems. The disadvantages of use of surgical drains include hernias, breakdown of anastomoses, fistula formation, erosion into adjacent structures, and discomfort during the presence of and removal of the drain.<sup>10</sup>

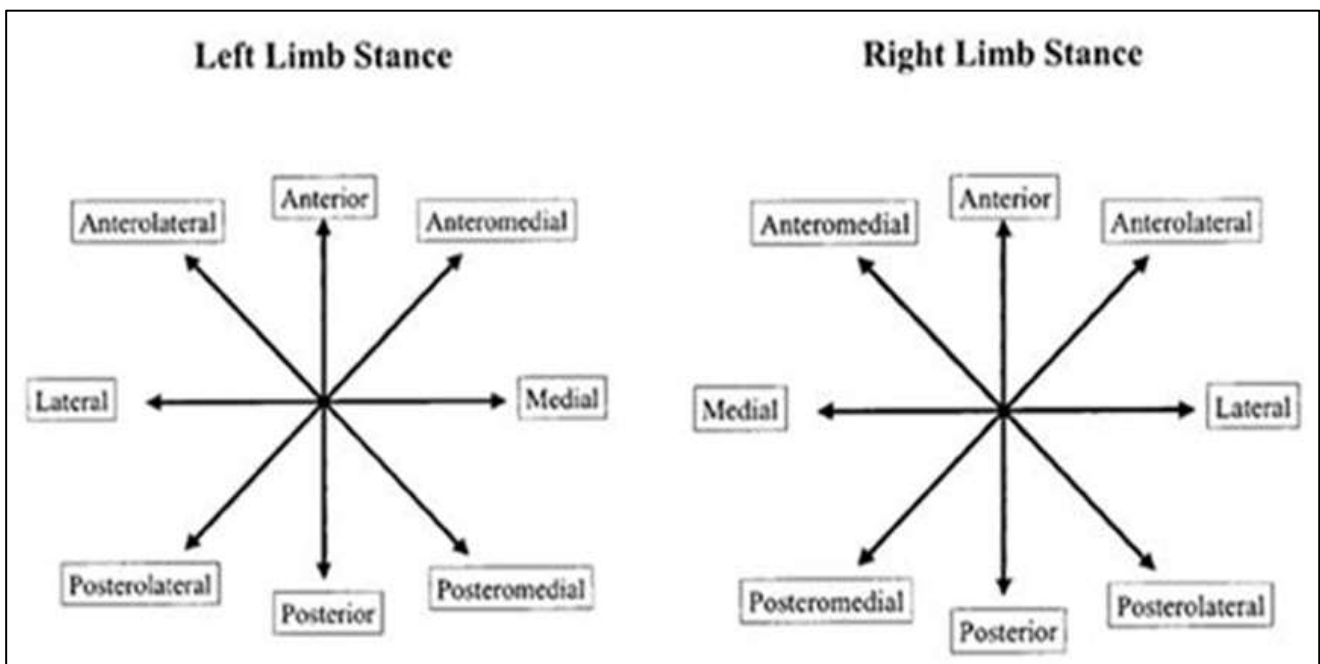
We conducted a prospective randomized clinical trial to determine the effect of postoperative drain use in arthroscopically assisted ACL reconstruction with quadrupled hamstring graft following the surgery. The null hypothesis was that use of a drain would not result in improvement in proprioception for patients who had drains compared with those who did not.

**METHODS**

We performed the evaluation of effect of drain use on dynamic proprioception using SEBT in the postoperative period after arthroscopically assisted ACL reconstruction with quadrupled hamstring graft in ACL deficient patients.

All patients undergoing primary anterior cruciate ligament tear reconstruction, using quadrupled hamstring graft between august 2013 to august 2014 were included

in the study. They were then followed up for the duration of one year post operatively. We divided the patients into 2 groups: one in which closed wound drains were used for 24 hours postoperatively and another in which no drains were used. The participants of this study were divided into two groups with first group having patients undergoing anterior cruciate ligament reconstruction with insertion of drainage tube (DT) postoperatively for a period of 24 hours. Second group had patients undergoing anterior cruciate ligament reconstruction without insertion of drainage tube post operatively. Patients with ACL deficient knee requiring isolated ACL reconstruction, patients with ACL tear presenting after six weeks but before six months from the date of injury, patients with ACL tear who had minimum of 120 degrees of flexion possible at the knee before surgery and had no pain in the affected knee were included in the study. Patients with multi ligament injuries, Presence of fractures or deformities in the lower limb, revision anterior cruciate ligament reconstruction, Patients with grade III/IV cartilage injury and patients with irreparable grade 3/4 meniscus injury at menisco-capsular junction were excluded from the study. Proprioception analysis was assessed using star excursion balance test as given in Figure 1. SEBT was performed on patient’s preoperatively and post operatively at 1, 3, 6 and 12 months from the surgery.



**Figure 1: The 8 positions of the SEBT are based on the stance of the affected limb.**

Patients who were to take the test were selected based if they had no history of ankle injury, no history of cerebral concussions, no ear infection or upper respiratory infection at the time of test, no prior balance training. To perform the SEBT, subjects were asked to stand on one foot and reach as far as they could in each of 8 different directions with the other foot, touching down lightly on the line, then return to the starting position as shown in

Figure 2. Subjects maintained a single-limb stance until they returned to the starting position. The 8 directions extend out in a circle and each target line is 45° from the adjacent lines. Each direction is completed as a separate trial and reach distance is recorded in centimetres. Six practice trials were permitted for each lower extremity to minimize learning effect. Subjects were then allowed to rest and completed 3 measured trials on each lower

extremity. The mean reach distance for each lower extremity was recorded. Trials were discarded and repeated if the hands were removed from the hips, the reaching limb was used for weight bearing, the stance limb was displaced or there was a loss of balance. Random allocation was made in blocks in order to keep the sizes of treatment and control groups similar. Block randomization was used to divide the patients into 2 groups: one in which closed wound drains were used for 24 hours postoperatively and another in which no drains were used. It was not a blinded study and there were 27 patients in each of the groups.



**Figure 2: Star excursion balance test.**

The type of anesthetic (regional or general) was not controlled and was selected at the discretion of the anesthesiologist. All patients received prophylactic intravenous antibiotics preoperatively. A pneumatic tourniquet was used following exsanguination to produce a relatively bloodless operative field. Same team of surgeons performed all of the ligament reconstructions in the patients in this study. The anterior cruciate ligament was reconstructed with quadrupled hamstring graft, harvested from the ipsilateral knee under tourniquet. Trans-tibial technique was used in graft placement. Anchorage of the graft was done using bio-absorbable interference screws at tibial side and either cross pins or endobutton for femoral side. After arthroscopic ACL reconstruction, two mini-vac drains were inserted, one at extra articular site deep to the sartorial fascia and one at intra articular site. For patients in the control group, the knee was closed primarily, without the drain placement. In the operating room, a 3 layered compressive dressing was placed on the knee of all patients. A knee immobilizer was applied for all the patients for first 2 weeks at rest. Patients were allowed partial weight bearing from the next day after gait training with bilateral axillary crutches. All patients were encouraged to elevate the extremity when not performing therapy. Postoperative rehabilitation was performed in accordance with the accelerated ACL protocol and was identical in both the treatment and control group. The drain was pulled out from the patients in the treatment group 24 hours after the operation. No drain malfunctions were noted. After

removing the drain, 3 layered compression dressing was continued till 4th postoperative day. On 4th day, 3 layered compression dressing was removed and lower limb compression stocking was applied. In all the patients, similar postoperative analgesia regimen was followed.

Assessment was done on postoperative 1, 3, 6 and 12 months after the surgery based on the same criteria considered preoperatively. Results were expressed as mean±SD. Statistical analysis was performed by using repeated-measures analysis of variance (ANOVA). Independent sample t-test was used to compare the treatment group and control group over a period of time. Post hoc test was used in finding patterns and/or relationships between subgroups of samples under study. The difference between the two groups was considered significant if the p value was less than 0.05.

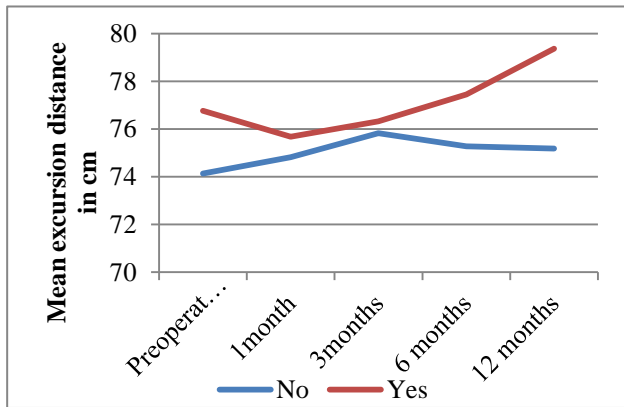
## RESULTS

This study included 70 cases of colorectal malignancies. A prospective non randomized evaluation was performed on the effect of drain use in the postoperative period after arthroscopically assisted ACL reconstruction with quadrupled hamstring graft in 54 patients. Reconstructions were performed on the left knee in 28 patients and on the right knee in 26 patients

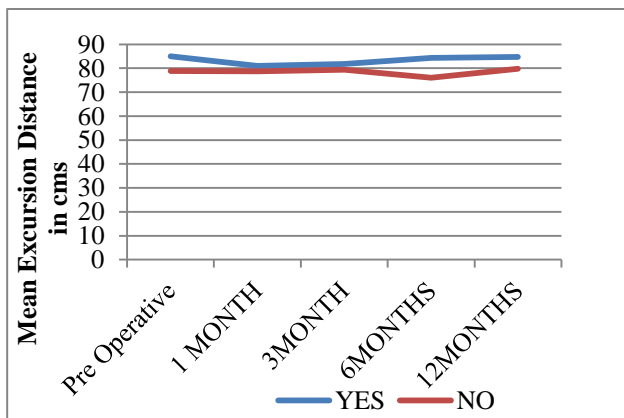
As per the criteria set forth in the methodology, 54 cases were recorded during the period, August 2013 to August 2014. The cases were included in the study as and when they were posted for anterior cruciate ligament reconstruction and randomized into two groups, the DT group and the no DT group and were followed up regularly. The following results will give an overview of the cases collected during the study period. The age of the patients treated was ranged between 18 and 50 years, average being 30 years. This group represents the active working class. Those less than 25 years of age were comprised mainly of students. The gender distribution of cases was eccentric, with 94.5% (n=42) males, and a mere 4.5% (n=2) females in the study. This can be explained on the basis of lower rates of road traffic accidents among females and lesser participation in sports activities

Proprioception was assessed using star excursion balance test and excursion distances in eight different directions were measured preoperatively and postoperatively at 1, 3, 6 and 12 months following surgery. Mean excursion distance for anteromedial (AM) direction as given in Figure 3 in DT group showed decline at 1 month and progressive increase over a period of 1 year. For the no DT group, the improvement in excursion distance was noticed at 1 and 3 months after which no further improvement was seen. At the end of 1 year, the mean excursion distance for anteromedial direction was more for DT group compared to no DT group. Similarly in DT group, mean excursion distance in anterior (ANT)

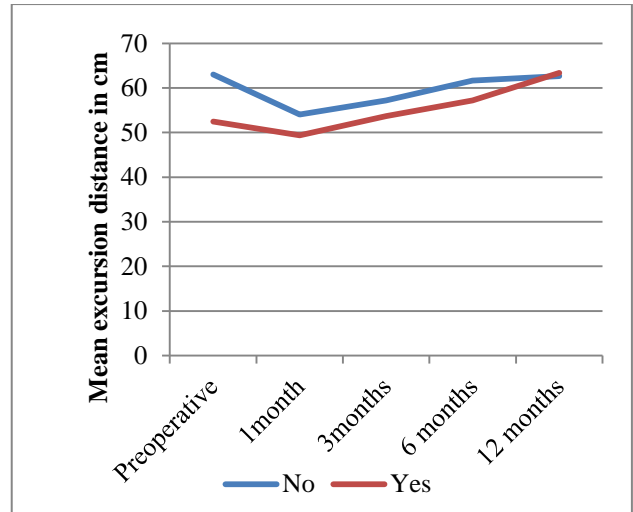
direction as in Figure 4 showed improvement over a period of time and was statistically significant ( $p = 0.002$ ). In no DT group no clinically or statistically significant difference was seen over a period of follow up of 12 months ( $p = 0.435$ ).



**Figure 3: Mean excursion distance for anteromedial direction in both the DT and no DT groups.**

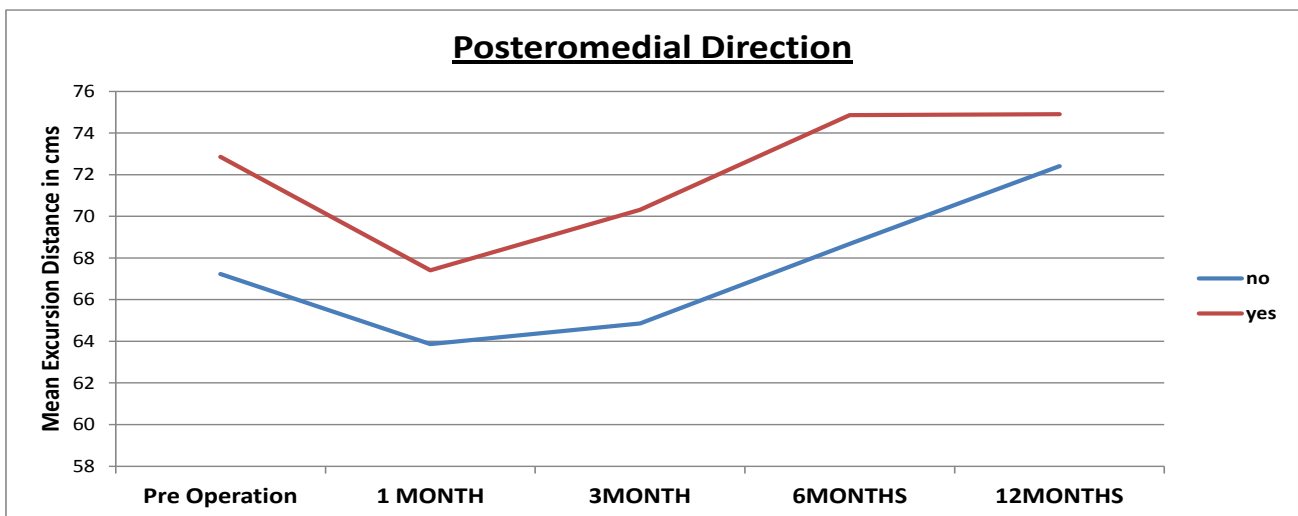


**Figure 4: Mean excursion distance for anterior direction in both the DT and no DT groups.**



**Figure 5: Mean excursion distance for medial direction in both the DT and no DT group.**

Excursion distances for each of the four directions namely, anterolateral (AL), lateral (L), posterolateral (PL) and posterior (POS) showed decline in values at 1 month following surgery compared to preoperative values following which they showed a uniform increase over a period of 1 year as presented in Table 1, this finding was seen in both the treatment and control group. However, this difference was not found statistically significant (AL  $p = 0.102$ ; L  $p = 0.204$ ; PL  $p = 0.508$ ; POS  $p = 0.22$ ). In both the groups, mean excursion distance in medial as in Figure 5 and posteromedial direction as in Figure 6 showed a decline at 1 month after which a uniform increase was seen in no DT group over a period of one year while the max excursion distance for DT group was seen at 6 months following which it showed a mild decline at the end of 1 year. In both the groups, mean excursion distance in medial direction showed a decline at 1 month after which a uniform increase was seen over a period of 1 year.



**Figure 6: Mean excursion distance for postero medial direction in both the DT and no DT group.**

**Table 1: Independent sample t- test for comparing excursion distances in different directions in DT and no DT group over 12 months.**

Direction	DT	N	Mean	SD	p-value
Anteromedial	Y	22	2.59	3.32	0.159
	N	22	1.05	3.81	
Anterior	Y	22	-0.18	6.80	0.52
	N	22	1.00	5.18	
Anterolateral	Y	22	2.05	5.48	0.102
	N	22	-0.23	3.26	
Lateral	Y	22	-0.45	9.66	0.204
	N	22	2.68	6.04	
Posterolateral	Y	22	1.41	5.20	0.508
	N	22	2.27	3.13	
Posterior	Y	22	3.41	5.59	0.22
	N	22	1.64	3.66	
Posteromedial	Y	22	5.18	7.18	0.018
	N	22	0.73	4.47	
Medial	Y	22	10.95	7.80	<0.001
	N	22	-0.36	5.96	

## DISCUSSION

Measurement of postural control is an important tool in the assessment of paediatric, geriatric, and athletic populations for establishing levels of neuromuscular function for the purposes of injury prevention and rehabilitation. Postural control is often described as being either static (attempting to maintain a position with minimal movement) or dynamic (maintaining a stable base of support while completing a prescribed movement).<sup>11</sup> A clinician or researcher may assess static postural control by having an individual attempt to maintain a stationary position while standing on either one or both feet. A common clinical example of static postural control assessment is the modified Romberg test, first described by Freeman.<sup>12</sup> This test is performed by having participants stand as motionless as possible, on one foot, as a series of task demands are added to challenge the postural control system. These task demands include closing the eyes, tilting the head up, and touching an index finger to the nose. Although this test is commonly used in the assessment of cerebral concussion (bilateral stance) and lower extremity joint injuries (unilateral stance), it typically does not place strength or movement demands on the participant.

Dynamic postural control often involves completion of a functional task without compromising one's base of support. The advantage of assessing dynamic postural control is that additional demands of proprioception, range of motion (ROM), and strength are required along with the ability to remain upright and steady. The star excursion balance test (SEBT) is one test that provides a significant challenge to an athlete's postural control system.<sup>13-16</sup> The SEBT involves having a participant maintain a base of support with one leg while maximally

reaching in different directions with the opposite leg, without compromising the base of support of the stance leg. Earl and Hertel demonstrated the usefulness of the SEBT for the recruitment of lower extremity musculature contraction and discussed its application in rehabilitating various lower extremity musculoskeletal injuries.<sup>14</sup> Researchers have provided evidence that the SEBT is sensitive for screening musculoskeletal impairments, such as chronic ankle instability, quadriceps strength deficits, and patella-femoral pain syndrome. The anterior cruciate ligament reconstruction (ACLR) subjects who demonstrated a quadriceps strength deficit during isokinetic testing also demonstrated decreased anterior reaching distance while performing the SEBT compared to uninjured matched control subjects. The SEBT has been shown to be a reliable and valid instrument for assessing dynamic postural control. A decrease in proprioception and kinesthesia occurs after ACL injury. Changes that occur within the joint affect normal recruitment and timing patterns of the surrounding musculature.<sup>17</sup>

Miller correlated quadriceps strength deficits with performance of the SEBT among subjects who had undergone anterior cruciate ligament reconstruction (ACLR).<sup>18</sup> The ACLR subjects who demonstrated a quadriceps strength deficit during isokinetic testing also demonstrated decreased anterior reaching distance while performing the SEBT compared to uninjured matched control subjects. The test has also been shown to have high intra and inter-tester reliability.<sup>19</sup> Performance deficits are seen in patients with chronic ankle instability when undertaking SEBT.

The findings of our study indicate that patients with ACLD limb would appear to have deficiencies in their



dynamic postural control when compared to normal asymptomatic limb when attempting to balance on their injured leg whilst moving the other limb in specific directions. Those directions showing differences involved moving the contra-lateral limb in all directions but statistically significant difference was noticed mainly in the posterior-medial and medial directions. If injury to the ACL causes disruption to the mechanoreceptors mainly golgi tendon organs and muscle spindles, causing significantly diminished proprioception in the ACLD knee, then it is not unreasonable to assume that this could also have a serious effect on postural control. Lack of proprioception may therefore be a contributing factor in preventing adequate motor control to establish satisfactory levels of stability whilst performing such complex movements as those involved in the SEBT. The constant neuromuscular activity required for the fine motor adjustments in order to maintain control of the body as a whole is considerable and any disturbance in the feedback from mechanoreceptors may cause errors of judgement that may lead to a lack of postural control. This forms a likely explanation of the differences between the normal contralateral limb and ACLD limbs performance.

Goldie et al previously established that the medial and lateral components of sway were, in their opinion, the best indicators of poor postural sway in relation to ACL injury.<sup>20</sup> In fact the findings of our study demonstrated a potential predisposition in the medial and posteromedial directions of the SEBT. Thus it is quite possible that Posteromedial, medial and lateral stability are the most sensitive measures of postural control. They may be related to apprehension as these directions involve considerable rotary load being imparted on the knee.

There are little data in the literature with reference to drain use after arthroscopic procedures on the knee or ACL reconstruction. Coupens and Yates examined the effects of drain use in a variety of arthroscopic procedures on knees that included meniscectomies, retinacular releases, and chondroplasties.<sup>21</sup> These authors found that patients who had drains placed after surgery averaged a 15° greater range of motion and statistically significantly less hemarthrosis one week after surgery. In a prospective evaluation of analgesic use, effusion, return of power to the quadriceps muscle, and range of motion after 100 open meniscectomies, Browett and associates found no statistically significant sustained benefit from the use of closed-suction drainage.<sup>22</sup> Data on effect of drains on proprioception and especially dynamic posture control in ACL Deficient knees is lacking. We undertook this study to assess the effect of drains on proprioception deficits that occur in ACLD Knees over a time period after ACL reconstruction. Hematoma and haemarthrosis occurring after ACL reconstruction acts as a good bacterial culture medium, and its accumulation within a wound provides an opportunity for development of infection.<sup>10,23</sup> The iron products in a wound hematoma,

and more specifically a hemarthrosis, can affect both chondrocytes and matrix adversely.<sup>21</sup>

Mechanoreceptors present on the articular surface are responsible for proprioception and posture control. The deficits in proprioception that occurs due to damage to ACL are compounded by the collection of hematoma and haemarthrosis which has an adverse effect on these mechanoreceptors and increased deficits in proprioception.

In our study the excursion distances in the drain group showed faster recovery compared to the non-drain group. This difference however was statistically significant in posteromedial and medial directions but clinically significant in all the directions.

This signifies the fact that using drains can provide us a conduit for collected hematoma and hearthrosis to be evacuated thus minimizing joint distension and relieving pressure on mechanoreceptors. This minimizes their damage and in turn faster recovery of proprioception and posture control of ACL reconstructed limb can occur.

## CONCLUSION

The SEBT has been shown to be a reliable and valid instrument for assessing dynamic postural control. In our study, we showed that posteromedial and medial directions are most appropriate for detecting functional deficits following ACL reconstruction as statistically significant difference was noticed between two groups.

Postoperative drain should be used after arthroscopically assisted anterior cruciate ligament (ACL) reconstruction with quadrupled hamstring graft for improving the deficits in dynamic posture control. More studies are required to collaborate the findings.

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