

Wallplasty Versus Non Wallplasty in Arthroscopically Assisted Anterior Cruciate Ligament Reconstruction

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ABSTRACT:

BACKGROUND:

Anterior cruciate ligament reconstruction (ACLR) is one of the most commonly performed orthopedic procedures. Technical factors especially correct tunnel placement play major role in its success. However its failure rate is still high (10%), and impingement of the graft on the posterior cruciate ligament (PCL) and the medial wall of the lateral femoral condyle is an important cause of failure. Wallplasty is a technique used to prevent graft impingement, but there is no consensus on its routine use.

OBJECTIVE:

Is to compare between the postoperative knee functional outcome and stability of arthroscopic ACLR performed with wallplasty versus those performed without wallplasty.

PATIENTS AND METHODS:

A prospective experimental non randomized study was performed on 32 patients (30 males and 2 females) who necessitated arthroscopic ACLR. The patients were divided into 2 groups, in group A (made of 16 patients) the reconstructions were done without wallplasty and in group B (made of 16 patients) were done with wallplasty. Three months postoperatively the two groups were compared in regard to Lasholm score changes (preoperative and postoperative), Lachman test, and Pivot shift test results.

RESULTS:

There was better improvement in Lasholm score in group B than in group A, and the difference was statistically significant (p value =0.036). Knee stability tests were better in group B than in group A, but the differences were statistically not significant.

CONCLUSION:

Wallplasty has statistically better functional outcome than non wallplasty in ACLR and it is recommended to be done routinely in all cases of ACLR.

KEY WORDS: wallplasty + anterior cruciate ligament+reconstruction.

INTRODUCTION:

ACLR is one of the most common orthopedic surgeries with estimated rate of about 100,000 surgeries performed annually in the United States alone^(1,2). Its aim is to restore knee stability and function thereby minimizing both meniscal and articular cartilage injuries⁽³⁾, however many studies showed still relative high incidence of knee osteoarthritis in the anterior cruciate ligament (ACL) reconstructed knees on long term follow up (more than 50% for up to 13 years postoperatively)^(4,5,6). In spite of many advances in its surgical technique and instruments, the ACLR have shown to fail in about 10 % of these surgeries resulting in recurrent giving way and instability^(6,7,8). The most common technical causes of ACLR failure are non anatomic tunnel

placement, screw divergence, inadequate graft fixation, graft impingement and improper tensioning⁽⁹⁾. Tunnel placement being the most common cause of ACLR failure can lead to PCL impingement, roof impingement and high contact pressure in the knee joint during the arc of movement, in anteromedial portal technique, if the tibial tunnel is placed too medial or the femoral tunnel is placed too vertical in coronal plane then the ACL graft will impinge on the PCL and cause pain before terminal knee flexion is reached (PCL impingement) and this will prevent full flexion or full flexion will be regained after gradual elongation of the graft which can lead to recurrent laxity and joint instability⁽¹⁰⁾. Many authors reported that accurate placement of the tibial and femoral tunnels in both coronal and sagittal planes can

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prevent graft impingement and its complications^(11,12,13). Other authors suggested that in addition to accurate tunnel placement, a wallplasty (removal of few millimeters, usually 1-2, from the medial wall of the lateral femoral condyle until the space between the lateral femoral condyle and PCL is 1 millimeter wider than the diameter of ACL graft) is usually mandatory to prevent PCL impingement, lateral wall impingement and ACL graft high tension⁽¹⁴⁾. They recommended to assess PCL impingement by inserting impingement gauge or rod which has the same diameter of the ACL graft in the notch between the PCL and lateral femoral condyle and to perform wallplasty only if this rod deforms (impinge on) the PCL with the knee joint is 90° flexed^(10,14). In the literatures, there is no consensus about performing wallplasty routinely. The hypothesis of the current study is that routine wallplasty is mandatory to prevent ACL graft impingement and its complications in all cases of arthroscopically assisted ACLR, even if the tibial and femoral tunnels are correctly placed, and this is because of the differences between the native ACL and ACL graft in size and shape. Up to our knowledge there is no study comparing between the knee functional outcome of ACLR done with wallplasty versus those done without wallplasty and the current study was performed to compare between the two.

PATIENTS AND METHODS:

A prospective experimental non randomized study was performed on 32 patients (30 males, 93.75% and 2 females 6.25%) with an average age of 27.6 years ranging from 21 to 37 years who had diagnosed (clinically and radiologically by MRI) to have ACL injury in their knee joints (19 left sided and 13 right sided) that required arthroscopic ACLR during the period from October 2013 to April 2015. The patients in whom the tunnels positions were not correct or could not be evaluated on postoperative x ray, patients with associated other knee ligament injuries (e.g. posterior cruciate ligament, medial or lateral collateral ligament injuries) and patients with postoperative complications (e.g. arthrofibrosis, infection) were excluded from this study. The patients included in this study were divided into two groups (A) and (B), each group consisted of 16 patients (15 males and 1 female). In group (A), all patients were admitted to hospital 1 day before surgery where all required preparations were done. In all cases prophylactic intravenous antibiotics were given 30 minutes before skin incision, lateral knee support was used, pneumatic tourniquet was applied proximally on the thigh, deep knee

flexion up to 130° was tested and required to facilitate drilling of the femoral tunnel through anteromedial portal and under general anesthesia the knee joint was examined for stability by anterior drawer, Lachman and Pivot shift test^(15,16), if the ACL injury was confirmed then the procedure was started by harvesting the hamstring tendon graft, otherwise initial diagnostic arthroscopy was performed to confirm the diagnosis. About 5 Centimeters vertical incision was made on the anteromedial tibial surface of the ACL injured knee over the pes anserinus, the semitendinosus tendon then cleared and harvested and if needed the gracilis tendon was harvested too. The ACL graft was prepared; its diameter was measured throughout its length and kept in a moist environment. Then a diagnostic arthroscopic tour was performed and any meniscal or chondral injury was treated. The remaining ACL fibers were shaved and cleaned except at its tibial insertion and at femoral footprint, over the top position was cleared until well visualized. An anteromedial single bundle single tunnel ACLR technique with aperture fixation by bioabsorbable interference screws was performed. The femoral tunnel was drilled first through anteromedial portal with the use of femoral target guide with correct offset and with the use of correct drill diameter while the knee was in deep flexion (about 130°), the footprint of the native ACL and bony ridges were used as landmarks. Then the tibial tunnel was drilled with the use of 55° angled tibial guide, the tip of this guide was positioned slightly medial to the centre of the intercondylar area, in line with the posterior edge of the anterior horn of lateral meniscus and about 7 Centimeters anterior to PCL⁽¹⁷⁾. The graft was pretensioned by cyclic loading, then the prepared graft was passed from the tibial tunnel to femoral tunnel and the femoral side was fixed by interference bioabsorbable screw passed through anteromedial portal over a guide wire while the knee was in deep flexion (about 130°), the diameter of the screw was the same as the diameter of the femoral last drill, the screw length was 23 millimeters. Then the knee was flexed and extended many times while pulling the distal tibial sutures of the graft in order to pretension the graft more and to test the femoral fixation. Then the tibial side was fixed by interference bioabsorbable screw 1 millimeter more than the diameter of last tibial drill while the knee was in extension and appropriate tension was applied on distal sutures of the graft. The tibial screw length was 28 millimeters. Then the graft was tested by anterior drawer and Lachman tests followed by closure of

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the wounds, dressing and applying extension brace .postoperative anteroposterior and lateral plain x-rays of the operated knee were done. In group (B) the same technique and procedure as in group (A) were performed to all patients,except that a wallplasty done by shavers and small osteotomes ⁽¹⁴⁾ was added to all patients and (figure 1) shows one of them. The postoperative rehabilitation program was the same for all patients in both groups.

In the postoperative x-ray the correct anatomic tibial tunnel placement in the coronal plane necessitates the passage of the lateral tunnel edge through the lateral tibial spine tip, and in the sagittal plane with the knee in full extension the anterior tibial tunnel edge should lie just posterior

and parallel to the Blumensat's line⁽¹⁰⁾ and the tibial tunnel should lie about 43% of the anteroposterior length of tibia (18)(figure 2and 3 are the postoperative x rays of one of our patients with correct tunnel placement).For the femoral tunnel, the femoral coronal angle (FCA) was evaluated on weight bearing 45° knee flexion posteroanterior view 6 weeks postoperatively, it is measured between the line that bisecting the femoral tunnel and the line of the long anatomical axis of the femur, this angle should be not less than 32.7° for correct anatomical tunnel placement⁽¹⁹⁾, and in the sagittal plane the correct femoral tunnel should lie at about 80% of the anteroposterior length of the Blumensat's line⁽²⁰⁾(figure 2and 3).



Figure 1: Intraoperative arthroscopic Photograph showing wallplasty



Figure 2: Correct anatomical tibial and femoral tunnels in coronal view



Figure 3: Correct anatomical tibial and femoral tunnels in lateral view

tunnels in coronal view In the current study, all the included patients were only those with correct anatomical femoral and tibial tunnels which were evaluated on the postoperative x-rays in both coronal and sagittal planes.

All patients were evaluated for stability of the operated knee by Pivot shift test ⁽¹⁶⁾ and Lachman test ⁽¹⁵⁾ three months postoperatively. The Lachman test was graded into 3 grades, grade 1 (from zero to 5 millimeters), grade 2 (6 to 10 millimeters) and grade 3 (more than 10 millimeters), only grade 1 was considered satisfactory. The subjective clinical outcome was measured for all patients by Lasholm score ⁽²¹⁾ both preoperatively and 3 months postoperatively. Then all the results of group A were compared with those of group B.

RESULTS:

Pivot shift test was positive in 2 patients in group A and in 1 patient in group B three months

postoperatively, while the Lachman test was positive (unsatisfactory) in 7 patients in group A (5 patients had grade 2 and 2 patients had grade 3) and in 4 patients in group B (3 patients had grade 2 and 1 patients had grade 3) three months postoperatively.

The statistical difference between group A and B in regard to Pivot shift test results was not significant (P value =0.0544) and in regard to Lachman test results was also not significant (P value =0.264).Chi square test was used.

In group A, the mean of Lasholm score was 71.13 preoperatively and 86.81 postoperatively (Table 1) and the difference between the preoperative and postoperative results was statistically significant (P value <0.001), Paired t test was used.

In group B, the mean of Lasholm score was 67.62 preoperatively and 94.37 postoperatively (Table 1) and the difference between the preoperative

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and postoperative results was statistically significant (P value<0.001), Paired t test was used.

The difference between the improvement (changes in Lasholm scores) in group A and

improvement in group B was statistically significant (P value =0.036), mix Anova test (repetitive measures) was used.

Table 1:Preoperative and postoperative Lasholm scores for both groups (A) and (B).

Patient's number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Group A Lasholm score preoperatively	71	70	70	68	68	74	74	73	72	75	73	75	66	68	67	74
Group A Lasholm score postoperatively	86	95	83	87	77	86	88	95	86	80	90	87	90	86	95	78
Group B Lasholm score preoperatively	68	74	64	71	66	63	73	60	64	63	70	71	69	68	68	70
Group B Lasholm score postoperatively	94	92	97	95	96	85	92	96	97	96	93	96	95	95	96	95

DISCUSSION:

The cross sectional area of ACL graft is usually rounder and larger than the normal native ACL which is usually flat, thin and spindle-shaped in its cross section⁽¹⁰⁾, so a wallplasty is required to widen the intercondylar notch and prevent graft impingement in nearly all cases of ACLR especially in females who has significantly narrower intercondylar notch than males of the same height and weight^(22,23). Many recent studies demonstrated that the ACL graft diameter that is less than 8 millimeters is usually associated with high failure rate when hamstring tendon graft was used⁽²⁴⁾, so a graft diameter of 8 millimeters or more is necessary for success, and this will add another risk factor for graft impingement if wallplasty is not performed. The process of ACL graft healing (ligamentization) that involves revascularization and proliferation in the hamstring graft will cause increase in cross sectional area of the graft by up to 29% after surgery⁽²⁵⁾, this also will add a risk factor for impingement when wallplasty is not done. During screw home motion at the knee, the tibia is internally rotated with the flexion of the femur and externally rotated with the extension of femur⁽²⁶⁾, and this may add another risk factor of graft impingement on the wall of the lateral femoral condyle (wall impingement) and thus wallplasty will be necessary to eliminate this risk. The other advantage of wallplasty is better visualization of the medial wall of the lateral condyle of the femur and so better localization of the femoral ACL footprint. However when

performing wallplasty care must be taken not to remove remnants fibers in the ACL footprint and bony ridges which help to localize the femoral tunnel placement site and to avoid removing much bone especially in the area of ACL femoral tunnel because this can lead to lateralization of the tunnel and changing rotational axis of the ACL graft.

Notchplasty (widening of the notch from all its dimensions) must be avoided as it affects anterior stability greater than rotational stability and this can negatively affect graft healing process and cause early failure⁽²⁷⁾.

In the current study the ACL injury was much more in males than in females in spite of that females have 4 to 6 times more risk of ACL injury than males⁽²⁸⁾, and this may be due to limited sport participation of females in Iraq, this was beneficial for the results because it nearly eliminated the gender as a confounding factor. In both groups there was statistically significant functional improvement after surgery and this signify the benefits of ACL reconstruction surgery, which had also been shown by other studies^(29,30).

In spite of that the differences in the stability tests results were statistically not significant between the two groups but the stability was better in group B (less positive tests).

The functional outcome and improvement measured by Lasholm score was statistically better in group B (wallplasty group) than group A and this can be due to all above mentioned

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advantages of wallplasty. The effect of wallplasty on incidence of knee degeneration needs long term follow up. The main limitations of this study were small sample size and being non-randomized.

CONCLUSIONS AND RECOMMENDATIONS:

Wallplasty has statistically significant effect on knee functional outcome after ACLR on short term follow up; it showed positive effect on the anteroposterior and rotational knee stability but this was statistically not significant. It is recommended to do wallplasty routinely for all cases of ACLR.

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