

## KNEE CARTILAGE AND QUADRICEPS MUSCLE LOSS AFTER POSTERIOR CRUCIAL LIGAMENT (PCL) INJURY

**S. Cotofana**<sup>1</sup>, H. Boeth<sup>2</sup>, W. Wirth<sup>1</sup>, G. Diederichs<sup>3</sup>, M. Hudelmaier<sup>1</sup>, G. Duda<sup>2</sup>, F. Eckstein<sup>1</sup>, T. Jung<sup>4</sup>;  
<sup>1</sup>Paracelsus Med. Univ., Salzburg, AUSTRIA, <sup>2</sup>Julius Wolff Inst., Charité – Univ.smedizin Berlin, Ctr. for Sports Sci. and Sports Med., Berlin, GERMANY, <sup>3</sup>Dept. of Radiology, Charité - Univ.smedizin, Berlin, GERMANY, <sup>4</sup>Dept. of Traumatology, Charité - Univ.smedizin, Berlin, GERMANY.

**Purpose:** Posterior cruciate ligament (PCL) rupture is a serious injury that is associated with joint instability, structural changes in articular tissues, and with a markedly elevated risk of incident knee OA. Although the rate of knee cartilage and thigh muscle loss has been described for various stages of radiographic knee OA, and also after anterior cruciate ligament (ACL) injury, quantitative changes in cartilage and thigh muscle tissue after PCL rupture and reconstruction have not been previously reported. Detailed knowledge on such changes may be useful as a model of “early OA”, and in monitoring the success of therapeutic intervention by surgery, medication and/or physiotherapy.

**Methods:** 20 participants with PCL and other concomitant ligament injuries, and consecutive reconstructive surgery, were examined. Sagittal high-resolution MR images (3D VIBE) of the injured knee, and axial images (T1w SE) of both thighs were acquired between 4-15 (8.6±3.2) years after PCL surgery. 15 participants (12 men, 3 women; age 38.7 ±9.5 yrs.) also had a follow-up exam 407±61 days later, using the same MRI scanner and imaging sequence. Manual segmentation of the knee cartilages (medial and lateral tibia, medial and lateral weight-bearing femoral condyle, patella, and femoral trochlea), and of the quadriceps muscle, was performed using proprietary software. From these segmentations, the cartilage thickness was computed at baseline and follow-up, side differences in muscle anatomical cross sectional areas (ACSAs) at baseline, and the annualized longitudinal rate of change in the above measures.

**Results:** The femorotibial cartilage loss was -204µm (-2.6%) p.a. [95% CI: -301, -108µm] and that in the femoro-patellar joint -132µm (-2.9) p.a. [95% CI -194; -69]. The thickness changes were greater in the medial than in the lateral femorotibial plates, and greater in the patella than in the femoral trochlea (Table 1). At a subregional level, the greatest rates of femorotibial cartilage loss were observed in the internal subregions of the medial and lateral tibia (-132µm/-93µm respectively), and in the internal aspects of the medial and lateral femoral condyles (-82µm/-37µm). At baseline, limbs with PCL injury had -3.5±4.8cm<sup>2</sup> (-4.7±7.5%) lower quadriceps ACSAs than contra-lateral limbs, and the side differences showed a weak association with time after injury (r=-0.22 [95% CI -0.60;0.25]). No significant change in quadriceps ACSA was observed during the 1-year observation period, neither in PCL (p=0.81) nor in contralateral knees (p=0.45).

Cartilage Plate (Label)	Mean Change absolute	Mean Change %	95% CI lower bound	95% CI upper bound
Medial tibia (MT)	-69±76µm	-3.9%	-111	-27
Medial femur (cMF)	-70±60 µm	-3.6%	-103	-37
Lateral tibia (LT)	-32±85 µm	-1.5%	-79	+15
Lateral femur (cLF)	-33±36 µm	-1.7%	-53	-13
Patella (P)	-85±68 µm	-3.4%	-122	-47
Trochlea (Tr)	-47±62 µm	-2.2%	-81	-13

**Conclusions:** Large rates of annual knee cartilage loss were observed after PCL rupture and reconstruction. These rates were greatest in the medial femoro-tibial compartment (particularly in the internal subregions), and in the patella. The observed rates of change exceed those typically seen in knees with advanced knee osteoarthritis, i.e. knees with radiographic joint space narrowing (KLG3). They also markedly differ from cartilage thickness changes in (young) patients observed within 5 years of anterior cruciate ligament rupture (and repair), in whom cartilage thickening was reported. Quadriceps atrophy relative to the contra-lateral knee was seen at baseline, but no significant change was observed over time during the 1-year follow-up period. These findings indicate that muscle loss may occur at some point after PCL injury and/or reconstructive surgery, but may not represent a continued process. PCL rupture may be a particularly suitable as a model of “early OA”, because the

time point at which the pathogenetic process is initiated is precisely known. The model also has the advantage that relatively large rates of medial femorotibial and patellar cartilage loss are seen over relatively short periods of time, with the opportunity to test the of therapeutic intervention by preventive medication or other therapeutic measures in an efficient manner.

Category (Complete): Clinical Aspects / Outcomes

Keyword (Complete): Impact Injury ; Cartilage Morphology ; Muscle