Patterns of Knee Cartilage Thickness Loss after Posterior Crucial Ligament Injury

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INTRODUCTION

The magnitude and pattern of knee cartilage thickness change after posterior cruciate ligament (PCL) injury and reconstruction has not been previously reported. Detailed knowledge on such changes may, however, be potentially useful in monitoring the success of therapeutic intervention by surgery, medication, and/or physiotherapy.

Quantitative MR image analysis makes it possible to measure changes in knee cartilage thickness with high accuracy and precision in vivo [1-3], as a measure of post-traumatic structural progression.

OBJECTIVE

To evaluate the magnitude and pattern of longitudinal knee cartilage thickness change after PCL injury and reconstruction

MATERIALS

Participants: 20 participants with PCL injury and consecutive reconstructive surgery were studied at baseline, of which 12 (8 men, 4 women; age 37.0 ±10 yrs.) had an follow-up exam thus far

Study design: Baseline MR images were acquired between 3-38 months after PCL surgery, and 1-year later on the same scanner

Methodology: Manual segmentation of of the cartilage surfaces and subchondral bone area; computation of annual change in cartilage thickness in the femoro-tibial and femoro-patellar joint [2].

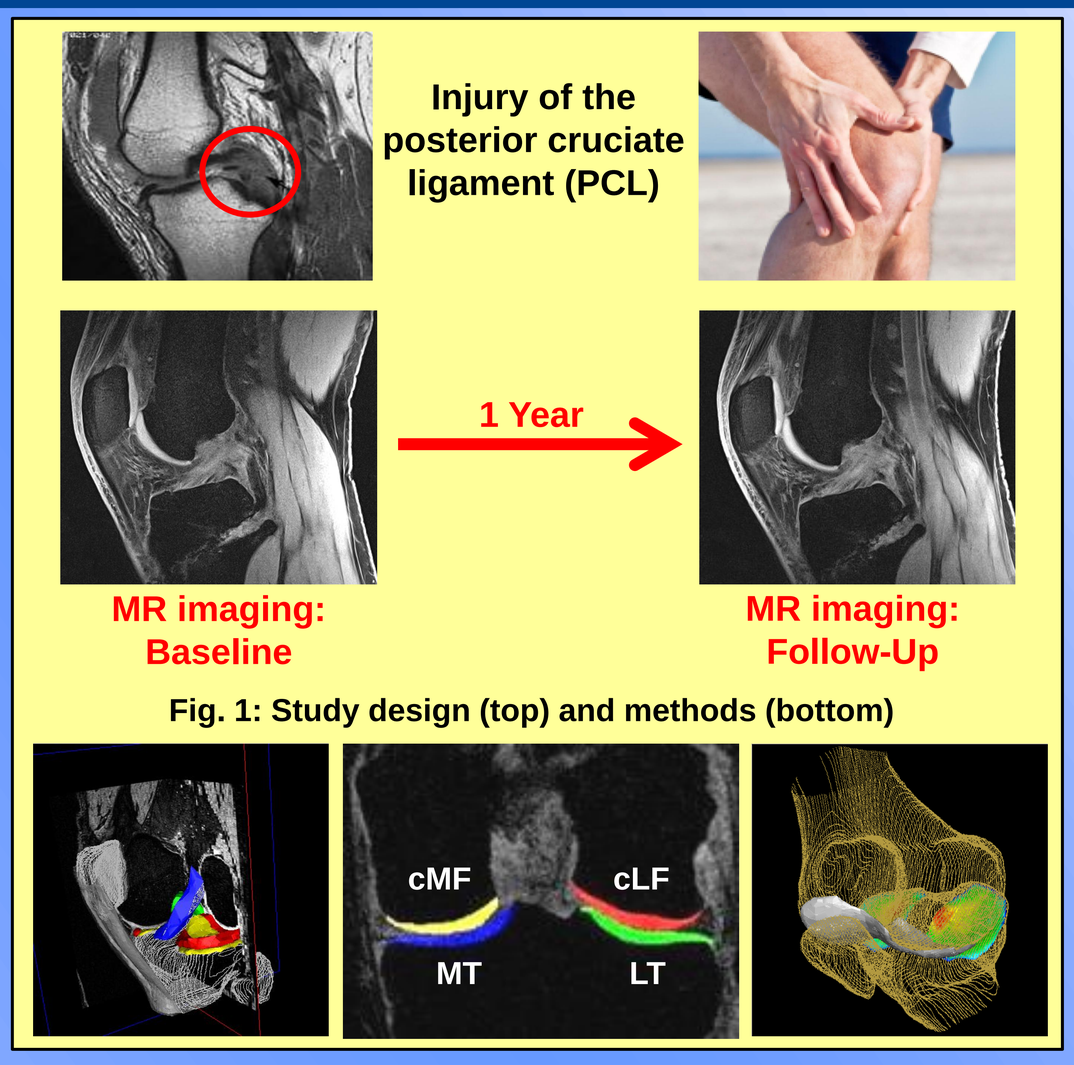

Fig. 1: Study design (top) and methods (bottom)

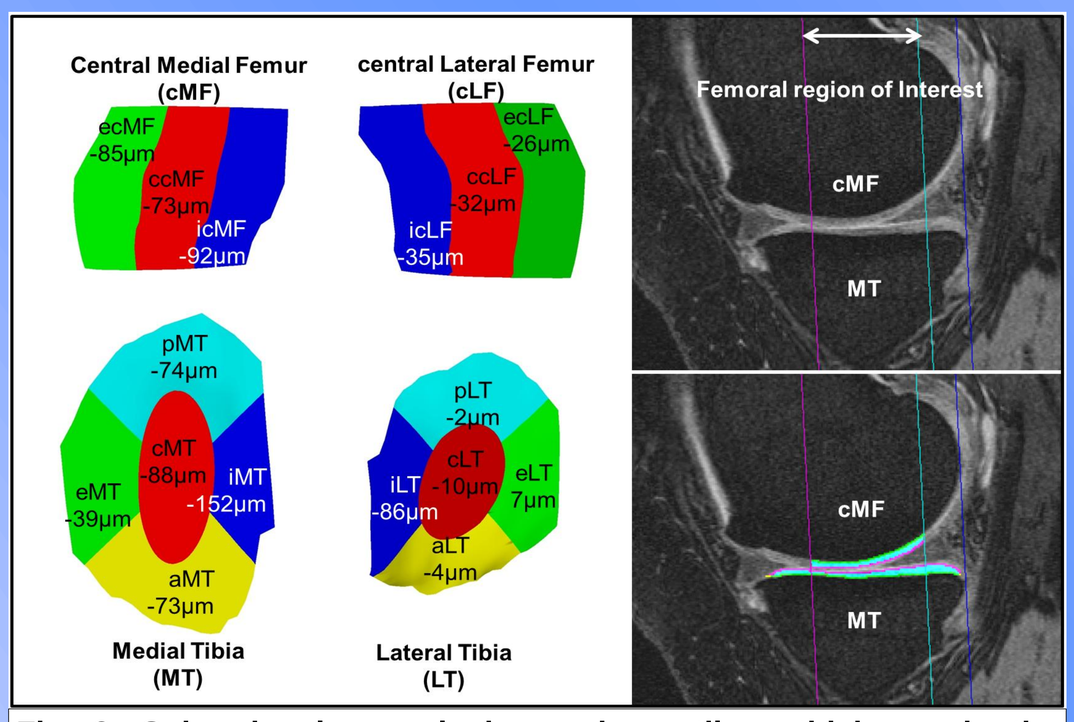

Fig. 2: Subregional annual change in cartilage thickness in the external (e), central (c), internal (i) medial and lateral central femur (cMF & cLF) and in the anterior (a), posterior (p), external (e), central (c), internal (i) medial and lateral tibia (MT & LT)

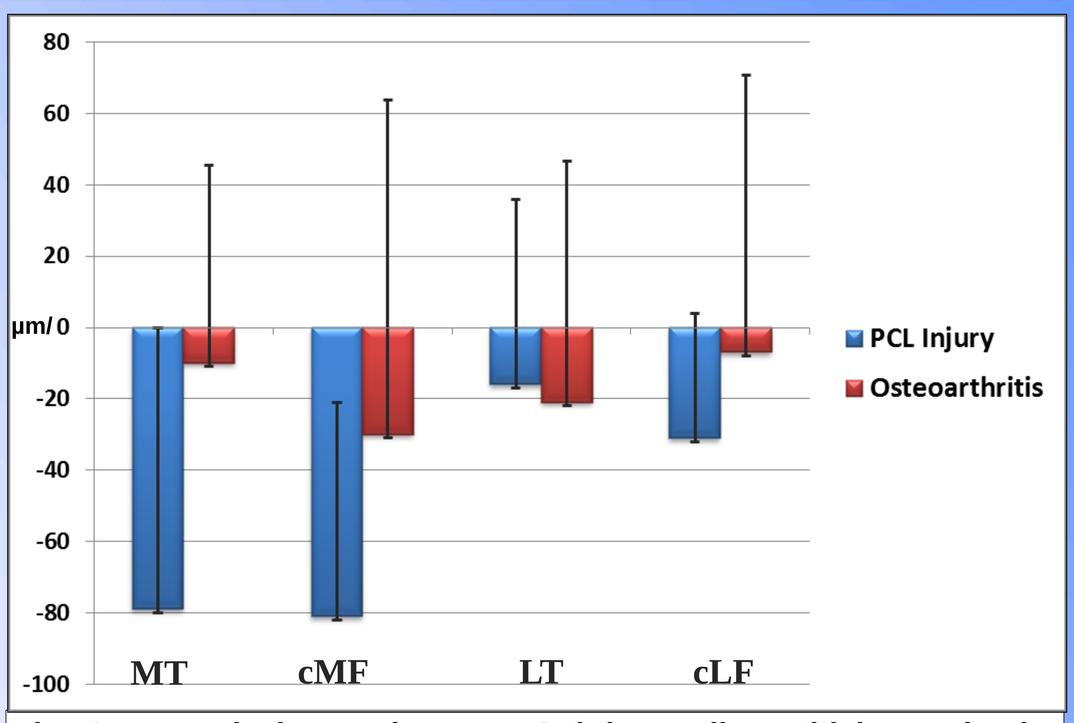

Fig. 3: Annual change (mean ± SD) in cartilage thickness in the medial and lateral tibia (MT & LT) and in the medial and lateral femur (cMF & cLF) in PCL injured knees (blue) and in knees with advanced (KLG3) knee osteoarthritis (red) [1]

RESULTS

- Cartilage thinning was observed in all femoro-tibial cartilage plates, the total joint (FTJ) changes amounting to -208µm [95% confidence interval -322; -95µm] :
- The changes were greater in the medial than in the lateral femorotibial cartilage plates (Fig. 3):

  Medial tibia (MT): -79µm [95%CI -129; -29]
  Medial femur (cMF): -81µm [95%CI -119;-43]
  Lateral tibia (LT) -16µm [95%CI -49; 16]
  Lateral femur (cLF): -31µm [95%CI -53;-9]
- Cartilage thinning was also observed in the femoro-patellar joint (FPJ: -102µm [95% CI -156; -48
- The cartilage thickness changes were greater in the patella than in the femoral trochlea:

  Patella (P): -76µm [95%CI -113; -39]
  Trochlea (Tr): -26µm [95%CI -50; -3]
- On a subregional level, the greatest rate in femorotibial cartilage thinning (Fig. 2) was observed in the

  internal MTl (iMT) -152µm [95%CI -237; -67]

CONCLUSION

The rates of cartilage thinning observed after PCL rupture and reconstruction were greatest in the medial femoro-tibial compartment and in the patella. They exceed those typically seen in knees with advanced knee osteoarthritis, i.e. knees with radiographic joint space narrowing (KLG3; Fig. 3) [1]. They also differ from the cartilage thickness changes in young patients with anterior cruciate ligament rupture (and repair), in whom cartilage thickening was observed after injury (unpublished data).

References

[1] Eckstein F. et al. Arthritis Care Res (Hoboken). 2011; 63(3):311-319

[2] Wirth W &Eckstein F. IEEE Transactions Medial Imaging 2008; 6:737-744.

[3] Eckstein F, Nevitt M., & Wirth W. Nat. Rev. Rheumatol 8: (10) 622-630

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