Can Clinical Evaluation Detect Isolated One Bundle or Complete Two Bundles ACL Rupture?

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Objectives: Anterior cruciate ligament (ACL) is generally composed of anteromedial bundle (AMB) and posterolateral bundle (PLB). The function of AMB is not same as one of PLB. When they are injured, they should have different clinical features. At least, isolated one bundle ACL rupture should have different features compared to complete 2 bundles ACL rupture. The purpose of this study is to investigate the clinical features of a isolated one-bundle ACL rupture and a complete two-bundle ACL rupture. The hypothesis is that clinical evaluation, including physical examination and arthrometer measurements, can differentiate isolated from complete two-bundle ACL ruptures.

Methods: This is a prospective research (18 November 2003 to 09 August 2011). 525 ACL deficiency were collected in this study. Two groups were confirmed by arthroscopy. 27 patients with isolated one bundle ACL rupture (SB group), including 11 AMB rupture (AMB group) and 16 PLB rupture (PLB group), and 498 patients with complete two bundles ACL rupture (DB group) were employed for the biomechanical test before and after anesthetic according to arthroscopy. Statistics was done between DB group and SB group in order to investigate whether clinical evaluation can detect isolated one bundle or complete two bundles ACL rupture. Statistics was done between AMB group and PLB group in order to investigate whether clinical evaluation can detect AM bundle or PL bundle rupture. The clinical evaluation include KT1000 (unit:mm), Lachman test (grade 4) and Pivot shift test (grade 5) before anesthetic and Lachman test (grade 4) and Pivot shift test (grade 5) after anesthetic. The data were analyzed using a un-paired t test, nonparametric test and discriminant analysis. The data of KT1000 was analyzed with un-paired t test. The data about Lachman and Pivot shift test was analyzed with Mann-Whitney test. It was assumed that there was statistical significance when \( P < 0.05 \). According to the variables with statistical significant result, two formulae were developed with discriminant analysis. All statistical data were calculated with the SPSS statistical software package (SPSS version 17.0, SPSS Chicago, IL, USA).

Results: In response to KT1000 side to side difference before anesthetic, between DB group (3.4216±2.80607mm) and SB group (2.3077±1.82799mm), there was significant differences between the two groups (\( t = 2.002, P = 0.046 \)). In response to Lachman test before anesthetic, there was significant differences between DB group and SB group (\( Z = -2.051, P = 0.04 \)). In response to Lachman test after anesthetic, there was significant differences between DB group and SB group (\( Z = -3.913, P = 0.000 \)). In response to Pivotshift test after anesthetic, there was significant differences between DB group and SB group (\( Z = -6.305, P = 0.000 \)). In response to Lachman test before and after anesthetic, there was not significant differences between AMB group and PLB group (\( Z = -1.210, P = 0.226, \) before; \( Z = -1.719, P = 0.086, \) after). In response to Pivot shift test before and after anesthetic, there was not significant differences between AMB group and PLB group (\( Z = -0.397, P = 0.691, \) before; \( Z = -0.307, P = 0.79, \) after). According to discriminant analysis, two formulae were developed to diagnose isolated one bundle or complete 2 bundles ACL tears. Before anesthetic, \( Z > 0.7783 \) indicates a two-bundle tear and \( Z < 0.7783 \) indicates an isolated bundle tear (False accept rate 0.049). After anesthetic, \( Z > 2.665895 \) indicates an isolated bundle tear and \( Z < 2.665895 \) indicates a two-bundle tear (False accept rate 0.053). In general, false accept rate <0.1 means that the formula is useful.

Conclusion: Clinical evaluation can differentiate an isolated one-bundle ACL rupture from a complete two-bundle ACL rupture. However, it cannot detect AM bundle rupture from PL bundle rupture.
The ideal femoral tunnel position using 3D-CT in anatomic single-bundle ACL reconstruction

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Background: The purpose of this study was to find the ideal femoral tunnel position in single-bundle ACL reconstruction using three-dimensional computed tomography (3D-CT) by comparing clinical scores, stability of the knee joint, and graft signal intensity on follow-up MRI.

Materials and Methods: Two-hundred patients underwent arthroscopic single-bundle ACL reconstruction with a soft tissue graft; all patients had the same surgical technique and rehabilitation protocol. Each patient underwent 3D-CT within 1 week after the operation and MRI at 1 year after the operation. Outcomes were evaluated with 3D-CT 1 week postoperatively using the Quadrant method of Bernard et al. We classified patients into three groups based on the femoral tunnel position: group A, AM tunnel; group B, PM tunnel; and group C, center tunnel. We evaluated graft signal intensity on follow-up MRI.

Results: This study included 77 patients (group A, 25 patients; group B, 15 patients; group C, 33 patients). The three groups did not differ significantly in preoperative demographics. There were no significant differences between groups in clinical scores or stability. However, patients in the AM tunnel and center tunnel groups had better graft signal intensity on follow-up MRI than those in the PL tunnel group.

Discussion and Conclusion: Positioning the femoral tunnel near the AM bundle and center led to better graft signal intensity on follow-up MRI in anatomic single-bundle ACL reconstruction than did positioning the femoral tunnel near the PL bundle. There were no differences in clinical scores or stability of the knee joint between groups.
Novel Anatomical Single Bundle ACL Reconstruction
Using A Rounded Rectangle Femoral Dilator

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Background: During the past 10 years, the main trend for ACL reconstruction has shifted to anatomic reconstruction. There is no significant difference in the postoperative stability and clinical results between single and double bundle ACL reconstruction. So, an attention has returned to single bundle ACL reconstruction with grafts that are placed at the center of anatomical footprint. In the conventional circular femoral bone tunnel, creation of a large anatomical bone tunnel is not possible because of roof impingement. Several anatomical studies have reported that the femoral insertion of the ACL has a rounded rectangle shape, and we have also realized that the quadrupled semitendinosus tendons appear to be a rounded rectangle, rather than circular. Therefore, we created an original femoral dilator and developed a new ACL reconstruction technique: “Rounded rectangle femoral tunnel ACLR” (RFTR). This study aimed to compare the femoral tunnel size and clinical results between conventional anatomical single bundle ACL reconstruction (ASBR) and RFTR.

Material: Between May 2010 and January 2015, 120 primary ACL reconstructions were performed. After implementation of inclusion criteria, 97 ACL reconstructions were analyzed (ASBR = 57 patients, 21 male, 36 female; age, 24.1±9.3 years; RFTR = 40 patients, 24 male, 16 female; age, 23.2±8.3 years). The evaluation items were area of the femoral tunnel, anteroposterior laxity with KT-1000, pivot-shift test, and Lysholm score.

Results: RFTR created a bigger femoral tunnel area than did ASBR (average area, 51.9±5.3 mm² vs 47.0±7.3 mm²; P<0.01). RFTR resulted in better anteroposterior stability and Lysholm score than did ASBR (average side-to-side difference for anterior tibial translation, 0.8±1.1 mm vs 1.8±1.2 mm; P<0.01); average Lysholm score, 98.9±2.7 vs 97.6±3.3; P=0.03). Differences in rotational stability between groups were not statistically significant (negative pivot shift, 90.0% vs 82.5%; P=0.39).

Conclusion: Compared with conventional anatomical single bundle ACL reconstruction, rounded rectangle femoral tunnel ACL reconstruction created a large femoral tunnel and improved anteroposterior laxity and clinical results.
CT value and tunnel enlargement of rounded rectangular femoral bone tunnel for anterior cruciate ligament reconstruction

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Background: We developed a novel technique for anatomical single-bundle anterior cruciate ligament (ACL) reconstruction: creation of a rounded rectangular femoral bone tunnel. The purpose of this study was to compare the computed tomography (CT) value and tunnel enlargement ratio of the femoral bone tunnel with those of rounded tunnel ACL reconstruction.

Material: We included 39 knees that underwent rounded tunnel ACL reconstruction and 42 that underwent rounded rectangular ACL reconstruction. To evaluate the CT value, we compared the CT images approximately 1 week after surgery. Making a parallel slice toward the opening of bone tunnels to a depth of 3 mm, we evaluated the CT value of eight directions in the bone tunnel wall. To evaluate tunnel enlargement, we compared CT images approximately 1 week after surgery with images taken 3 months after surgery. Using a parallel slice toward the opening of the bone tunnel, we measured the bone tunnel area and calculated the tunnel enlargement ratio. The level of significance was P<0.05, and the t-test was used for statistical analyses.

Results: The CT value was significantly high for the rounded rectangular tunnel in comparison with the rounded tunnel in almost all directions (P<0.05). The rounded rectangular tunnel area enlargement ratio was significantly lower (rounded: 110±38% vs rounded rectangular: 73±37%, p=0.001).

Discussion: A femoral bone tunnel created for ACL reconstruction may enlarge over time through mechanical and biological factors induced by the reconstructed ligament. Bone tunnel malposition, rehabilitation too early, frictional heat of the drill, synovial fluid invasion in the bone tunnel and micromotion of the graft in the bone tunnel all cause bone tunnel enlargement. Of these, we prevented osteonecrosis attributable to drill heat by creating a rounded rectangular dilation, and micromotion in the bone tunnel of the graft and invasion of synovial fluid in the bone tunnel were inhibited by the fit-and-fill effect of the graft due to the bone tunnel shape. We think that we can expect early osteosclerosis with cancellous bone compression.

Conclusion: We created a larger rounded rectangular bone tunnel for ACL reconstruction using a rounded rectangular dilator. It was suggested that the rounded rectangular tunnel could be expected the compression effect of the cancellous bone and the fit and fill effect of the graft in the bone tunnel that may be reduced the bone tunnel enlargement.
Efficacy and Safety of Self-flip Technique of TightRope RT Button for Anterior Cruciate Ligament Reconstruction

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Introduction

The TightRope RT (Arthrex, Naples, FL) is a fixation device for anterior cruciate ligament (ACL) reconstruction. The TightRope RT has an adjustable loop that fits all sizes of tunnels, and it is not necessary for orthopedic surgeons to create an extra socket (6 to 7 mm) to facilitate button flipping. Therefore, relatively short femoral tunnels will be beneficial for anatomic soft tissue ACL reconstruction. However, there is no side suture in the TightRope RT button for flipping. In addition, there is a potential risk that the button will be pulled too far off the lateral femoral cortex into the soft tissue and lead to inappropriate positioning of the button on the vastus lateralis muscle or fascia, because the loop of the TightRope RT is long. So far, various techniques have been reported to seat the TightRope RT button appropriately on the lateral cortex of the femur. However, the reported techniques are relatively difficult. Therefore, our novel technique (Self-flip Technique) was introduced for the button flipping.

The purpose of the present study was to investigate the efficacy and safety of the technique of the button for ACL Reconstruction.

Methods

Participants

A total of 67 patients were enrolled in the present study. All the patients underwent arthroscopic single bundle or double bundle ACL reconstruction using hamstring tendon by five surgeons. Average age of the patients was 31 years old.

Self-flip Technique

As preparation, the appropriate diameter of tibial tunnel is created using the ACL tibial guide, and the appropriate diameter of femoral tunnel is also created using inside-out or outside-in technique using the ACL femoral guide under the arthroscopy. A 15-mm femoral socket is then created with a drill adjusted to the diameter of the graft. As
to the preparation of the graft, we draw a first line in the loop of the TightRope RT at the same length as the femoral tunnel, and then draw a second line at 7 mm longer than the length of the femoral tunnel as a self-flip line. Moreover, the third line is drawn on the graft at 15 mm from its end that is the same length as the femoral socket.

A braided No. 5 suture is passed from the tibial tunnel to the femoral socket and brought out of the skin laterally. The TightRope RT passing sutures are passed through the tibial tunnel and then through the femoral socket and brought out laterally using the suture. The side sutures are then pulled from the lateral side, with the TightRope RT button being pulled into the femoral socket under direct arthroscopic vision. We confirm the drawn lines in the loop of the TightRope RT through the anterolateral portal. We then stop pulling the TightRope RT button just at the second line (self-flip line).

We should hold the graft at the tibial end on the anterior side not to pull too far. Then, the scope should be removed, and the knee position is changed from 90 degrees flexion to full extension. It is necessary to pull the side suture strongly, with the surgeon holding the graft at the tibial end. The side suture is inclined to the medial side with strong pulling of the suture. Then surgeon pulls the tibial end of the graft until he feels a secure positioning of the TightRope RT on the lateral side of the femoral cortex. The knee position is changed from full extension to 90 degrees flexion. We should insert the arthroscope again and confirm the first line is just at the exit of the femoral tunnel through the anterolateral portal. Thereafter, final tensioning of the graft is made by pulling the white loop until the third line on the graft aligned to the exit of the femoral tunnel. Countertraction on the tibial end of the graft is applied during graft final tensioning. Finally, double stapling is done for tibial fixation at 20 degrees of knee flexion.

A postoperative radiograph is obtained for each patient to confirm the appropriate positioning of the button. The number of cases was evaluated if the malpositioning of the button was seen. The definition of the malpositioning was as follows; migrating to the vastus lateralis muscle or fascia, and the button left in the femur using the plain radiographs.

**Results**

In a total of 150 flips in 95 patients, 96% of the buttons were seated correctly on the lateral cortex of the femur using postoperative plain radiographs.

**Conclusions**

According to previous studies, malpositioning of the button may lead to either soft tissue irritation or migration of the button. In addition, a previous study indicated that a rate of soft-tissue interposition between the button and the lateral cortex of the femur would be up to 25.2% on postoperative radiographs obtained after ACL reconstruction. A positive correlation between this complication and a higher rate of button migration was also seen. This technical error can result in a worse clinical outcome. The advantages of the self-flip are: easy preparation of the graft, easy confirmation of the drawn line as the same length of the femoral tunnel, safe procedure for the patient, easy procedure for novice surgeons, and it does not take much time.
Comparison of clinical and radiologic outcomes and second-look arthroscopic findings after ACL reconstruction using a fixed-loop and adjustable-loop cortical suspension devices

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Abstract

Background The purpose of this prospective randomized clinical study was to compare the clinical and radiological outcomes, including possibility of loop lengthening and graft displacement after ACL reconstruction using different femoral cortical suspension devices, a fixed loop and adjustable loop device. All patient used allograft of tibialis anterior tendon. We evaluated results of ACL reconstruction about clinical and radiologic outcome. In addition, we compared the graft tear, and synovial coverage of grafts in patients that underwent the second-look arthroscopy. Stress view was checked after 1 year of operation to compare instability.

Material and Method Among 63 patients with an ACL injury underwent ACL reconstruction, 30 patients of fixed loop group and 33 patients of adjustable loop group were included for this study after minimum of 1-year follow-up. The Lachman and pivot-shift tests, Tegner activity score, Lysholm knee score, and IKDC score were compared between the two groups. And radiologic evaluation about tunnel widening was compared between the two groups through X-ray. 49 patients (24 patients in fixed loop group and 25 in the adjustable loop group) underwent the second-look arthroscopy, in which we compared the apparent tear of graft and synovial coverage of grafts. Anterior drawer stress test was checked and side to side difference was compared.

Results At the final follow-up, there were no statistical significances in the two groups in Lachman and pivot-shift tests. The Tegner activity, Lysholm knee score, and IKDC scores were similar in the two groups. Moreover regarding the findings of second-look arthroscopy, although there was no significant difference in graft tear and synovial coverage. Radiologic findings comparing instability showed no significant difference.

Conclusions Even though adjustable-loop system’s intended flexibility has possibility of loop lengthening and subsequent graft displacement, compared with fixed-loop system, both group provided good functional and radiologic outcomes without significant differences. Also the second-look arthroscopy revealed no difference in graft tear and synovial coverage between fixed-loop and adjustable-loop device.
Retrograde cross-pin (RigidFix) femoral fixation in anatomic single-bundle ACL reconstruction with the transportal technique

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Background: Although the safe zone of transverse femoral fixation by means of an anteromedial portal (transportal technique) minimizes the risk of damage to the saphenous nerve, femoral artery, and peroneal nerve, anterograde transverse pins which are placed percutaneously through the lateral femoral condyle to medial condyle, pose a risk of iatrogenic damages to the posterolateral structures of the knee joint. The research group hypothesized that retrograde (through the medial femoral condyle to lateral condyle) cross-pin (RigidFix, DePuy Synthes Mitek Sports Medicine, Raynham MA USA) femoral fixation using transportal technique would decrease the risk of iatrogenic damages to the posterolateral structures of the knee joint without increasing the risk of iatrogenic damage to the medial structures.

Methods: A pilot cadaver stuff was performed to develop the surgical technique: the anterior cruciate ligament (ACL) was reconstructed arthroscopically in 5 fresh cadaveric knees by the same author. After complete excision of the ACL by using of a shaver, the lateral wall of the intercondylar notch was cleared to show the foot-print of ACL femoral insertion. A guidewire was inserted through the anteromedial portal and was introduced into the center of the foot-print of the ACL femoral insertion with the knee flexed at 120°. The femoral tunnel was constructed through the anteromedial portal, with a length of 30 mm. The Rigidfix femoral guide frame, which was originally developed for a transtibial drilling technique, was introduced through the anteromedial portal into the femoral tunnel. By means of the guide frame, two sleeves for introducing Rigidfix pins were fixed to the lateral face of the lateral condyle. From negative 20° to negative 40° (rotational angles about the axis of the femoral tunnel), the drilling angles for the two sleeves were determined by the safe zone for transportal technique. Then, the extra-articular portion of the frame was rotated to lie on the medial femoral condyle of the operative knee joint. The two RigidFix sleeves were fixed to the medial face of the media femoral condyle, after going over the interlocking trocar and drilling through the hole of the guide frame. The drilling angles for the 2 sleeves were determined by the safe zone for transportal technique. Lateral and medial dissections were then performed to measure the distances from the 2 sleeves to the lateral collateral ligament, the popliteus tendon, the lateral gastrocnemius tendon, the medial patellofemoral ligament, and the medial collateral ligament. Then, a clinical series of 106 patients were selected on which to perform retrograde RigidFix fixation using the newly-developed transportal technique between January 2010 and May 2012. All of them were operated by the same surgical team using the RigidFix frame developed for a transtibial drilling technique, and underwent computed tomography with 3D reconstruction post-operation.
**Results:** In the cadaveric study, the popliteus tendons were partially torn by the distal sleeve in 3 specimens. The average distance to the lateral collateral ligament was shorter than 1.5 mm (range, 0.5 to 2.5 mm). The lateral gastrocnemius tendons were pierced by proximal sleeve in 4 specimens. Also, 4 specimens demonstrated the point of entry of the distal sleeve at the border of the joint cartilage of the lateral face of the lateral femoral condyle. The minimum distance between the distal sleeve to the medial patellofemoral ligament was 20 mm, and to the medial collateral ligament was 25 mm. In the clinical series, the extra-articular portion of the frame couldn’t be rotated to the medial condyle in 8 cases (7.5 %) because of the bigger thigh circumference of the patients. In 3 cases (2.8%), one of the crosspinholes missed the femoral tunnel. In no case (0.0%) did the tocar breach through the bone cortex of the lateral femoral condyle.

**Conclusions:** Retrograde RigidFix femoral fixation using transportal technique can have a low incidence of iatrogenic damages to the medial and lateral femoral condyle structures of the knee joint.
Biomechanics of single-tunnel double-bundle anterior cruciate ligament reconstruction using fixation with a unique expandable interference screw

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Background: Single-tunnel double-bundle (STDB) anterior cruciate ligament (ACL) reconstruction can restore biomechanical function and anatomic structure, but existing methods of graft fixation are not adequate. The aims of this study are to examine knee biomechanics after STDB reconstruction using a unique expandable interference screw for fixation.

Methods: The biomechanical parameters of six pairs of human cadaveric knee specimens were measured with the ACL intact, after ACL removal, and after STDB reconstruction using the interference screw or single-tunnel singlebundle (STSB) reconstruction. Anterior tibial translation under 134 N anterior tibial load in a neutral position as well as in 15° and 30° internal and external knee rotation and the internal tibial rotation angle under the rotatory load (5 N · m internal tibial rotation) were measured.

Results: Anterior tibial translations at each degree of knee flexion in the STDB group were significantly less than in the STSB group (all, P < 0.05). The internal rotation angles in the STSB group at five flexion angles were significantly higher than in the ACL intact group, whereas there were significantly less than those of the ACL absent group (P < 0.05). Under rotatory loads in the neutral position, the tibial internal rotation angles of the STDB group were significantly lower than in the STSB group at all flexion angles (all, P < 0.05).

Conclusions: STDB ACL reconstruction with the expandable interference screw provides better anteroposterior and rotational stability than STSB reconstruction.

Clinical relevance: The technique provides the advantages of double-bundle reconstruction using a single-tunnel technique.
Relationship between tunnel malposition and intra-articular degeneration in anterior cruciate ligament reconstruction

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ABSTRACT

Background: To elucidate the relationship between radiographic tunnel position parameters in primary anterior cruciate ligament (ACL) reconstruction and arthroscopic findings of cartilage degeneration or bucket-handle meniscal tear using arthroscopy in revision surgery.

Materials and Methods: Thirty-five patients who underwent ACL revision reconstructions were recruited; their primary surgeries were single-bundle reconstructions. Tunnel positions of primary reconstructions were evaluated using the plain radiograph prepared before revision surgery. The sagittal tunnel positions (%) of the femur (FP) and tibia (TP) were determined on the lateral view. To evaluate the tunnel angle, the line connecting the midpoint of the femoral and tibial tunnel aperture was drawn to divide a line parallel to the tibial plateau on the coronal view. Articular cartilage was evaluated arthroscopically by International Cartilage Repair Society (ICRS) grade at primary surgery and at revision surgery, and two-grade progression was defined as cartilage degeneration. The bucket-handle meniscal tear was also evaluated by probing. Logistic regression analysis was conducted using the prevalence of cartilage degeneration or bucket-handle meniscal tear as the dependent variable; tunnel parameters, including sex and the duration (months) from primary surgery to revision surgery, were used as the independent variables.
**Results:** Seven patients (20.0%) had cartilage degeneration and nine patients (25.7%) had bucket-handle meniscal tear in their medial meniscus. In logistic regression models, %FP [odds ratio (OR): 1.547; P=0.089] was not correlated with cartilage degeneration, whereas the cut-off of 59% in the FP (OR: 14.859; P=0.027) was significantly correlated with cartilage degeneration. On the contrary, %TP (OR: 1.204; P=0.026) was significantly correlated with the prevalence of bucket-handle meniscal tear.

**Discussion:** While there are substantial evidences of the tunnel position on the femoral side, it is less debated on the tibial side. Limited studies have mentioned how posterior tunnel malposition on the tibial side affected the biomechanical or clinical outcome in ACL reconstruction. One important biomechanical function of menisci is to stabilize the ACL-deficient knee. During chronic ACL deficiency, menisci always are in danger of the bucket-handle meniscus tear, which occurs with continuous episodes of giving way. In accordance with the current data, posterior tibial tunnel malposition can induce clinical and biomechanical burdens on the medial meniscus.

**Conclusion:** In our revision series, anterior femoral tunnel malposition in the femur affected the definitive cartilage degeneration, and posterior tibial tunnel malposition resulted in the prevalence of bucket-handle meniscal tear.
Femoral and Tibial Tunnel placement correlate with Graft Tunnel Motion: A Quantitative Clinical Imaging Study

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Background In ACL reconstruction, once the reconstructed graft is not in isometric during knee motion, poor graft-bone healing, graft loose and potential bone tunnel enlargement may happen due to graft-tunnel motion (GTM) such as the effect of bungee cord or windshield wiper. Animal experiments and clinical MRI studies have proved that the amplitude of graft-tunnel motion correlated with bone-graft healing. Cadaver studies showed that femoral and tibial tunnel placement correlate with GTM. In surgical practice of ACL reconstruction, various amplitude could be notified. However, there’s no clinical evidence to quantify this phenomenon. So we managed to quantify the coordination of Femoral and Tibial Tunnel and the amplitude of GTM in order to find out how to minimize GTM with a proper set of femoral and tibial tunnel placement.

Method Thirty patients were included in the study. ACL reconstruction was performed with use of a hamstring autograft in suspensory fixation technique by a single surgeon. The intra-articular part of the graft was marked with suture knots, one and the other at the tibial and femoral tunnel aperture, the third at the middle point between the previous two. The tibial tunnel was drilled along the anterior root of the lateral meniscus randomly. The femoral tunnel was drilled slightly above the residential ridge and near the elongation of bifurcate ridge randomly. During ACL reconstruction, we use an intra and an extra articular GTM measuring device to measure the amplitude of GTM while the knee was flexed from 0 degree to 120 degree. Notchplasty would be performed if impingement existed. After the surgery, the patient received a multi-slice computer tomography (MSCT) to locate the intra-articular tibial and femoral tunnel point through 3D reconstruction. Bernard-Hertel grid was used to quantify the coordinates (h, t) of the femoral tunnel. While a rectangle coordinate system was used to quantify the coordinates (a, b) of the femoral tunnel. Statistical correlation analysis was proceed to evaluate the data.

Results The average GTM was 2.36±0.61mm. There’s no significant difference between the methodology of intra and extra articular GTM measurement. The average h and t was 0.263±0.118 and 0.475± 0.094, respectively. The average a and b was 0.532±0.127 and 0.382±0.144. Notably, the minimum GTM was 0.4mm and the femoral and tibial coordinate was (h: 0.5201, t: 0.2117) and (a: 0.512, b: 0.441). h, t and b showed significant correlation with GTM with the factor of 0.581, 0.639 and
Conclusion We successfully developed a method to evaluate intraoperative GTM and quantify the tunnel on MSCT. Further investigation will focus on clinical outcomes correlation with GTM and tunnel placement.
Twenty-Year Comparison Outcome Data of a Longitudinal Prospective Evaluation of Isolated Endoscopic Anterior Cruciate Ligament Reconstruction with Either Patellar Tendon or Hamstring Autograft

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Background: Long-term prospective follow-up studies of single-incision isolated endoscopic anterior cruciate ligament (ACL) reconstruction are limited and may include confounding factors. This longitudinal prospective study reports the compared outcomes of isolated ACL reconstruction using middle-third patellar tendon autograft (PT) and 4-stand hamstring autograft (HT) in 180 patients over 20 years.

Methods: Between January 1993 and April 1994, a total of 180 patients met study inclusion criteria: evaluation at 1, 2, 3, 4, 5, 7, 10, 15, and 20 years after surgery. Assessment included the IKDC Knee ligament evaluation including radiographic evaluation, KT1000, Lysholm Knee Score, kneeling pain, and clinical outcomes. Exclusion criteria were associated ligamentous injuries requiring surgery, previous meniscectomy or meniscal injuries requiring more than one-third meniscectomy, chondral injuries, and an abnormal contralateral knee.

Results: At 20 years, 16 (18%) patients had sustained an ACL graft rupture in the HT group, and 9 (10%) patients in the PT group. ACL graft rupture was not associated with the parameters of family history of ACL injury, or the type graft construct. Males were more likely to rupture than females (p=0.007), and non-ideal tunnel position were more likely to re-rupture (p=0.019). Patients age 18 or less at time of surgery had an increased odds ratio of 4.6 times for risk of graft rupture (p=0.003). With regards to contralateral ACL rupture, those patients receiving the PT had a 2.2 times greater odds ratio for rupture compared to HT graft (p=0.02). If the age of reconstruction was 18 or less, the risk of rupturing the uninjured knee ACL was 3.4 times greater than over 18 years of age at time of reconstruction (p=0.001). The incidence of further ACL injury to either the reconstructed or contralateral did not show a significant difference, 37% in PT and 30% in HT. The mean International Knee Documentation Committee (IKDC) score was 86 for the PT and 89 for HT at 20 years. There was no difference in the Lysholm score between the groups. Of the PT patients, 53% participated in strenuous/very strenuous activities, and kneeling pain was present in 63% at 20 years. In the HT group 57% participated in strenuous/very strenuous activities, and kneeling pain was present in 20%. Radiographic degenerative change in the PT group was found in 61%, 20% had IKDC grade C, and 0% had grade D. The HT group found radiographic degenerative change 41%, 7% had grade C, 7% had grade D. The progression of osteoarthritic change over time was reviewed, and these changes occurred gradually, with the PT group being more rapid than the HT. If patients with an ACL graft rupture are assumed to have an abnormal IKDC clinical evaluation, then 74% of HT had a normal/nearly normal knee, compared to 76% PT at 20 years (p=0.752).

Conclusion: Subjects receiving the PT graft had significantly worse outcomes compared to those receiving HT, with regards to radiologically detectable osteoarthritis, kneeling pain and contralateral ACL injury. At 20 years both HT and PT autografts continue to provide good subjective outcomes and objective stability. However, ACL reconstruction using the PT graft is associated with persisting kneeling pain and radiological osteoarthritis, compared to the HT graft. Risk factors for ACL graft rupture include males, young age, and those with tunnel malposition. This information may help in the counseling of patients undergoing this procedure and stratifying their individual risk of reinjury.
Comparison of three different methods for drilling PLB femoral tunnel in double bundle ACL reconstruction.

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Purpose
The purpose of this study was to compare the PL femoral tunnel geometry between flexible and rigid drilling systems in TP technique and OI technique based on three-dimensional image analysis of postoperative CT images.

Method
Postoperative CT images at 1 week were available for analysis in 67 patients. Rigid drill, flexible drill and OI group was 20, 27 and 20 knees. Thereafter, three-dimensional CT image analysis using ZioTerm2009 R imaging software was applied to the PL femoral tunnels, and the following parameters were evaluated: position of the center of the tunnel aperture, tunnel length, shape of the intraarticular aperture (major axis length of the ellipse in relation to the original drilling diameter), and bending angle of the graft (angle formed by long axes of the intraarticular graft and femoral bone tunnel).

Results
Assessment of the tunnel center location based on the Bernard and Hertel method showed that anatomic tunnel placement was achieved. There are no significant difference in the tunnel length. The major axis of the aperture/drill diameter ratio averaged 1.29 in the flexible drill group, 1.24 in the rigid drill group and 1.13 in the OI group. The mean graft bending angle at the femoral tunnel aperture was 63.4° in the flexible drill group, 63.6° in the rigid drill group and 99.4° in the OI group.

Conclusions
The present study showed that anatomic placement of the femoral tunnel was feasible with both TP and OI techniques. The shape of the tunnel aperture was more ellipsoidal with both TP techniques, it was not more round aperture with the flexible drilling system. It was thought that the flexible drill guide was constraint by the preserved remnant. The graft bending angle at the tunnel aperture was sharp with OI drilling technique, which may increase the mechanical stress at the aperture.
The Effect of SB-ACLR vs ADB-ACLR on the Patellofemoral Joint by MRI evaluation and more than 2-Year’s of Follow-up

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\textbf{Background and Hypothesis:} Little is known about the effect of anterior cruciate ligament reconstruction on the patella-femoral joint. It was hypothesized that after anterior cruciate ligament reconstruction, the ADB-ACLR (anatomical double-bundle ACL reconstruction) will be superior to the SB-ACLR (single-bundle ACL reconstruction) in restoring the altered patella-femoral joint.

\textbf{Material and Methods:} Among the randomized included 56 patients, 26 in the ADB group and 30 in the SB, all of them were followed up at least for more than 2 years. ACL were reconstructed with autologous STG grafts arthroscopically. For the SB- and DB ACLR, Endo-Button were used for the femoral sides’ fixations and bioabsorbable interference screws plus staple fixations were used for the tibia sides’ fixations. Patients with partial meniscectomies which were more than 40% of the total menisci, older than 45 years old and younger than 18 years old, with multi-ligament injuries, bilateral knee injuries, revision ACLRs, and serious cartilage injuries were excluded. Outcome assessments at final follow-up included IKDC2000, Tegner, and Lysholm scores; side-to-side difference by KT-2000 and back-pushing KT-2000, pivot shift (0, +, ++); range of motion (ROM) and muscular strength; radiographic assessment included the TT-TG, patellar tilt angle, lateral deviation angle (LDA), lateral patellofemoral angle, lateral patellar displacement.

\textbf{Results:} Mean follow-up was 26.9±2.7 and 27.1±1.9 months for the DB group and SB group, respectively. A statistically significant difference in favor of the DB group was found with the total AP laxity (the back-pushing KT-2000 arthrometer). There was significant difference of the LDA between the two groups, the data of DB group has obviously smaller and near normal than the SB group. No significant differences were found between the 2 groups in terms of IKDC score, Lysholm score, Tegner score, conventional KT-2000 arthrometer anterior laxity, ROM, muscle strength, and any other imaging evaluation results. (TT-TG, patellar tilt angle, lateral patellofemoral angle, lateral patellar displacement).

\textbf{Conclusion:} ADB-ACLR is feasible and achieved more satisfactory results than the transtibial SB technique in terms of anteroposterior stability of the knee and to restoring normal patella-femoral relations in spite of no significant differences among other clinical and imaging evaluation parameters.
Single vs. double vs. triple bundle anterior cruciate ligament reconstruction with hamstring tendon. --How is the effect of multi-tunnel reconstruction?

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Concomitant Cartilage and Meniscal Injuries in Patients with ACL Injuries Sustained During Basketball versus Soccer: a Matched-Pair Analysis

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Background
According to the literature, there are meniscus and cartilage injury patterns associated with ACL injuries in different sports. Both soccer and basketball are two of the commonest sports injuries in our centre. We planned a study to compare the patterns of injury in our ACL-injured patients, sustained during soccer and basketball.

Materials
From 2014-2015, over 296 patients underwent arthroscopic ACL reconstruction, and institutional review board approval was obtained to study these patients. We identified the patients who sustained their ACL injuries either from basketball or from soccer.

Methods
To limit the confounding factors, we matched these patients in pairs – basketball injured patients versus soccer injured patients. The patients were matched for age and duration from injury to ACL reconstruction surgery. A total of 26 pairs were identified. The intra-operative findings of concomitant cartilage and meniscal injuries were noted and analysed.

Results
The average age of our patients was 25 years. There were a total of 28 medial meniscus injuries, 33 lateral meniscus injuries, and 21 cartilage injuries in these matched subgroup of 52 patients. There were a total of 41 patients with meniscal injuries (78.8%), amongst whom there were 8 isolated medial meniscus injuries, 13 isolated lateral meniscus injuries, and 20 combined medial and lateral menisci injuries. Amongst the 52 patients in the cohort, there were a total of 21 patients who had cartilage injuries (40.4%), and 17 patients who had both meniscus and cartilage injuries (32.7%).

For isolated medial meniscus injuries: 6 soccer players had isolated medial meniscus tears while their paired basketball counterparts did not (23.1%); 1 pair of soccer and basketball patients had medial-meniscus tears (3.8%); 19 pairs of patients did not have isolated medial meniscus tears (73.1%). (p = 0.031)

For combined meniscal injuries: 6 basketball patients had both menisci injured while their paired soccer counterparts did not (23.1%); 7 pairs of soccer and basketball patients had both menisci injured (26.9%); the remaining 13 pairs of patients did not have both menisci injured (50.0%). (p = 0.031)

For cartilage injuries: 8 basketball patients had cartilage injuries while their paired soccer counterparts did not (30.8%); 3 soccer patients had cartilage injuries while their paired Basketball counterparts did not (11.5%); 5 pairs of patients had cartilage injuries occurring in both groups (19.2%), while 10 pairs of patients did not have any cartilage injuries (38.5%). (p =0.227)

For combined meniscal plus cartilage injuries: 6 basketball patients had combined meniscus and cartilage injuries while their paired soccer counterparts did not (23.1%); 3 soccer players had combined injuries while their paired basketball counterparts did not (11.5%); 4 pairs of patients had combined injuries occurring in both (15.4%), while 13 pairs of patients did not have combined injuries (50%). (p=0.508)
Discussion
There are few studies that study the injury patterns in ACL injuries across different sports. Many of these are large cohort studies. The use of a match pair analysis enables us to limit the confounding factors to study our cohort of ACL patients.

We have found that patients injured from basketball injuries sustain more meniscus and chondral injuries. This can be attributed to their mechanism of injury which often involves jumping and landing awkwardly. In soccer, the majority of injuries are a non-contact pivot injury.

This information is useful when counselling patients with injuries from basketball and soccer to prognosticate their recovery as well as the possible need for additional procedures such as a concomitant meniscus repair or microfracture.

Conclusion
Compared with soccer patients, our basketball patients have more combined lateral plus medial menisci injuries, and a higher likelihood of cartilage injuries and combined meniscus plus cartilage injuries. Our soccer patients have a higher likelihood of isolated medial meniscus tears compared to our basketball patients.
Clinical Study on Anterior Cruciate Ligament Combined with Meniscus Ramp Injury Based on 268 Cases And the Analysis of Typical Cases

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Abstract: [Objective] The study aims to investigate clinical characteristics of anterior cruciate ligament (ACL) injury complicated with meniscus ramp injury. We also share our successful clinical experience of diagnosis and treatment to the special injury by means of Retrospective cases in ShengJing-Hospital. [Methods] The clinical data included 268 patients who were diagnosed as anterior cruciate ligament with ipsilateral meniscus injury in Joint Surgery and Sports Medicine Department of ShengJing-Hospital from January 2013 to March 2015. Among them meniscus ramp injury are 57 cases. The incidence of meniscus ramp injury accounted for 21.3%. The 57 patients included 39 males and 18 females respectively. Their ages ranged from 16 to 63 years old. We analyzed epidemic characteristics of the meniscus ramp injury systematically. The other clinical data included patients’ age, the type of ACL injury, the reason of injury, the time length between operation and injury, the comparison between preoperative MRI examination and arthroscopy surgery examination, the comparison between preoperative and postoperatively Lysholm score respectively. [Results] Among them, 35 injuries were secondary to chronic ACL injury accounting for 61.4% however 22 injuries were secondary to acute group accounting for 38.6%. The incidence of secondary to chronic ACL injury was significantly higher than the acute in meniscus ramp injury (P <0.01). 24 cases suffered because of sports accident accounting for 42.1% in the various causes of meniscus ramp injury. The peak time from the injury to diagnosed as meniscus ramp injury in the surgery was about 1-1.5 years. There are 63 cases were reminded of suspicious signal appearing in the medial horn of meniscus in the magnetic resonance image (MRI) examination before operation. The preoperative MRI diagnostic rate was 90.4% in anterior cruciate ligament combined ramp injury. Preoperative Lysholm’s score was (39.4 ± 7.8) while the postoperative lysholm’s score was (90.3 ± 11.4). Postoperative score was significantly better than the preoperative (P <0.01). [Conclusion] Meniscus ramp injury is often secondary to old ACL; Male and younger (<30 years) patients should pay more attention to it when ACL injury happened; Preoperative MRI can be used as one usual auxiliary diagnosis; Meniscus ramp injury should be early diagnosed and early accepted surgery. All-in-side suture technology is an effective method for treating meniscus ramp injury and the following-up results are often satisfactory.
Clinical Study on Anterior Cruciate Ligament Combined with Lateral Meniscus Root Tear Injury Based on 577 Cases and the Analysis of Typical Cases

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Abstract: [Objective] The study aims to investigate clinical characteristics of anterior cruciate ligament (ACL) injury complicated with lateral meniscus root tear injury. We also share our successful clinical experience of diagnosis and treatment to the special injury by means of retrospective cases in ShengJing-Hospital. [Methods] The clinical data included 577 patients who were diagnosed as anterior cruciate ligament injury with ipsilateral meniscus injury in Joint Surgery and Sports Medicine Department of ShengJing-Hospital from March 2014 to January 2016. Among them lateral meniscus root tear injury were 53 cases. The incidence of meniscus ramp injury accounted for 9.2%. The 53 patients included 35 males and 18 females respectively. Their ages ranged from 14 to 61 years old. We analyzed epidemic characteristics of the lateral meniscus root tear injury systematically. The other clinical data included patients’ age, the type of ACL injury, the reason of injury, the time length between operation and injury, the comparison between preoperative MRI examination and arthroscopy surgery examination, the comparison between preoperative and postoperative lysholm score respectively. [Results] Among them, 39 injuries were secondary to acute ACL injury accounting for 73.6% however 14 injuries were secondary to chronic group accounting for 16.4%. The incidence of secondary to acute ACL injury was significantly higher than the chronic in lateral meniscus root tear injury ($P < 0.01$). Lateral meniscus root tear includes simple root tear and root combined body radial tear (complex injury). Among 53 cases, 19 injuries were simple root tear accounting for 35.8% however 34 injuries were complex injury accounting for 64.2%. The complex injury can be divided into type A-root injury but femoral ligament intact accounting for 85.3% (29/34) and type B-root injury and femoral ligament missing accounting for 14.7% (5/34). 36 cases suffered because of sports accident accounting for 67.9% in the various causes of lateral meniscus root tear injury. The peak time from the injury to diagnosed as lateral meniscus root tear in the surgery was about 3 months - 1 year. There are 63 cases were reminded of suspicious signal appearing in the lateral horn of meniscus in the magnetic resonance image (MRI) examination before operation. The preoperative MRI diagnostic rate was 84.1% in anterior cruciate ligament combined lateral meniscus root tear injury. Preoperative Lysholm’s score was (45.4 ± 6.8) while the postoperative lysholm’s score was (93.3 ± 10.2). Postoperative score was significantly better than the preoperative ($P < 0.01$). [Conclusion] Lateral meniscus root tear injury is often secondary to acute ACL injury; Male and younger (<30 years) patients should pay more attention to it when ACL injury happened; Preoperative MRI can be used as one usual auxiliary diagnosis; Lateral meniscus root tear injury should be early diagnosed and early accepted surgery. All-in-side suture technology is an effective method for treating meniscus ramp injury and the following-up results are often satisfactory.
Staged Anatomical Reconstruction of MCL using Achilles Allograft, A Modification to Marx’s Technique

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Background: Medial collateral ligament (MCL) is the primary stabilizer of the knee that provides resistance against valgus deforming forces. Superficial MCL is the largest structure of the medial part of the knee. It originates from 3.2 mm proximal and 4.8 mm posterior to the medial epicondyle at the center of knee motion on the medial femoral epicondyle of the femur. According to LaPrade and Brantigan, it has proximal and distal attachments on the tibia.

Most patients who sustain MCL injuries regain their activity level with nonoperative treatment, but in some severe cases, especially those with multiple ligament injuries, and those with isolated symptomatic chronic MCL laxity, may require operative treatment. There are several techniques to reconstruct the MCL. Some surgeons use semitendinosus autograft with preservation of the tibial insertion, while some use allografts. Double-bundle reconstruction is another technique, which in comparison to single-bundle reconstruction is relatively complex.

Marx et al. described the latest technique for reconstruction of MCL. They used Achilles tendon allografts and reconstructed the MCL at the same time as the cruciates. They secured the allograft by fixing the bone block attached to the allograft into the tibia using a metallic screw and washer. They used tendoachilles allograft with a calcaneal bone block to promote bone-to-bone healing on the femur. Their technique required small incisions. They eliminated the need for extensive exposure and the risk of donor site morbidity with autografts.

While good results have been generated using the Marx technique, some issues have been observed with the technique. For instance, the allografts don’t stay in contact with the tibial bone proximal to the allograft’s attachment during surgery, as the allograft is fixed only to the superficial MCL distal attachment site. Also, patients have had complaints from the metallic hardware underneath the skin in the proximal and medial parts of their leg. Another issue has been the loss of ROM in some patients, potentially due to reconstruction of the MCL and other ligaments at the same time. The aim of this study was to modify this technique by using anchor sutures instead of metallic hardware and to fix the graft on proximal of tibia.

Material: We enrolled 11 patients and repaired their ligaments according to our technique after obtaining consent.

Methods: In order to address the abovementioned issues, we have implemented a modification to the Marx technique. We used Achilles tendon allograft without a bone block attached to it. We fixed the allograft on the proximal and distal attachment footprints of the superficial MCL and used 3 suture anchors for that purpose, 2 sutures on the distal attachment footprint and one on the proximal. Also for preventing loss of knee ROM we reconstructed MCL and other ligaments in 2 separate stages. At the last follow up we evaluated the range of
knee motion, knee ligament laxity and functional outcome scores, subjective International Knee Documentation Committee [IKDC] and Lysholm score. Follow up range was from 12 to 27 months.

**Results:** Knee motion was maintained in all cases. Two cases demonstrated 1+ valgus instability at 30 degree of knee flexion. Both were treated for combined MCL and PCL tear, the rest were completely stable. Average IKDC-subjective score was 93 ± 4 and average Lysholm score was 92 ± 3. All patients were completely satisfied and returned to their previous level of activity.

**Discussion:** In the modified Marx technique, we reconstructed the superficial MCL closer to its anatomical construct by attaching the allograft on the proximal and distal footprints of the superficial MCL. This resulted in better adhesion of allograft onto the bone, kept the allograft in complete contact with the tibial bone and completely restored the knee stability. By not using metallic hardware in the proximal medial side of the leg, patients didn’t have any complaints and the need for second surgery to remove the hardware was avoided. Also reconstructing the ligaments in 2 stages helped to better preserve the knee motion.

**Conclusions:** Staged MCL reconstruction with modified Marx technique have good short term results.
A COMPARISON OF TWO SUPERFICIAL MCL RECONSTRUCTION INCLUDING SINGLE-BUNDLE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION

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INTRODUCTION

Anterior cruciate ligament (ACL) and medial collateral ligament (MCL) are the most commonly injured ligaments in the knee, which serves as the primary medial stabilizer to anterior translation and valgus stress [1]. It is not uncommon for superficial medial collateral ligament (sMCL) damage to occur with ACL injury. While conservative treatment of the MCL injury is often done, in cases of severe injury, reconstruction of the sMCL can be done in addition to the ACL reconstruction. There are two MCL reconstructions (parallel and tri-vector) in clinic. But we don’t know which technique can better restore the biomechanics of the intact knee. The objective of the study was to compare knee biomechanics of two sMCL reconstructions combined with single-bundle ACL reconstruction using a porcine model.

METHODS

Twenty (n=20) fresh frozen unpaired adult pig knees were used for biomechanical testing. Specimens with a congenital abnormality or arthritis were excluded from the study and the existence of an intact ACL was confirmed arthroscopically. All specimens were frozen at -20°C, and thawed the night before testing at room temperature. The knees were kept intact and the specimens were kept moist with physiologic saline solution. The tibia and femur were sectioned ~15 cm from the joint line and the ends of femur and tibia were potted in heavyweight epoxy putty.

The specimens were divided into two groups, tested with the robotic testing system (CASPAR Orto MAQUET, Germany) under (1) an 89-N anterior tibial (AT) load at 30° (porcine full extension), 60°, and 90° of knee flexion, (2) 4-Nm internal and external tibial torques at 30° and 60°, and (3) a 7-Nm valgus torque at 30° and 60° of knee flexion [2, 3]. The groups were divided into either parallel or tri-vector group sMCL reconstruction and both groups had single bundle ACL reconstructions. The ACL reconstructions were performed with a 7 mm graft which was fixed with 60 N at 30° of flexion. The sMCL reconstructions were performed with 6 mm grafts and fixed with 44 N at 30° of flexion. The ACL reconstructions were done arthroscopically in an anatomic fashion with hamstring grafts and graft fixation was done with a screw and washer on the tibia and an extra-cortical button on the femur.

Differences in anterior tibial translation (ATT) displacement, internal / external rotation angles, and in situ forces at the different flexion angles were analyzed using one-way ANOVA with repeated measures, and statistical significance was set at p < 0.05.
RESULTS AND DISCUSSION

With ACL MCL co-injuries, ACL reconstruction alone can’t restored ATT, valgus, internal or external rotation result. With ACL and two different sMCL reconstructions, no significant differences were found between two groups for ATT at 30° flexion, and both method restored intact knee biomechanics. At 60° and 90° of flexion, MCL tri-vector reconstruction can restore the ATT, while parallel MCL reconstruction cannot improve the ATT (Fig.1a). Under valgus loading, ACL reconstruction alone did not restore intact knee stability, the parallel sMCL reconstruction did restore stability while the tri-vector method did not (Fig.1b). Under the external tibial torque, parallel sMCL reconstruction does restore external rotation while tri-vector sMCL reconstruction does not restore (Fig. 1c). Under the internal tibial torque, both sMCL reconstruction techniques restored intact knee internal rotation (Fig. 1d).

REFERENCES

Primary reconstruction of ACL and PMC of the knee

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Background: Combined injury of ACL (anterior cruciate ligament) and PMC (posteromedial corner) is common in acute sports injury. It is in consensus that ACL need primary reconstruction, but the treatment of acute PMC injury is controversial. Controversy lies mainly in dealing with 3 degree injury. Some advocated conservative treatment, some advocated suture repair, but reconstruction was rarely advocated. Author found that some patients had seriously damaged PMC fibrous structure. Conservative treatment can't restore ligament tension, and seriously damaged fibre could not return to normal structure by suture repair. For this kind of the special cases, primary reconstruction of PMC was necessary. ACL and PMC was primarily reconstructed, and had obtained good clinical results.

Materials: From September 2005 to June 2013, 35 cases of acute ACL and PMC injury got primary reconstruction. There were 20 male and 15 female cases. 35 cases had obvious anterior, valgus and rotational instability. The MRI revealed anterior cruciate ligament injury, medial collateral ligament injury and PMC injury. Preoperative Lysholm score was 26.3±6.6 (16~72), IKDC was 28.3±8.7 (18~63).

Methods: Two allograft tibialis anterior tendons was used, one for ACL reconstruction, the other for PMC reconstruction, including sMCL (superficial medial collateral ligament) and POL (posterior oblique ligament). Single bundle for ACL reconstruction was used, with RigidFix for femoral fixation, and Intrafix for tibial fixation. sMCL and POL had a common insertion in a tunnel on medial epicondyle, and two separate insertion in two tibial tunnels. Interference screws were used for ligament fixation. Clinical evaluation includes symptoms and physical signs, Lysholm and IKDC scores.

Results: ALL cases got successful operation, no infection or ligament failure was found. All patients received follow-up for 24~84 months (average 48 months). All of the knee had regained anterior, lateral and rotational stability. Valgus test in 0° and 30° flexion was negative, and Slocum test was negative. Anterior drawer test and Lachman test was negative or positive of 1 degree. 21 cases (60%) returned to sports as the preoperative level, 14 cases (40%) returned to sports a bit lower than the preoperative level. Terminal Lysholm score was 89.4±5.1 (82~93), and IKDC was 87.2±7.2 (80~94) (P < 0.05).

Discussion: It is in consensus that ACL need primary reconstruction, but the treatment of acute PMC injury is controversial. In clinical practice, The author strictly follow the indications for reconstructive surgery. ① Preoperative MRI showed completely torn of the medial structure with scattered fibre. ② Under arthroscopy, the medial gap widened significantly with positive dive through sign. The positive dive through sign did not disappear after ACL reconstruction. ③ While opening, the medial structure was completely torn, unable to repair with suture. These particular cases need primary reconstruction to restore stability and normal function of the knee.

Conclusion: Primary reconstruction of ACL and PMC of the knee for acute sports injury can restore the knee stability. And the reconstructed PMC can protect the reconstructed ACL. It is safe and effective to reconstruct ACL and PMC with allograft tibialis anterior tendon.