The length and width of each ACL bundle were measured on digital MRI using Stentor, Philips Medical System. Measurements were performed on sagittal and coronal images through the ACL and were independently measured in blinded fashion by 2 observers. In the sagittal plane, the AM bundle was defined as the oblique fibers inserting at the anterior border of the ACL on the tibia and the proximal aspect of the lateral femoral condyle attachment. The PL bundle was defined as the oblique fibers inserting posteriorly on the tibial insertion, and inferiorly on the lateral femoral condyle. In the coronal plane, the AM bundle was defined as the central of the two bundles; where as the PL bundle was defined as the lateral of the two bundles, from its insertion on the tibia to its origin in the intercondylar notch.

Results: The average age of patients included was 33.5 years (range: 15-61) There were 20 females and 30 males. Both the AM and PL bundles were visualized for all 50 patients. In the sagittal plane MRIs, the AM bundle was an average of 36.9 mm ± 2.8mm in length, and 5.1 mm ± 0.7mm in width. The PL bundle, by contrast, was an average of 20.5mm ± 2.4mm in length, and 4.4 ± 0.8mm in width. In the coronal plane, the width of the AM bundle was 4.2 ± 0.8mm and the PL bundle 3.7 ± 0.8mm. The inter-observer reliability for length of the ACL in the sagittal plane was .849 with a 95% CI of .748 to .911 for the AM bundle, and .748 with a 95% CI of .597 to .849 for the PL bundle.

Conclusion: This is the first study that quantifies the two anatomic bundles of the ACL based on MRI. Digital MRI allows for a high degree of accuracy. Providing precise measurement of the AM and PL bundles of the ACL on MRI allows for an accurate determination of damage to one or both of the bundles following injury.

Tunnel Positioning of AM and PL Bundle in Anatomic ACL Reconstruction (SS-10). *Thore Zantop, MD, Wolf Petersen, MD, Freddie Fu, MD*

Summary: The centre of the femoral PL bundle is shallow and inferior to the AM bundle. To reproduce the anatomy, it is mandatory to place the tunnels exactly within the femoral origin and tibial insertion of the ACL.

Purpose: Aim of the current study was to provide anatomical details of AM and PL bundle of the ACL giving guideline for tunnel positioning in anatomical ACL reconstructions.

Methods: A total of 20 human cadaveric knees (range 45-87 years) were dissected and the the medial femoral condyle cut to expose the ACL. The bundles were separated due to their tensioning pattern and the distances of the centre of AM and PL bundle to the articular cartilage were measured. Radiographic analyses were performed using the techniques of Bernard and Hertel and Harner at the femur as well as the method by Harner and Stäubli and Rauschning at the tibia.

Results: The center of the PL bundle was more shallow and inferior when compared to the center of the AM bundle with a distance of 6.5 mm and a mean of 5.8 mm to the shallow and inferior cartilage margin, respectively. On the tibia, the center of the AM bundle is aligned with the anterior horn of the lateral meniscus. According to Bernard and Hertel the center of the AM bundle is at 18.5% and 22.3% and the PL bundle at 29.3% and 53.6%. At the tibia, the centre of the AM bundle is at 30% and the PL bundle is located at 44% according to Stäubli and Rauschning.

Conclusions: The centre of the femoral PL bundle is shallow and inferior to the AM bundle. To reproduce the anatomy, it is mandatory to place the tunnels exactly within the femoral origin and tibial insertion of the ACL.

Double Bundle ACL Reconstruction Better Restores the Tibiofemoral Pressure and Contact (SS-11). *Yusuke Morimoto, MD, Mario Ferretti, MD, Rodrigo Kaz, MD, Patrick Smolinski, MD, Freddie Fu, MD*

Summary: In order to evaluate the tibiofemoral pressure and contact area after ACL reconstruction, ten knees from cadavers were tested under 1000 N axial load. The tibiofemoral pressure and contact area were marked in a pressure measuring film placed between tibia and femur. Double-Bundle (DB) ACL reconstruction demonstrated better restoration of the average and maximum tibiofemoral pressure as well as tibiofemoral contact area when compared to the Single-Bundle (SB) ACL reconstruction. These in vitro findings may suggest that DB ACL reconstruction better preserve the cartilage after an ACL reconstruction compared to the SB ACL reconstruction.

Purpose: The long-term clinical outcomes of ACL surgery show a large amount of patients with cartilage degenerative changes. Biomechanical studies have shown that Double-Bundle (DB) ACL reconstruction better restores the knee biomechanics when compared to the conventional Single-Bundle (SB) ACL reconstruction. However, it is unknown whether the tibiofemoral cartilage pressure and contact area is better restored after DB reconstruction when compared to SB reconstruction. The purpose of this study is to evaluate the tibiofemoral pressure and contact area after SB or DB ACL reconstruction.

Methods: 10 knees from cadavers were used for this study. Five knees were tested for DB and five for SB

ACL reconstruction. Pressure measuring film was inserted between tibia and femur, and subject to 1000N axial load using an uniaxial testing machine. The superlow film was used to assess the average and maximum tibiofemoral pressure, and the contact area at 0, 15, 30 and 45degrees. Three conditions were evaluated: 1) intact ACL(Int), 2)DB ACL reconstruction, and 3)SB ACL reconstruction. The pressure measuring films were scanned after the experiment and the images evaluated by specific software. Statistical analysis was performed using the Repeated Measures Anova. The level of significance was set a prior at $p<.05$.

Results: The average pressure in the lateral compartment of DB and SB groups at all flexion angles tested was not different from the intact ACL group. However, at 15 degrees SB had higher pressure than DB. The average pressure in the medial compartment at 15, 30, and 45 degrees showed no difference between groups. But, at 0 degrees DB had significant less pressure than SB. The maximum pressure in the lateral compartment at all flexion angles showed no difference between groups. The maximum pressure in the medial compartment showed no difference at 0, 30, and 45 degrees, but at 15 degrees DB restored close to normal the maximum pressure values while SB did not. Though no statistical differences were found in several circumstances regarding to average and maximum pressure, there was a trend to better restoration in the DB group compared to SB.

DB restored the contact area in the lateral compartment at 0, 15 degrees of flexion to values close to normal while SB did not. At 30 and 45 degrees neither DB nor SB restored the normal contact area in the lateral compartment. In the medial compartment at 0, 15, 30 degrees DB is significant better to SB and restore the contact area close to normal. At 45 degrees there was no difference between DB and SB compared to the normal.

Conclusions: We found that DB has superior restoration of the tibiofemoral pressure and contact area than SB reconstruction. It suggests in our experimental model that DB reconstruction may preserve better the cartilage after ACL reconstruction when compared to SB reconstruction. However, further clinical studies are needed to elucidate clinically this issue.

Computer-Assisted Evaluation of the Kinematics of the AM and PL Bundle and the Value of Parameters According to the IKDC Knee Ligament Examination Form (SS-12). *Hanno Steckel, MD, Patricia Murtha, MD, Ryan Costic, MD, James Moody, MD, Branislav Jaramaz, MD, Freddie Fu, MD*

Summary: The aim of this cadaveric study was to describe the kinematics in the ACL-Intact (ACL-I), PL bundle-Deficient (PL-D), and ACL-Deficient (ACL-D) knee by applying a protocol for computer-assisted evaluation of knee kinematics. Our study demonstrated a force distribution between the two bundles that changes with knee position. Current clinical knee laxity measurements may not be suited for detecting subtle changes (like PL deficiency) in the ACL anatomy, and therefore might fail to assess outcome differences in various ACL reconstruction techniques.

Purpose: The double bundle concept is an accepted model for describing both the anatomy and the tension patterns of the AM and PL bundles in the ACL. The aim of this cadaveric study was to describe the kinematics in the ACL-Intact (ACL-I), PL bundle-Deficient (PL-D), and ACL-Deficient (ACL-D) knee by applying a protocol for computer-assisted evaluation of knee kinematics.

Methods: An optical position measurement system was used to acquire knee joint motion ($n=10$) during clinical evaluations by tracking markers rigidly attached to the bones. The protocol included acquisition of AP translations and IE rotations, and evaluation of the IKDC knee ligament examination form.

Results: Comparison of the AP translation between PL-D and ACL-D states demonstrated an increase at 0°, 15° and 30°. Comparison of IE laxities did not show any significant change between ACL-I, PL-D and ACL-D. The instrumented and the manual Lachman test, the total AP translation at 25° and 70°, and the pivot shift test showed differences between the PL-D and ACL-D states.

Conclusions: Our study demonstrated a force distribution between the two bundles that changes with knee position. Current clinical knee laxity measurements may not be suited for detecting subtle changes (like PL deficiency) in the ACL anatomy, and therefore might fail to assess outcome differences in various ACL reconstruction techniques. An instrumented measurement of rotational laxity needs to be evaluated as a step towards a more precise kinematic test of knee stability not only in the native and torn ACL but also in the reconstructed knee.

Mid-Term Results of ACL-Rupture Treatment with the "Healing Response" Procedure (SS-13). *Holger Grehn, MD, Martin Reese, MD*

Purpose: Retrospective evaluation of the minimal invasive, "Healing response" procedure in the treatment of a ACL-rupture in relatively young patients.

Method: We treated 22 patients with a mean age of 32,5 years (16-45 years) after a proximal ACL-rupture