

Discussion: The results from this study suggest that the current optoelectronic motion analysis system is able to detect kinematic differences between the ACL-deficient knee and healthy knees. A tibial internal rotation pattern was identified in ACL-deficient knees during stair descent. This finding was in line with a previous kinematic study that reported similar kinematic outcome [3]. However, we did not find reduced extension and increased knee varus in ACL-deficient knees as reported in the same study. This discrepancy may be due to subject heterogeneity of the current study as subjects with meniscal injuries were included. Furthermore, no limit was imposed on duration between injury and assessment during subject recruitment. Several of our subjects had injury to assessment duration of over one year, which may have provided ample time to cope well enough with the injury during the performance of low demand tasks. Stair descent is considered a less strenuous biomechanical task as compared to other conventional tests such as the single leg hop. This task was selected as it is appropriate for patients who refuse or who are unable to perform the single leg hop due to apprehension or fear. Hence, kinematic difference may not be as pronounced. Nonetheless, our results show that stair descent may be sufficient when comparing ACL-deficient knees with uninjured knees.

Conclusion: The current study suggests that altered knee kinematics in ACL-deficiency can be observed by using the Opti-Knee® during stair descent. Although other motion tasks may elicit more observable changes in kinematics, stair descent is sufficient and appropriate for those who are unable to perform more challenging tasks. The system is portable and easy to use, making it appropriate for use in the clinical setting compared to conventional motion analysis systems.

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B00194

Quantitative evaluation of three-dimensional dynamic knee laxity with isolated anteromedial- or posterolateral-bundle anterior cruciate ligament deficient knees

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Background: Anterior cruciate ligament (ACL) consists of the anteromedial bundle (AMB) and posterolateral bundle (PLB). The purpose of this study was to clarify how these bundles contribute to the knee joint stability during the Lachman test and the pivot shift test.

Materials & Methods: Twelve fresh-frozen hemi-pelvis lower limbs (6 paired) were used. Each bundle was determined arthroscopically and the AMB or PLB was cut first and subsequently the remained bundle was cut. The Lachman test and the pivot-shift test were performed under the following conditions: (1) ACL-intact (n=12), (2) AMB-cut/PLB-intact (n=6), (3) PLB-cut/AMB-intact (n=6), and (4) ACL-deficient (n=12). Each knee went through the conditions, either (1)-(2)-(4) or (1)-(3)-(4). The anterior tibial translation (TT) during the Lachman test and the acceleration of posterior tibial translation during the pivot-shift test (APT) were measured using an electromagnetic measurement system.

Results: The mean TT during the Lachman test in the ACL-deficient condition was significantly larger than those in other three conditions. No significant differences were observed among the conditions, (1), (2) and (3). The mean APT in the ACL-deficient condition was significantly larger than those in other three conditions. In addition, the mean APT was significantly increased in the PLB-cut (only AMB intact) condition compared with the ACL-intact group, whereas, no significant difference was observed between the AMB-cut (PLB intact) condition and the ACL-intact condition.

Discussion & Conclusions: These results suggested that both AMB and PLB contribute to the control of TT and PLB may play a more dominant role in the control of the pivot-shift phenomenon than AMB.

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B0208

Characteristics and clinical outcomes of the patients with articular side and bursal side rotator cuff tears

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Background: The partial thickness tears of rotator cuff divided into bursal side tears and articular side tears. However, the differences between articular side tears and bursal side tears have not yet been revealed sufficiently. The purpose of this study was to analyze characteristics and clinical outcomes of the patients with articular side tears and bursal side tears.

Method: 114 patients with articular side and bursal side cuff tears treated by arthroscopic rotator repair were the subjects of this study. There were 70 females and 44 males whose average age was 58.4 years. 30 patients had history of trauma. The average duration of disorder was 35.5 weeks. 17

patients were diagnosed as diabetes. On types of the tears, articular side tear was observed in 60 patients (AST group) and bursal side tear in 54 patients (BST group). Stiff shoulder (passive flexion range of motion < 90 degrees) was observed in 37 patients. Capsular release was performed to the patients with stiff shoulder. The clinical outcomes were evaluated on the basis of the UCLA shoulder score between AST group and BST group. Factors compared between AST group and BST group were as follows: gender and age of the patients, preoperative history of trauma, duration of disorder, diabetes, smoking, stiffness and LHB lesion. All data were evaluated statistically by t-test and chi-square test and the significance level was set at less than 0.05.

Results: The average UCLA shoulder score of each group improved significantly postoperatively. There was no significant difference in postoperative UCLA score between two groups. The rate of the patient with history of trauma in AST group was significantly higher than that in BST group. The rate of the patient with stiff shoulder in AST group was significantly higher than that in BST group. The other factors such as gender, age, duration of disorder diabetes and smoking were not significantly different between two groups.

Conclusion: This study suggests that atraumatic history contributes to bursal side tears. The rate of stiff shoulder is more frequently observed in the patients with articular side tears. However, the patients with articular side tears can get satisfactory outcomes as well as the patients with bursal side tears to add correct procedures such as capsular release with rotator cuff repair.

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B0213

Use of estradiol promotes tendon bone healing in rabbit model underwent anterior cruciate ligament reconstruction

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Background: Anterior cruciate ligament (ACL) injury is a common injury of articular ligament with an incidence rate of 91 per 100,000 individuals, among which ACL reconstruction surgery is recommended for most of the patients hoping for a complete healing and heading back to the sports activity. Apart from autograft and allograft ligament, artificial ligament, considered as a promising graft in ACL surgery, is used in more than 10% ACL reconstruction surgery. Enhancement strategy in Polyethylene terephthalate (PET) artificial ligament graft ligamentization is a hot issue in sports medicine research. Estradiol has been used in osteoporosis treatment and shows its potency in bone formation. Given the research results previously, we hypothesized that use of estradiol may improve tendon bone healing in ACL reconstruction course.

Material and method: In an in vitro study, MC3T3-E1 murine preosteoblast cell line is cultured with estradiol in gradient concentration and a contrast group without estradiol is cultured as well. Cell morphology, cell proliferation rate, cell bioactivity and ossification capacity, along with BMP-2, OPN, and OPG protein which are related with bone formation are gauged at different time point during cell culture. In an in vivo study, we perform ACL reconstruction with PET artificial ligament fabricated with LARS artificial ligament remnant in 24 New Zealand rabbits. Rabbits in experimental group take subcutaneous injection of estradiol every 3 day after surgery, while the control group take equivalent normal saline at the same time. Animals are scanned with X-ray computed tomography 2 weeks, 4weeks, 8 weeks and 12 weeks after surgery to evaluate bone tunnel aperture. Phlebotomization and centrifugation are performed every week to test serum estradiol concentration level continuously. We sacrificed one third of the rabbit at 4weeks, 8 weeks and 12 weeks separately for further study, including Micro-CT testing for bone density around bone tunnel, biomechanical tests focusing on ultimate failure load and stiffness, histology study with use of hematoxylin and eosin stain or Masson's trichrome stain.

Results: In the in vitro study, the experimental group cultured with estradiol is superior to the control group in cell morphologic and proliferation test, cell bioactivity, ossification capacity. Western blot and Realtime-PCR revealed rises in BMP-2, OPN and OPG in estradiol group compared with that of control group. The trend is consistent with the increase concentration of the estradiol in cell culture. In the in vivo study, serum estradiol concentration goes up over time in estradiol group while the control group results stay still. Bone tunnel diameter shrinking and Hounsfield Unit up going are observed group over time in experimental and control group via CT scan. The former group results excel the latter one at 8 weeks and 12 weeks with statistical significance (P<0.05). The estradiol group species present higher ultimate failure load and stiffness in biomechanical testing. Micro-CT scanning at different timing shows increase in bone density in estradiol group which cannot be matched in that of control group. HE and Masson staining demonstrate the scar tissue thickness is smaller in the estradiol group compared with control group in 8 weeks and 12 weeks. Moreover, new bone tissue formation can be found in the estradiol group via Masson staining, reflecting bone formation in the interface.

Discussion: the results verify our hypothesis previously that the use of estrogen may promote tendon bone healing in anterior cruciate ligament reconstruction. As expected, Estrogen shows its ossification ability in vitro, inducing bone formation associated protein up regulation as detected in Western blot and Realtime PCR. In the in vivo study, the CT scan every 4 weeks combined with Micro-CT shows an upward trend in bone density and a downward trend in bone tunnel diameter and HU value as time goes by. The trend is more distinct in estradiol group than control group, indicating estradiol may promote bone formation in tendon healing period after ACL reconstruction. Biomechanical and stain results also support our hypothesis as shown in the results part. Uses of estrogen in bone formation research have been reported before, but its use in tendon to bone interference healing research lacks reports. Our job takes an intra-articular animal model instead of extra-articular ACL model to better mimic the ACL injury and surgery condition. Admittedly, the rise in serum estradiol concentration in estradiol group suggests that subcutaneous injection may lead to side effect in experimental animal to some extent, we believe that a new drug loading carrier that enables drugs like estradiol to be released at the certain location under control for a long time will be helpful in our further research.

Conclusion: use of estradiol improves ossification capacity in vitro and promote tendon to bone healing after anterior cruciate ligament reconstruction in vivo.

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B0218

Percutaneous repair of Achilles tendon rupture under ultrasound surveillance as effective method of treatment in patients with other diseases

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Background: Open repair of torn Achilles tendon is a standard procedure, however complications may occur due to extensive approach, especially in older patients with general conditions. Different systems for minimally invasive procedures were also introduced but the risk of damaging sural nerve was pointed out.

Aims: We developed percutaneous repair of Achilles tendon rupture under ultrasound surveillance and assessed safety and results of the procedure.

Methods: Since May 2011 until September 2015 we performed 14 procedures. The tendons were repaired with Ethibond suture loop passed through the tendon below and above rupture through the skin with elastic needle under direct ultrasound visualization.

We analyzed results of patients with minimally 3 months follow up. Some of patients were also burden with diabetes, cardiac diseases, psychiatric disorders and thrombocytopenia. We qualified for treatment only acute ruptures (up to 10 days), with relative contraindications for open procedures.

Results: We assessed function of repaired tendon in clinical examination and ultrasound exam 6 weeks and three months after surgery. Also AOFAS score was used.

13 of 14 patients healed tendon and returned to their activities. In one case conversion to open surgery was necessary as patient experienced another trauma in postoperative period. Another patient reported persisting pain due to suture conflict with soft tissues. Release of the suture was necessary six months after surgery. There was no sural nerve entrapment nor skin healing problems. AOFAS score raised from 57,8 to 92,8 three months after surgery.

Conclusions: Percutaneous repair of Achilles tendon rupture under ultrasound surveillance is minimally invasive and effective method of treatment of acute ruptures. It is safe and allows to avoid both sural nerve entrapment and skin healing problems. However, it requires some experience with ultrasound diagnostics.

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B0220

Open wedge high tibial osteotomy using three-dimensional printing model: Experimental analysis using porcine bone

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The purpose of this study was to evaluate the usefulness of a three-dimensional (3D) printing model for open wedge high tibial osteotomy (HTO) in patients with medial knee osteoarthritis. Computed tomography (CT) images were obtained from 10 extended porcine knees and 3D imaging was planned using the 3D-Slicer program. The osteotomy line was drawn from the predicted medial osteotomy site (approximately 3 cm below the medial tibial plateau) to the hinge point, the proximal end of the fibular head. After the osteotomy, the osteotomy gap was opened until the mechanical axis line connecting the hip and ankle joint centers was 62.5% from the medial border along the longest medial-to-lateral width of the tibial plateau maintaining the posterior tibial slope angle. The wedge-shaped 3D printing model was designed with the measured angle and osteotomy section and was produced by the 3D printer. The open wedge HTO surgery was reproduced in porcine bone using the 3D printing model and the osteotomy site was fixed with a plate. Accuracy of osteotomy and posterior tibial slope was evaluated after the osteotomy. The mean mechanical axis line on the tibial plateau was $61.8 \pm 1.5\%$ from the medial tibia. There was no statistically significant difference ($p = 0.160$). The planned and post-osteotomy correction wedge angles were $11.5 \pm 3.2^\circ$ and $11.4 \pm 3.3^\circ$, and the posterior tibial slope angle was $11.2 \pm 2.2^\circ$ pre-osteotomy and $11.4 \pm 2.5^\circ$ post-osteotomy. There were no statistically significant differences ($p = 0.854$ and $p = 0.429$, respectively). This study could obtain good results of high tibial osteotomy using 3D printing model in porcine legs. Therefore, this method can be applied later to open wedge high tibial osteotomy clinically in human.

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B0228

Chondral lesions with medial meniscal posterior root tear are located more medially and more progressive than those with other meniscal tears

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Introduction: Medial meniscal posterior root tear (MMPRT) is associated with development or worsening of medial tibiofemoral cartilage damage. The purpose of this study is to demonstrate the characteristics of chondral lesion on the medial femoral condyle (MFC) in patients with MMPRT.

Materials and Methods: Fifteen patients who underwent arthroscopic repair of MMPRT from August 2014 to July 2015 were included. Chondral lesions of the medial femoral condyle on preoperative MRI and arthroscopic finding were recorded according to ICRS - articular cartilage injury classification and mapping system. The incidence of grade 3 or above chondral lesion on each compartment was compared between the findings on MRI and arthroscopy. And the incidence of grade 2 or above chondral lesion and the location of first lesion (most severely injured) on arthroscopic findings were compared between the MMPRT group and the patients group who underwent arthroscopic surgery for degenerative medial meniscus posterior horn (MMPH) tear other than MMPRT during the same period as the control.

Results: Arthroscopic findings of 13 patients (86.7%) exhibited grade 3 or above chondral lesion on the MFC, whereas it is exhibited on only 8 preoperative MRI (53.3%). The incidence of chondral lesion in central-medial compartment showed significant difference between the findings on MRI and arthroscopy (26.7% vs 66.7% , $p < 0.05$), and the difference between MRI and arthroscopy is significantly correlated with the day from the taking MRI to the surgery (Pearson's correlation coefficient = 0.659 , $p = 0.008$). All 15 patients with the MMPRT had the ICRS grade ≥ 2 chondral injuries at medial compartment, whereas only 23 of 69 patients (33.3%) in control group had the grade ≥ 2 injuries. In MMPRT group, central-medial compartment is most frequently affected ($N=17$, 73.3%), whereas central-central compartment is major affected site in control group ($N=13$, 56.5%). This injury pattern showed statistically significant difference between two groups ($p=0.004$).

Conclusion: Chondral lesions on MFC developed in patients with MMPRT are located more medially than those in patients with degenerative MMPH tear other than root tear, and these lesions are more likely to develop with the time. Early intervention should be considered in patients who exhibiting MMPRT, to prevent the development of these lesions.

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B0236

Relationship between tunnel malposition and intra-articular degeneration in anterior cruciate ligament reconstruction

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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.

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B0237

Relationship between humeral torsion and career of pitcher in elementary and junior-high schools

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Background: Repetitive throwing motion generates tremendous stress on the dominant shoulder in baseball players, resulting in osseous change in the shoulder joint, especially increased humeral retroversion. Here we hypothesized that the career of a pitcher in elementary and junior-high