Early Mobilization with Double Elbow Crutches on Stability and Functional Knee Score in Patients With Anterior Cruciate Ligament Repair.

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Abstracts: Objective: Anterior Cruciate Ligament (ACL) is the most commonly torned ligament in the sporting activities, athletes desiring to return to physical activities that require use of the ACL need surgical reconstruction and proper rehabilitation. In the recent years, there have been advancements in the surgical techniques as the femoral tunnel positioning has been shifted from vertical position to more stable oblique position, thus it is a necessary to investigate the effect of early mobilization with the double elbow crutches and its outcome responses. Methods: Total 40 subjects of day one post ACL oblique repair with mean age of 30±3.6 yrs. were participated in the study. Subjects were divided into Group-A and Group-B for rehabilitation with double elbow crutches and walker respectively, along with conventional exercises for 6 weeks. At 4^{th} week both crutches and walker were discarded in both groups. Rehabilitation outcomes were assessed by static, dynamic stability and lysholm knee functional score were assessed at 4^{th}, 6^{th} weeks post operatively for both groups. Results: There was significant difference between static, dynamic stability and lysholm knee functional score at 4^{th} and 6^{th} weeks when compared within each group ($p<0.001$). Between group comparison showed insignificant difference in outcomes such as static stability ($p=0.18$; $p=0.55$) dynamic stability ($p=0.09$; $p=0.06$) and lysholm score ($p=0.51$; 0.65) at 4^{th} and 6th week post repair respectively. Conclusion: It is concluded that knee Stability and lysholm functional knee score was significantly improved by early mobilization with double elbow crutches and walker independently although there is no significant difference between double elbow crutches and walker in post oblique ACL surgical repair rehabilitation. [John S NJIRM 2012; 3(2) : 152-158]

Key words: ACL Repair, Lysholm Knee Score, Elbow Crutch, Knee Stability

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Introduction: The anterior cruciate ligament (ACL) is the important ligament to stabilize the knee. The rupture of the ACL is a common injury in recreational and competitive sports, as well as other activities. When the affected knee is left with substantial instability during sport and/or daily activities, a ruptured ACL is a risk factor for meniscal and cartilage injury linked to later osteoarthritis[1]. The ACL reconstruction has increased in popularity following improvements in surgical and rehabilitative procedures. Many risk factors have been identified in ACL injury, both intrinsic and extrinsic, although some individuals may be treated non-operatively with an aggressive rehabilitation program, athletes desiring to return to physical activities that require use of the ACL need surgical reconstruction.

Surgical techniques remain controversial in regard to tunnel placement and optimal graft choices. The most common method that is used for ACL reconstruction is single bundle a standard technique of ACL surgery[2]. Previously, the surgeons preferred patellar tendon graft and with the help of rehabilitation, the patient can return to their former activities in 5-6 months. But there have studies done according to which hamstrings tendon graft is the best graft, which can be used for ACL reconstruction, as it does not have complications that are seen with patellar tendon graft, and the patient can return to the normal activities early without any complications[3].

Recent literatures advocate a more oblique ACL reconstruction to more closely recreate normal knee kinematics and eliminate pathologic rotational laxity. A supervised and intensive rehabilitation program is necessary to achieve desired results. A more oblique placement of the ACL graft has been related to better control of rotatory knee stability. Femoral fixation with a transverse system might injure its posterolateral structures[4]. Also due to recent advancement in ACL reconstruction the

femoral tunnel positioning has also been shifted from a vertical position (12'o clock position) to a more oblique position (10'o clock position) which has helped the patients to return to their activities without any complications[3].

All these factors can contribute to the timing of an athlete's return to sports and their ability to bear weight using elbow crutches but discarding brace immediately after ACL reconstruction. It is described that there were no worse outcomes when only elbow crutches and no brace was used after ACL reconstruction[5]. According to some authors, there is no difference in proprioception between the reconstructed knee and contralateral knee when brace was not used and thigh atrophy was increased when brace was given to the patients[6].

It has been reported that patients who were rehabilitated with the help of elbow crutches immediately after ACL reconstruction could achieve to their previous level of activity sooner than those who use brace after ACL reconstruction[7]. It has also been given that there is decreased swelling after 2 weeks when brace was not given to the patient[8]. It is also described that there is no difference in pain or any of the secondary outcomes when elbow crutches are given immediately after ACL reconstruction[9].

As there has been much advancement in the ACL reconstruction in terms of graft used, femoral tunnel placement according to which rehabilitation of the patient and ability to bear weight should also be changed[10]. Some authors demonstrated that immediate weight bearing with the help of two elbow crutches after reconstruction helps the patient to return to non-pivoting sport at 4 months and also there are no deleterious effects of early weight bearing on stability or function of vastus medialis[11].

A key predictor for ACL reconstruction outcome is rehabilitation. Current data support the principles of accelerated rehabilitation protocols including early weight-bearing and range-of-motion training. All the previous studies have explained use of brace and crutches but have not been able to explain clearly whether minimal weight bearing with the help of two crutches is better or weight bearing as tolerated with the help of walker is better. The purpose of this study was to see the stability and functional knee score with crutches as well as walker, which are used for gait training immediately after ACL reconstruction.

Material and Methods : Post ACL arthroscopic reconstruction with single bundle was used in which hamstring graft was fixed at 11'o clock position. All cases were unilateral involvement and had isolated ACL tear. All the subjects who did not met the inclusion criteria were excluded from the study such as patellar tendon graft, age beyond 30 years, any abnormality in knee, vertical fixation in the graft and double bundle ACL reconstruction. Current study conducted in the King Saud University (KSU) Hospitals in Riyadh, KSA and ethical committee clearance obtained from KSU prior to the study. Each subject was clearly explained about the study and informed consent was collected from the patient as well as the orthopaedic surgeon. Total 40 subjects were 20-30 years of age group with mean age of 30±3.6 were included in the study. The subjects were randomly divided in to two groups, Group-A and B (n=20 in each group) given double elbow crutch and walker respectively along with conventional physiotherapy regime with progression from day one to 6 weeks and all patients had followed the same rehabilitation protocol (Table 1), Cryotherapy was applied before and after exercises. Rehabilitation started day one after the repair, after ACL reconstruction in group-A subjects were given single crutch for 2 weeks and in group-B walker for 4 weeks. The patient with the two elbow crutch was asked to hold the crutches such that the body should be between the two elbow crutches, patient was then asked to move the elbow crutches and affected extremity simultaneously. Prior to the training patients were evaluated for pain and swelling. Total duration of the study was for six weeks, after 4 weeks elbow crutch and walker were discarded. Rehabilitation outcomes were assessed by static, dynamic stability and the lysholm knee score were assessed at 4th and 6th weeks post operatively for both groups.

Static and Dynamic Stability measured by single leg stance and Star Excursion Balance Test (SEBT) respectively. The Lysholm knee scale is a condition-

specific outcome measure that was originally designed to assess ligament injuries of the knee. The Lysholm knee scale demonstrated overall acceptable psychometric performance for outcomes assessment of various ligament injuries of the knee it has been proved to allow for comparison of psychometric properties[12,13].

Result: Collected data were analyzed by SPSS 17 version software. A t-test was used to compare the difference between 4th and 6th week in the static and dynamic stability and lysholm knee score within the each groups respectively (Table 2) and found that outcomes were significantly improved (p<0.001) within each groups from 4th to 6th week.

Table 1: Rehabilitation Protocol

Post ACL Repair Period	Rehabilitation Regime
1st - 7th Day*	Ankle toe movements
	Isometrics of quadriceps
	Isometric of Hamstrings.
	Modified Straight Leg Raise
	Weight bearing with single elbow crutch. (For Group-A) Weight bearing with Double elbow crutch. (For Group-B)
2nd - 4th Week*	Co-contraction hamstrings and quadriceps
	Hip abduction and extension.
	Mini squats (0-30 deg).
	Squatting progressed to 0-90 deg in 3 week
	Prone knee hanging for 5-6 minutes
	Isometrics quadriceps
	Straight Leg Raise
	Isometrics hamstrings
	Elbow crutch discarded at end of 2nd week. (For Group-A) One elbow crutch discarded at end of 2nd week. (For Group-B)
4th - 6th Week*	All the above exercises
	Stationary bicycle (10Mnt.).
	Step ups
	Bilateral calf raise
	Adductor strengthening
	No more elbow crutch (For Group-A)
	Second elbow crutch discarded at end of 4th week. (For Group-B)
*Each Exercises performed 3times/ day for 10 repetitions with hold time of 10 seconds and Cryotherapy was applied before and after exercises	

Table 2: Within Group Comparison

Variabilities	Groups	4th Week	6th Week	p-Value
Static Stability	G-A	3.7±1.4	6.2±1.8	<0.001
	G-B	3.6±1.2	6.4±1.7	<0.001
Dynamic Stability	G-A	26.0±7.6	41.0±9.3	<0.001
	G-B	21.9±7.4	35.4±9.1	<0.001
Lyshom Knee Functional Score	G-A	49.5±10.0	82.9±10.6	<0.001
	G-B	47.4±9.6	84.3±9.6	<0.001

Between group comparison showed insignificant difference in outcomes such as static stability (p=0.18; p=0.55) dynamic stability (p=0.09; p=0.06) and lysholm score (p=0.51; 0.65) at 4th and 6th week post repair respectively (Table3).

Table 1.3:Between group comparison

Study Duration	Between Groups-A&B	Static Stability	Dynamic Stability	Lyshom Knee Functional Score
4th Week	G-A	3.7±1.4	26.0±7.6	49.5±10.6
	G-B	3.1±1.2	22.0±7.4	47.4±9.8
	p-Value	0.18	0.09	0.51
6th Week	G-A	6.2±1.8	41.0±9.3	82.9±10.1
	G-B	5.9±1.8	35.4±9.1	84.3±9.6
	p-Value	0.55	0.06	0.65

Discussion: The current study was designed to see the effect on stability and functional score after giving gait training with the double elbow crutches and walker immediately after ACL oblique reconstruction. According to the results, there was no difference between the patients who used

double elbow crutches and walker at 0 to 2 weeks in terms of static as well as dynamic stability and lysholm knee score. As the crutches and walker were discarded in the fourth week knee Stability and lysholm functional knee score was significantly improved by early mobilization with double elbow crutches and walker independently although there is no significant difference between double elbow crutches and walker in post oblique ACL surgical repair rehabilitation. It was also found that there were no deleterious effects when patients used double elbow crutch for weight bearing immediately after ACL repair.

The reason could be with the patients were unable to gain static stability in the 2 weeks due to pain, slight weakness and decrease in confidence level. When outcome variables were compared within groups 4^{th} and 6^{th} week, it was seen that both groups showed significant improvement independently ($p<0.001$). This means that the patients who were using double elbow crutches and walker gained knee stability and knee functional score plays the role in post repair rehabilitation. When outcome variables were compared at 4^{th} and 6^{th} week between group it was seen that there was no difference between the each aids used in the rehabilitation. This means that the patients who were using double elbow crutches and walker gained knee stability and knee functional score equally plays the role in post repair rehabilitation.

Lysholm knee score was taken at 6^{th} week post operative for both the groups and showed significant difference at $p< .05$. The Lysholm knee scale demonstrated overall acceptable psychometric performance for outcomes assessment of various ligament injuries of the knee it has been proved to allow for comparison of psychometric properties[12,13].

There reason of gaining knee stability in the 4^{th} and 6^{th} week and improved lysholm knee score in the patients with double elbow crutches were due to the surgical advancements in the ACL reconstruction in terms of femoral tunnel placement and the graft used in the reconstruction procedure. Earlier BPTB graft was used for the reconstruction that resulted in the increase incidence of anterior knee pain and thus time taken for the recovery was more but with the use of hamstrings tendon graft, with this more oblique technique the recovery was earlier with no incidence of anterior knee pain. Also due to the oblique femoral placement i. e. on 10'o clock position and 11'o clock position has also proved beneficial as is prevents the rotational instability and pain after ACL reconstruction. Due to the oblique femoral placement, the weight is not being put directly on graft, which was the main cause of the graft failure after ACL reconstruction earlier. In the oblique tunnel placement the weight is being distributed in the two directions that has helped the patients in the early weight bearing[3,14].

There is still a lot of controversy concerning the use of braces in rehabilitation following ACL reconstruction. According to surveys in Germany, Australia and the US, 56.2–85% of surgeons postoperatively prescribe a hard brace[15]. Some provide their patients with soft braces or bandages[14], while other surgeons believe bracing to be unnecessary or, in certain cases, even harmful[16]. Many would say it is self-evident that a brace will protect the graft from harm during its healing period, and there are studies which suggest braces protect ACL grafts from strain during minor stress. The same studies, though, admit that the protective value ceases as soon as the stress on the joint is increased[17]. An elastic bandage was at least as good as a brace to enhance proprioception, and Muellner et al.(1998) found free ROM to be achieved more quickly with an elastic bandage than with a brace, in the current study also used the elastic bandages during gait training along with walking aids could have supported the improvements[14].

Harilainen et.al immediately mobilized the patients after ACL reconstruction with the help of elbow crutch, which were discarded after 3 weeks and showed that there were no difference between the brace group and no brace group. Also the lysholm knee score and the tegner score were improved than the brace group. In addition, the stability of the knee was restored when the patients were mobilized without a brace[19]. Current data support the principles of accelerated rehabilitation protocols including early weight-bearing and range-of-motion training[16,18] .

Hiemestra et.al (2009) reported that use of crutches after ACL reconstruction reported decrease in the incidence of pain and swelling in the patients with ACL reconstruction. This method of rehabilitating a patient immediately after ACL reconstruction proved beneficial as it helped in the earlier recovery of the patients[9].

Tyler et.al (2008) evaluated the efficacy of immediate weight bearing with the help of two elbow crutches and discarding the crutches after 3 weeks to see the effects on ROM, stability, knee pain and lysholm knee score. In his study, found that due to early weight, bearing the patient achieved the ROM at 2 weeks and there was no incidence of anterior knee pain noticed. The pain was evaluated using lysholm knee score and demonstrated a greater improvement in the patients with early weight bearing[20]. There are no studies found that have showed deleterious effects of early weight bearing on stability or functions of the knee and anterior knee pain.

Noyes et.al (1989) also evaluated effects of early motion immediately i.e. 48 hours of knee surgery and showed that there was no increase in knee effusion, haemarthrosis, soft tissue edema and swelling. In his study the rehabilitation program was same for both the groups (early mobilized and immobilized) including the postoperative compression, dressing and exercises. An important finding in this study of was that there was significant decrease in thigh circumference in the patients who were not allowed to move leg and to bear weight on the operated leg early in the rehabilitation program. The thigh atrophy was more in non-mobilized group after 7 postoperative day[21]. Therefore, according to the current study traditional protocols used for later weight bearing can be replaced by early mobilization in preventing significant muscle atrophy that occurs within first few days of surgery.

The goal in the early rehabilitation period is the progression of the weight bearing process. Again, a range of weight bearing progression exists in current protocols, some of which advocate immediate full weight-bearing in a locked extension brace, while others advocate the use of crutches for upwards of four to five weeks. The concept of immediate full weight bearing programs has prevailed with the thought that the weight bearing facilitates faster extensor mechanism return. No data appears to support this claim and the patient may accommodate for a poor extensor mechanism by ambulating in a leg vault gait pattern[22,23].

Allowing an asymmetrical gait pattern secondary to extensor mechanism weakness leads to the potential development of a recurvatum at the midstance position. This recurvatum may result in an unwarranted side-effect of a prolonged altered gait pattern at midstance, due to poor extensor eccentric control as the knee attempts to go into flexion of 15 to 20 degrees[24]. There is a myth that early motion of reconstructed knee can stretch the liganentous reconstruction that can lead to improper recovery of the patient but studies found that early motion did not stretch the ligamentous reconstruction but limits the disuse atrophy, adhesion formation, capsular contracture and promotes articular cartilage nutrition.

Our approach has evolved to allow immediate partial weight bearing. From the initial phase, gait mechanics are retrained without compensation beginning on the first day. Concurrently, the patient is placed in a gait training program to emphasis the proper position and strength.

The other factors contributed to the current result could be classic use of isometrics, open chain isotonic such as active range of motion with the weight of the ankle, and straight leg raises. These exercises are generally low load and independently may not prevent the disuse muscle atrophy that affects the knee joint.

Conclusion: According to the results, there was no difference between the patients who used double elbow crutches and walker at 0 to 2 weeks in terms of static as well as dynamic stability and lysholm knee score. Thus method of rehabilitating a patient immediately after ACL reconstruction proved beneficial as it helped in the earlier recovery of the patients. It is concluded that knee Stability and lysholm functional knee score was significantly improved by early mobilization with double elbow crutches and walker independently although there is no significant difference between double elbow crutches and walker in post oblique ACL surgical repair rehabilitation.

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References:

1. Voigt C, Schoenaich M, Lill H. Anterior cruciate ligament reconstruction: state of the art. European Journal of Trauma, 2006; 32(4):332–9.
2. Sergi Sastre. Effect of single bundle ACL reconstruction using horizontal femoral portion. A prospective randomized study. Knee surg sports traumatolgy Arthroscopy, 2008; 67-79
3. Loh J C, Fakuda. Knee stability and graft function following ACL reconstruction. Comparison between 11'o clock and 10'o clock femoral tunnel placement. Arthroscopy, 2003;19(3): 297-304
4. Pablo Eduardo Gelber, Francisco Reina, Raúl Torres, Juan Carlos Monllau. Effect of Femoral Tunnel Length on the Safety of Anterior Cruciate Ligament Graft Fixation Using Cross-Pin Technique: A Cadaveric Study. The American Journal of Sports Medicine, 2010; 38(9):1877-84
5. Kurt P. Spindler, and Rick W. Wright. Anterior Cruciate Ligament Tear. N Engl J Med, 2008; 359:2135-2142.
6. Risberg, M. A., I. Holm, et al. Prospective study of changes in impairments and disabilities after anterior cruciate ligament reconstruction. Journal of Orthopaedic & Sports Physical Therapy, 1999; 29: 400-412.
7. 7 Nazem KH.A., H Sadeghian anterior cruciate ligament reconstruction: with brace vs without brace after operation, A randomized controlled clinical trial. Journal of Research in Medical Sciences,2001;7(1) 68-76.
8. Moller, E., Forssblad, M., Hansson, L., Wange, P., & Weidenhielm, L. Bracing versus nonbracing in rehabilitation after anterior cruciate ligament reconstruction: a randomized prospective study with 2-year follow-up. Knee Surgery, Sports Traumatology, Arthroscopy, 2001; 9(2):102-108.
9. Laurie A, Hiemestra. Knee immobilization for pain control after ACL reconstruction. A randomized control trial. Am J sport med.,2009; 37:155-157.
10. Lee M.,S.Scong.Vertical femoral tunnel placement results in rotational knee laxity after ACL reconstruction. J of arthroscopy and related surgery, 2007; 23:771-777.
11. 11. Tyler, Wnorowski. Comparison of immediate weight bearing with delayed weight bearing after ACL reconstruction. J.Knee surgery, 2008; 21; 225-238.
12. Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. Am J Sports Med ,1982; 10:150-154.
13. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. Clin Orthop,1985; 198:43-49.
14. Muellener, Colombett, Song DH. No benefit of bracing on early outcome after ACL reconstruction. Knee surg.sports traumatology.1998; 6(12):88-92.
15. Luering C. Therapie der vorderen Kreuzbandruptur des Kniegelenks — Ergebnisse einer Umfrage an unfallchirurgischen und orthopaedischen Kliniken in Deutschland. Sportverletz Sportschaden 2004;18(3):119.
16. Hoeher J. Rehabilitation following anterior cruciate ligament reconstruction; rehabilitation nach operativem Ersatz des vorderen Kreuzbandes. Arthroskopie 2005;18(1):41–7.
17. Harilainen A, Sandelin J. Post-operative use of knee brace in bone–tendon–bone patellar tendon anterior cruciate ligament reconstruction: 5-year follow-up results of a randomized prospective study. Scand J Med Sci Sports 2006;16(1):14–8.
18. Shelbourne KD, Klotz C. What I have learned about the ACL: utilizing a progressive rehabilitation scheme to achieve total knee symmetry after anterior cruciate ligament reconstruction. J Orthop Sci 2006;11(3):318–25.
19. Harilainen A, Sandelin. Knee surgery Knee brace after BPTB ACL reconstruction. Randomized prospective study with 2-year follow up. Knee Surg.Sports Tramatology Arthroscopy,1997; 5:10-15.
20. Tyler, Wnorowski. Comparison of immediate weight bearing with delayed weight bearing

after ACL reconstruction.J.Knee surgery.2008; 21:225-238.
21. Noyes FR, Mangine, Barber. Early knee motion after ACL reconstruction. Am J sports med.1989; 16:149-160.
22. Shelbourne KD, Nitz P. Accelerated rehabilitation after anterior cruciate ligament reconstruction. Am J Sports Med. 1990; 18:292–299.
23. Noyes FR, Mangine RE, Barber. The early treatment of motion complications following reconstruction of the anterior cruciate ligament. Clin Ortho., 1992; 220:275–283.
24. 24. Robert E. Mangine, Stephen J. Minning, Marsha Eifert-Mangine, Angelo J. Colosimo, Matthew Donlin. Management of the Patient with an ACL/MCL Injured Knee. N Am J Sports Phys Ther., 2008; 3(4):204–211.