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"An Evaluation of Quadruple Hamstring Grafts in Reconstruction of the Anterior Cruciate Ligament"

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Abstract: Introduction: *Anterior cruciate ligament(ACL) reconstruction is a surgical tissue graft replacement of the anterior cruciate ligament, located in the knee, to restore its function after an injury. Among several treatment procedure, hamstring graft or quadruplehamstring graft has been shown to be an excellent option for anterior cruciate ligament reconstruction.*

Aim of study:*The aim of the study was toevaluate the quadruple hamstring grafts in reconstruction of the anterior cruciate ligament.*

Method: *This was an observational prospective study. The study was conducted in the Orthopedic Department of Shaheed M. Monsur Ali Medical College,Sirajganj, Bangladesh during the period from January 2017 to December 2018. In total 46 patients with unilateral instability of the anterior cruciate ligament were finalized as the total study population. The written consent was taken from all the participants and the study was approved by the ethical committee of the respective hospital before starting the study.*

Result:*According to that report, extension deficit >3 (Degree) were found in 27 (58.70%) which was the highest and 3 to 5 (Degree) were found in 19 (41.30%) patients. Besides these, flexion deficit (I degree) were found 0 to 5 in 34 (&3.91%) and 6 to10 were found in 12 (26.09%) patients. In Lachman test, we found score 0 (0 to 2) in 22 (47.83%), +1(3 to 5) in 22 (47.83%) and +2 (6 to 10) were found in 2 (4.35%) patients. On the other hand, in Pivot shift test we found score 0 in 35 (76.09), 1 in 10 (21.74%) and 2 in 1 (2.17%) patients.*

Conclusion:*In this study we found some good features of quadruple hamstring grafts in reconstruction of the anterior cruciate ligament. We would like to recommend for wide use of quadruple hamstring grafts in reconstruction of the anterior cruciate ligament*

Key words: *Quadruple, Hamstring, Grafts, Anterior, Cruciate, Ligament.*

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I. Introduction

The anterior cruciate ligament (ACL) is an important ligament in the knee that plays a key role in knee joint stability and competitive sports performance.[1] In a study they claimed, there are approximately 200,000patientswithACLinjurieseachyearintheUnitedStates, and more than half of these patients under went surgical repair or reconstruction.[2] Anatomic ACL reconstruction (ACL-R) has been considered a satisfactory surgical procedure in sports medicine, and the auto graft has been commonly used for ACL-R in the past.[3] An auto graft is associated with earlier incorporation and tendon-bone healing, as well as reduced immunological rejection after transplantation. In addition, there is no risk of disease transmission.[4]The bone-patellar tendon-bone graft has been regarded as the procedure of choice in reconstruction of the anterior cruciate ligament (ACL) for more than two decades.[5]Alternatives include semitendinosus or combined semi-tendinosus/gracilis tendon grafts which is also known as quadruple hamstring grafts. Few of the numerous studies reflecting the functional outcome after these different procedures are prospective investigations and even fewer are both prospective and randomised.[6]

Figure I: Rehabilitation after ACL construction

Combined semitendinosus and gracilis grafts have been used in previous randomized studies. To the best of our knowledge, no prospective, randomized study comparing bone-patellar tendon-bone grafts with quadruple semitendinosus tendon grafts has been published from Bangladesh.

Figure II: Rehabilitation exercise after ACL construction

We did not find any observational study on our topic from Bangladesh. The particular clinical issues relate to possible elongation of hamstring tendon grafts over time, their possible lower donor site morbidity, especially reflecting patellofemoral problems, and optimal fixationtechnique. Considering all of these we select our motto of our study. The aim of the study was to assess the quadruple hamstring grafts in reconstruction of the anterior cruciate ligament.

II. Objectives

a) General objective:

- To evaluate the quadruple hamstring grafts in reconstruction of the anterior cruciate ligament

b) Specific Objectives:

- To know more about the utilization of VAS scores in quadruple hamstring grafts in reconstruction of the anterior cruciate ligament

III. Methodology & Materials

This was an observational prospective study. The study was conducted in the Orthopedic Department of Shaheed M. Monsur Ali Medical College, Sirajganj, during the period from January 2017 to December 2018. In total 46 patients with unilateral instability of the anterior cruciate ligament were finalized as the total study population. The written consent was taken from all the participants and the study was approved by the ethical committee of the respective hospital before starting the study.According to the inclusion criteria patients with single-leg insufficiency of the ACL with the trauma occurring at least two months before reconstruction, age between 20 and 50 years, no previous reconstruction of the cruciate ligaments in the involved knee and no concomitant insufficiency of the posterior cruciate ligament were included. On the other hand, according to the exclusion criteria, severely ill patients and patients with incomplete data and not suitable for quadruple hamstring grafts were excluded from the study. Before surgery, the patients were evaluated using the score of Lysholm and Gillquist,[7] the activity level score of Tegner and Lysholm (present, before injury and desired level of activity)[8] and the International Knee Documentation Committee (IKDC) scores.[9] A visual analogue scale (VAS) was also used. In all clinical tests the contralateral non-injured side was used as a reference. Stryker sagittal side-to-side laxity was determined at 9.08 and 18.16 kg (OSI Stryker, Kalamazoo, Michigan). Radiographs with weight-bearing views were evaluated. The ACL reconstructions were carried out by eight experienced arthroscopic knee surgeons who were all familiar with both methods. The semitendinosus tendon was harvested through a 5 cm longitudinal incision over the pesanserinus with a tendon stripper (Acufex, Microsurgical Inc). The length of each tendon was between 27-32 cm including 1 cm of periosteum from the insertionapproximately. The graft was prepared to quadruple thickness with mersilene bands in each loop (2

proximally and 1 distally), and distally with non-resorbable sutures, fixed as whip stitches in both free ends. The mean length of the graft was 7.5 cm (6.5 to 8) and the mean diameter was 9 mm (8 to 11). Fixation was by an endobutton (Acufex Microsurgical Inc) proximally and screws distally.[10,11] We pretensioned the graft, as in the patellar tendon groove, and fixed it distally with the leg in full extension. All semitendinosus tendons were of sufficient length to make quadruple grafts and the gracilis tendon was not used concomitantly. MS Excel and SPSS version 20 were used to analyze and disseminate the data and findings.

IV. Result

In our study, the total study population was 46 in number. Among them 40 were male and 6were female. Most of the cases were from 20-30 years age group and it was 24 (52.17%). This trend was followed by 15 (32.61%) from 31-40 years age group, and 7 (15.22%) from 41-50 years age group. Although the main study period was two years but there was a follow up period of 6 additional months. The final result were disseminated and displayed from the report after follow up period. Through our study, in IKDC grading we found 23 (50%) patients acquired grade B which was the highest. This trend was followed by 11 (23.91%) got grade C, 9 (19.57%) got grade D and 3 (6.52%) got grade A.After follow up period, Range of movement and stability were assessed. According to that report, extension deficit >3 (Degree) were found in 27 (58.70%) which was the highest and 3 to 5 (Degree) were found in 19 (41.30%) patients. Besides these, flexion deficit (I degree) were found 0 to 5 in 34 (&3.91%) and 6 to10 were found in 12 (26.09%) patients. All the deficits were corrected during follow up period by extensive physiotherapy. In Lachman test, we found score 0 (0 to 2) in 22 (47.83%), +1(3 to 5) in 22 (47.83%) and +2 (6 to 10) were found in 2 (4.35%) patients. On the other hand, in Pivot shift test we found score 0 in 35 (76.09), 1 in 10 (21.74%) and 2 in 1 (2.17%) patients.On the other hand, according to the Stryker laxity report in side-to-side difference in 9.08 Kg we found, <-1 score was in 1 (2.17%), -1 to 2 score were in 33 (71.74%), 3 to5 score were in 10 (21.74%) and >5 score ware in 2 (4.35%) patients. Besides these, in side-to-side difference in 18.16 Kg we found, <-1 in 2 (4.35%), -1 to 2 in 21 (45.65%) and 3 to 5 score were in 23 (50%) patients. The period from reconstruction to follow-up was 6 months.Only the patients completed the full tenure of study period as well as the follow up period were finally selected as the study population. The aim of the study was to evaluate the quadruple hamstring grafts in reconstruction of the anterior cruciate ligament. In this study we found some good features of quadruple hamstring grafts in reconstruction of the anterior cruciate ligament.

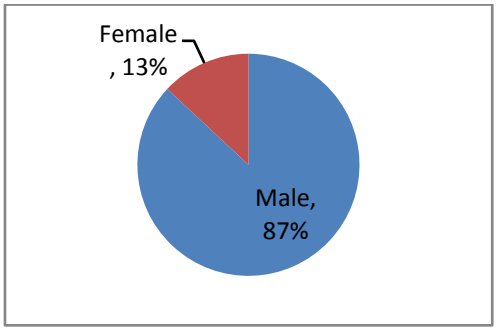

Figure III: Male female ratio of the participants (N=46)

Table I: Age distribution of participants (N=46)

Age (Yrs.)	n	%
20-30	24	53
31-40	15	33
41-50	7	14

Table II: Distribution of IKDC grade of participants (N=46)

IKDC grade	n	%
A	3	6.52
B	23	50.00
C	11	23.91
D	9	19.57

Table III: Range of movement and stability atfollow-up (N=46)

Scores	n	%
Extension deficit (degrees)		
<3	27	58.70
3 to 5	19	41.30
Flexion deficit (degrees)		

0 to 5	34	73.91
6 to 10	12	26.09
Lachman test (mm)		
0 (0 to 2)	22	47.83
+1 (3 to 5)	22	47.83
+2 (6 to 10)	2	4.35
Pivot shift test		
0	35	76.09
1	10	21.74
2	1	2.17

Table IV: Stryker laxity test reports of the participants (N=46)

Scores	n	%
Side-to-side difference (9.08 kg)		
<-1	1	2.17
-1 to 2	33	71.74
3 to 5	10	21.74
>5	2	4.35
Side-to-side difference (18.16 kg)		
<-1	2	4.35
-1 to 2	21	45.65
3 to 5	23	50.00

V. Discussion

The major findings of our study have been disseminated by several tables and figures. In data collection period we found maximum study were comparative with quadruple hamstring grafts in reconstruction of the anterior cruciate ligament. In a study,[12] there found, although not recording patellofemoral pain score and having differences in surgical technique, also found no significant differences in outcome scores or laxity between the patellar tendon graft and the multistranded semitendinosus graft.The IKDC evaluation system showed that only 65% of the patients were classified as normal, or nearly normal, and 45% as abnormal or severely abnormal at follow-up. These scores are lower than those in most other studies and a possible explanation for this is our unbiased observer follow-up in combination with self-administered question-naires.[13]In another study they noted a lower percentage of 'normal' or 'nearly normal' results when using the IKDC system compared with other rating systems.[9] Our final IKDC, VAS and Lysholm values were also comparable with a previous study of reconstruction using patellar tendon grafts.[14]There are some cases of failure in some study also. As for example in a study they claimed, knee kinematics do not return to normal after reconstruction.[15]The incidence of meniscal injuries at the time of injury to the ACL is common[16] and that such injury significantly influences the outcome scores has also been demonstrated previously.[17] A concomitant meniscal injury is a stronger predictive factor of outcome after reconstruction of the ACL than the choice of graft. In contrast to other reports[18] the timing of surgery in our study was another factor which influenced the final outcome, with benefit if the reconstruction was undertaken within four months of injury. There may have been some selection bias, since athletes with a higher activity level tend to undergo reconstruction earlier than recreational athletes. By contrast, no difference in outcome was noted between patients with preinjuryTegneractivity levels of 7 to 10 and 0 to 6. In a study they stated,'We also found no significant difference between the grafts regarding laxity'.[6] In our procedure there were a few more casesof increased stiffness compared with the non-operated side using the Stryker test (18.16 kg). This may possibly be due to the greater stiffness in the patellar tendon graft than in the semitendinosus graft.[19] The angle of the knee at which the hamstring graft should be fixed has been addressed previously.[20] A comparison of 30° knee flexion with 90° of knee flexion during multi-stranded semitendinosus graft fixation[21] showed that there was increased residual laxity with the smaller angle. Postoperative management and/or graft tension or avoidance of early aggressive rehabilitation with hamstring grafts was considered to be the reason for this difference. In our study, we also advised immediate weight bearing with a range of movement of 0° to 130°. The importance of minimizing the distance between the fixation points to reduce creep when using different grafts has been widely discussed,[22] but no clinical comparisons have been reported between different hamstring fixation techniques. Therefore, it is still not clear if the hamstring graft would provide less laxity if the fixation distance wasminimized.There storation of a full range of movement after reconstruction of the ACL and its correlation with patellofemoral problems has previously been emphasised.[23]In our study only 2 patients showed a lack of extension from anatomical zero and there was no significant difference in the flexion deficit between the types of graft. Speculation about a lower incidence of patellofemoral problems after reconstruction with a hamstring graft compared with a patellar tendon graft has not been verified by ourselves or others.[24]There is no evidence to support the suggestion of a lower incidence of persisting patellofemoral pain at 6 months follow-up using hamstring tendon grafts, compared with patellar tendon grafts. The correlation between hop tests and thigh muscle strength, both

concentrically and eccentrically,[25] is considered to reflect neuromuscular coordination.[26] Functional testing with one-leg-hop and triple-jump tests in our patients showed good results and also revealed no differences between the two grafts.[27] About VAS and IKDC scores in a study they stated, 'Weal so found no differences between men and women in outcome scores (VAS, Lysholm, IKDC, patellofemoral score)'.[28] There were no correlations between values for laxity and outcome scores, which has been reported previously.[29] Itseemsasifacertaindegreeofantero-posteriorlaxitycanbetoleratedaslongasthere is no giving away. We interpreted the high correlation between the patello-femoral pain score and Lysholm score as well as the IKDC score to mean that pain and discomfort, rather than instability, characteristics of most patients with suboptimal results. The aim of the study was to evaluate the quadruple hamstring grafts in reconstruction of the anterior cruciate ligament. In this study we found some good features of quadruple hamstring grafts in reconstruction of the anterior cruciate ligament.

Limitations of the study

It was a single centered study with small sized samples. So the findings may not reflect the exact scenario of the whole country.

VI. Conclusion and recommendations

In this study we found some good features of quadruple hamstring grafts in reconstruction of the anterior cruciate ligament. To get more specific information regarding quadruple hamstring grafts in reconstruction of the anterior cruciate ligament we would like to recommend for conducting more studies in several places.

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