

Reconstruction of the Anterior Cruciate Ligament using the Central Third of the Patellar Tendon

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Background: Conservative management of patients with torn anterior cruciate ligament (ACL) is not the usual way of treatment. The aim of ACL-reconstruction is to achieve normal function of the knee by using different approaches and grafts.

Methods:The results of fifty patients who had had a reconstruction of the anterior cruciate ligament (ACL) through a small arthrotomy, with the use of the central third of an autogenous, bone-patellar tendon-bone free graft, at King Hussein Medical Center, between the years 1994-1997, were reviewed retrospectively. Forty five (90%) patients were active soldiers between the ages of 20-30 years. The average time between injury and operation was 27 months (1-72). The analysis of causes of injury revealed that 50% were sport injuries (contact and non-contact), 46% due to fall and twisting injuries. All patients presented with knee pain, recurrent swelling, and giving way either partial or full. Twenty eight (56%) knees had an associated meniscal injury. The patients had an aggressive rehabilitation program advocated by Shelbourne and Nitz, aiming for early restoration and maintenance of movement and strength of the quadriceps and hamstrings. The patients were evaluated by clinical examination, radiological assessment, subjective questionnaire, and the functional status was evaluated according to the scoring scale of Lysholm and Gillquist.

Results: Based on the above scoring system we found that 45(90%) knees were graded as excellent or good and no longer gave way. Full motion (0-135 degree) was restored in all knees except in two who had restriction of flexion. No evidence of degenerative changes were seen except in one patient who developed late infection. The unsolved problem of anterior knee pain developed in ten (20%) patients.

Conclusion: This procedure, with the patient's cooperation and understanding of the rehabilitation program, yielded results similar to those of other procedures.

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Conservative management of patients who have torn anterior cruciate ligament (ACL) is not the usual way of treatment despite reports of good results^{1,2}. Although an

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improvement in function of the knee can be achieved by present surgical techniques of ACL-reconstruction, the problem of restoration of completely normal function of the knee has yet to be solved^{3,4}.

Reconstruction of the ACL can be performed through an open procedure, arthroscopically or arthroscopy-assisted procedures⁵⁻⁸ using an autogenous graft with or without augmentation (patellar tendon, iliotibial band, semitendinosus and gracilis tendon, meniscus), allograft tissue, various synthetic materials and intra-articular or extra-articular reconstruction (alone or in combination)⁵⁻¹². The purpose of this study is to review and assess the results of the ACL-reconstructed knees with the usage of an autogenous, free graft, central third of the patellar tendon.

METHODS

Fifty patients who underwent reconstruction of the anterior cruciate ligament using the middle third of an autogenous bone-patellar tendon-bone free graft at King Hussein Medical Center between the years 1994-1997 were reviewed retrospectively. The rupture of the ACL had been confirmed by clinical examination, MRI findings, and by arthroscopy. The average time between the injury and the surgery was 27 months (1-72 months). All patients were male active soldiers, 45 (90%) of whom were between 20-30 years of age. The average age the time of operation was 24 years (18-34 years). All patients were followed for at least 2 years (range from 2-5 years). Both sides were involved equally (25 each side). Analysis of the cause of injury revealed that 50% were sport injuries (contact and non-contact), 46% due to fall and twisting injury.

Before surgery the patients agreed to participate in the intensive rehabilitation program advocated by Shelbourne and Nitz¹³. This accelerated rehabilitation program was used to restore and maintain the range of movement and the strength of the quadriceps and hamstrings.

The indication for surgery in all our patients was clinical instability, which means repeated episodes of giving way (either partial or full) during sports or other physical activity.

There was no evidence of deficiency of the collateral ligaments or the posterior cruciate ligament in any patient, 22(44%) patients had an isolated rupture of the ACL, 28 (56%) patients were found to have a meniscal injury which was treated during the arthroscopic procedure by a partial meniscectomy, the medial meniscus was found to be torn in 22 knees, the lateral meniscus in 9 knees, a ratio of 2:4 to 1.

Operative Technique

During the arthroscopy any torn meniscus was treated with a partial meniscectomy. The remaining of the ACL were excised and a generous notchplasty was performed by removing a bone from the superior and lateral aspect of the intercondylar notch to prevent impingement of the graft during motion of the knee.

The (resident) ridge which presents 10mm anterior to the true posteromedial edge of the lateral femoral condyle may be confused with the true posteromedial edge of this condyle and was removed to expose the true edge of the condyle.

Through an anterior longitudinal incision the central one third of the patellar tendon was harvested in continuity with bone blocks from the patella and the tibial tubercle according to the technique described by O'Brien et al⁵. Two small drill-holes were made in the bone in each side of the graft, and sutures are passed through each hole.

The defect in the patellar ligament was used to enter the joint space by incising and retracting sideways the retropatellar fat pad. Sometimes excision of the fat pad was needed to obtain satisfactory exposure of the femur through this incision.

Through the same incision, traction of the skin inferomedially to expose the anteromedial aspect of the tibia just medial to the tuberosity was performed. Subperiosteally the tibial guide-pin was inserted from the outside to the anterior of the tibial spine, in the center of the original site of insertion of the ACL, then the tibial drill-hole was made.

A second longitudinal incision one inch long was made on the lateral aspect above the knee and deepened to the lateral aspect of the lateral femoral condyle which was exposed subperiosteally.

Through this incision the femoral guide-pin was inserted from the outside to come well posterior and superior in the lateral femoral condyle. Next the femoral drill-hole was made. The sizes of the femoral and tibial drill-holes were made according to the diameters of the bone – blocks on both ends of the graft. The prepared graft⁵ was then inserted in a retrograde direction, and the proximal patellar bone was secured to the femur from outside using an AO-cancellous screw located on the cancellous side of the block .

The distal patellar bone was rotated 90 degree medially around its axis, and the knee was moved through a range of motion while tension was applied to the bone- plug by the sutures previously placed. Once the graft was in an isometric position and did not impinge, the distal patellar bone was fixed into the tibia using another AO-cancellous screw⁶. At final assessment if the graft impinged, the notch of the femur was enlarged more around the graft.

Evaluation

Our patients were evaluated by clinical examination including an assessment of the range of movement (using a goniometer) and of knee stability by manual testing. The subjective assessment of the knee function was recorded as very satisfactory, satisfactory, and unsatisfactory. The functional status was evaluated according to the functional scoring scale of Lysholm and Gillquist¹⁴ which evaluates eight items; limp, use a walking aid, giving way, stair-climbing, squatting, instability, pain and swelling. Radiographic

assessment was made, by anteroposterior and lateral radiographs of the knee, of any degenerative changes of the knee¹⁵, and the tibial tunnel and screws position¹⁶.

RESULTS

Questionnaire

Forty five (90%) patients were either very satisfied or satisfied (i.e. they had no pain or had occasional mild pain). Five(10%) patients were dissatisfied (2 patients had moderate pain and restriction in the ROM, 1 had septic arthritis and recurrent instability, and 2 had painful crepitation in the anterior aspect of the knee). Ten patients (20%) developed anterior knee pain.

Physical Examination

The result of the Lachman test was 1+ or less in 47 (94%) of the knees. The other three knees (6%) which had a Lachman 2+ were considered a failure, one had a recurrent instability and two had some lengthening of the graft. The results of the anterior drawer test were 1+ or less in 49 (98%) of the knees. In 48 (96%) knees the extension was full and the flexion was to within 10 degrees of full flexion, the other two having loss of flexion (0-100 degrees)

The Radiographic Evaluation

Anteroposterior (standing) and lateral (in full extension) radiographs of the knee were made and the degenerative changes were graded as; minimum, moderate, and severe¹⁵. Despite the number of the meniscal injuries in this study (28 knees, 56%), no degenerative changes were noted except in one knee as a sequelae of the septic arthritis with progressive changes. In all cases the tibial tunnel was examined as seen on the lateral x-ray¹⁶ and the anterior border of the tunnel was at or posterior to the intersection of the line of the slope of the intercondylar roof and there was no divergence of the screws.

Functional Testing

According to the system of Lysholm and Gillquist (14) 45 (90%) of the patients scored (good and excellent) 84 points or more.

Complications

There was one septic arthritis which was managed conservatively by aspiration and antibiotics and later developed recurrent instability. Two other patients were considered as failures with 2+ Lachman test. Two patients had restricted ROM that required manipulation under anesthesia four months post operatively. No haematoma, deep vein thrombosis or neurovascular injury were noted.

DISCUSSION

We understand that there is still no ideal method that ensures restoration of the normal function of the ACL. An improvement in the function of the knee can be achieved by present surgical techniques that takes in consideration the importance of avoidance of the impingement by the notchoplasty¹¹, placement of the femoral and the tibial attachment³ and adequate fixation. We think that we achieved these goals by this technique through the same incision of the harvested graft. The surgery produces a somewhat more stable knee joint, at least for the first few years¹. The factors that may play role in the failure of the graft are many; roof impingement, fixation of the graft, rehabilitation technique, activity level of the patient, and the non-isometric placement of the graft¹⁶.

The patient must be involved in the decision making and he must be willing to participate in a prolonged and carefully designed rehabilitation program³. With the absence of the instrumented ligament testing devices such as the KT-1000 arthrometer, the Lachman test remains an excellent assessment for ACL laxity, and the examiner should estimate the displacement (in millimeters) and assess the firmness of the endpoint. Although the overall accuracy of MRI in assessing the ACL is approximately 95%, MRI of the knee should not be used routinely.

We agree that candidates for surgery are those with active lifestyle and those with functional instability^{1,4}. The autogenous patellar tendon was chosen as the graft because it provides excellent biomechanical properties^{17,18} which makes it superior to other grafts. This graft is stronger than the normal ACL by 1,6 times¹⁷ and by twisting the graft 90 degrees the tensile strength is increased by 30%⁴.

We agree with Howell and Taylor¹⁶ that the diagnosis of impingement can be made from a lateral radiogram of the fully extended knee. The impingement is present when the anterior border of the tibial tunnel is anterior to the slope of the intercondylar roof. Forty five (90%) of our patients had a score of more than 84 points on the scale of Lysholm and Gillquist, suggesting normal function. Change in the level of activity in all patients was explained by the fear of re-injury, pain during reconstruction and rehabilitation, or that they were awaiting compensation from the army because of their injuries.

The rehabilitation of the ACL-reconstructed knees has an extremely important role in the outcome of the surgery. Rehabilitation that focused on protection of the graft led to stiffness, weakness and patellofemoral problems⁴. This procedure appears to have minimal post operative pain and patients appear to regain motion sooner with the use of the accelerated rehabilitation protocol of Shelbourne and Nitz¹³. This rehabilitation protocol was effective in maintaining the objective of early and long term maintenance of full knee extension, as only two (4%) of the fifty patients needed a manipulation of the knee joint for limited flexion.

The issue of the anterior knee pain was not recorded preoperatively but on the follow-up examination ten patients (20%) were found to have this patellofemoral problem and only two of them had severe and symptomatic crepitation. The use of the substance of the

patellar tendon may lead to the patellofemoral pain but the exact cause and effect of that is difficult to know⁵. However, the results in the literature are nearly the same with different modern techniques of the reconstruction^{5,6,19}. With the use of the patellar tendon graft we cannot see a difference in outcome between this procedure and the endoscopic technique.

CONCLUSION

This technique of reconstruction of the anterior cruciate ligament of the knee joint using the central third of the patellar tendon is recommended as it is safe and reliable procedure. Using this technique we achieved proper placement, avoidance of impingement and adequate fixation of the graft through the mini arthrotomy. The patients cooperation and understanding of the carefully designed rehabilitation program yields excellent results.

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