

LONGITUDINAL FEMOROTIBIAL CARTILAGE THICKNESS INCREASE IN YOUNG ADOLESCENT (VS. MATURE) ATHLETES

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Anterior or posterior cruciate ligament (ACL/PCL) ruptures are thought to lead to early knee osteoarthritis (KOA) and thus considered scientifically valuable “models” of pre-radiographic change. Further, longitudinal studies can be initiated at a precise set-point, which is at the time of the trauma. Quantitative measurement of cartilage thickness change with MRI provides a powerful and sensitive tool for longitudinal analysis of structural cartilage change before, during, and after the onset of radiographic KOA [1]. Because ACL/PCL ruptures frequently occur in young athletes, the purpose of this study was:

OBJECTIVES

- To obtain reference data of knee cartilage thickness change in young athletes, at the end of adolescence
- To test for potential differences in cartilage change between male and female athletes
- To contrast the observed changes with those of more mature athletes

METHODS

- 20 young top volleyball players of the Olympiastützpunkt Berlin & 20 former top volleyball players, who were former participants of the Olympiastützpunkt.
- One had to be excluded due to limited image quality, one because of missing follow-up data:
 - 9 young women: age 15-17 years
 - 9 young men: age 15-18 years
 - 10 mature women: age 34-64 years
 - 10 mature men: age 43-53 years
- Baseline and 2-year follow-up MR images were acquired using a 3 Tesla MRI scanner, and a sagittal 3D VIBE sequence with water excitation (1.5x0.31x0.31mm³; Fig. 1)
- Cartilage thickness and subchondral bone areas in the medial/lateral tibia (MT/LT) and medial/lateral femur (cMF/cLF) were computed after segmentation (Fig. 1), using proprietary software (Chondrometrics GmbH); including femorotibial subregions [2]
- Differences between men and women were evaluated using unpaired t-tests, without correction for multiplicity, given colinearity

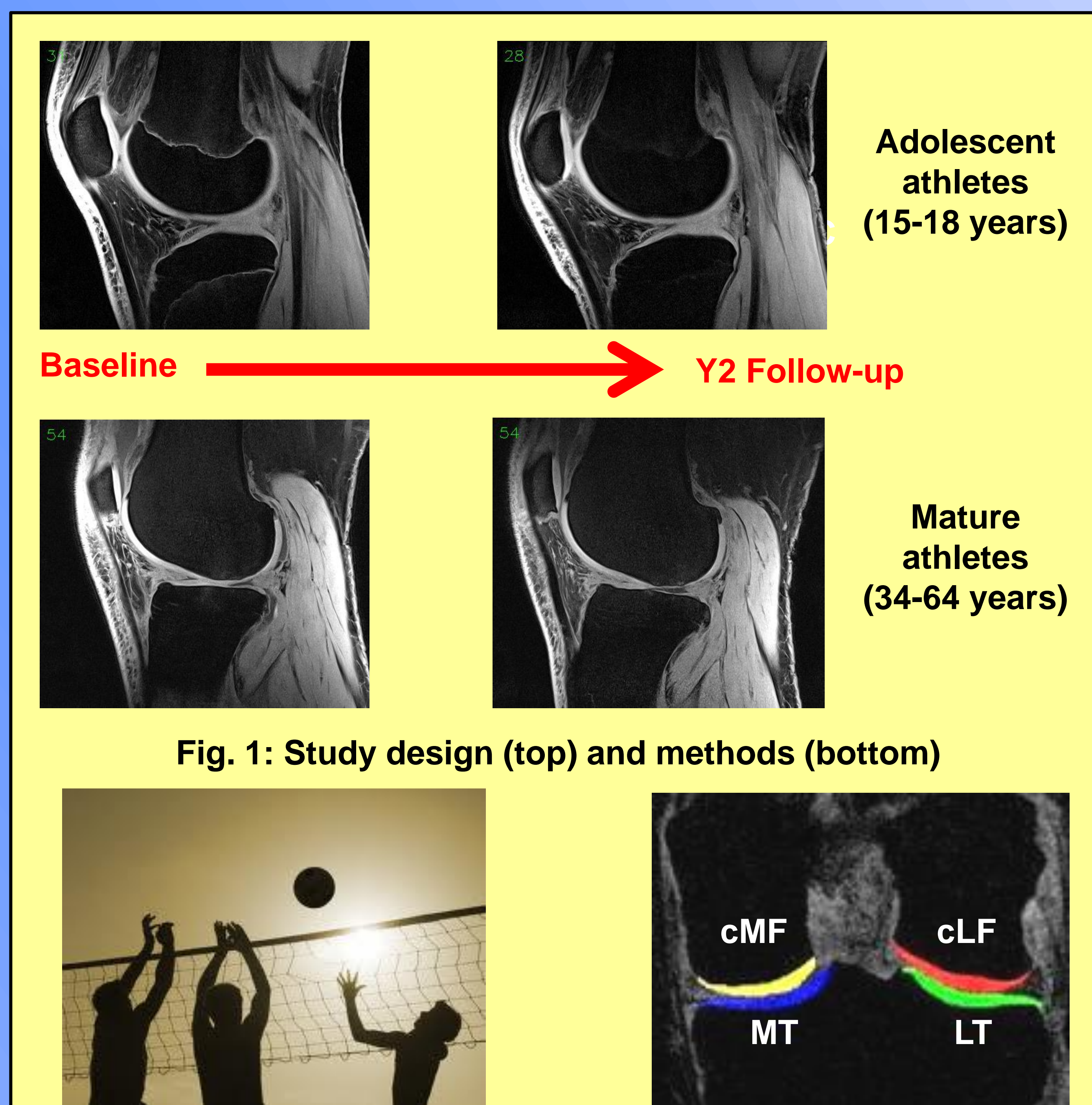


Fig. 1: Study design (top) and methods (bottom)

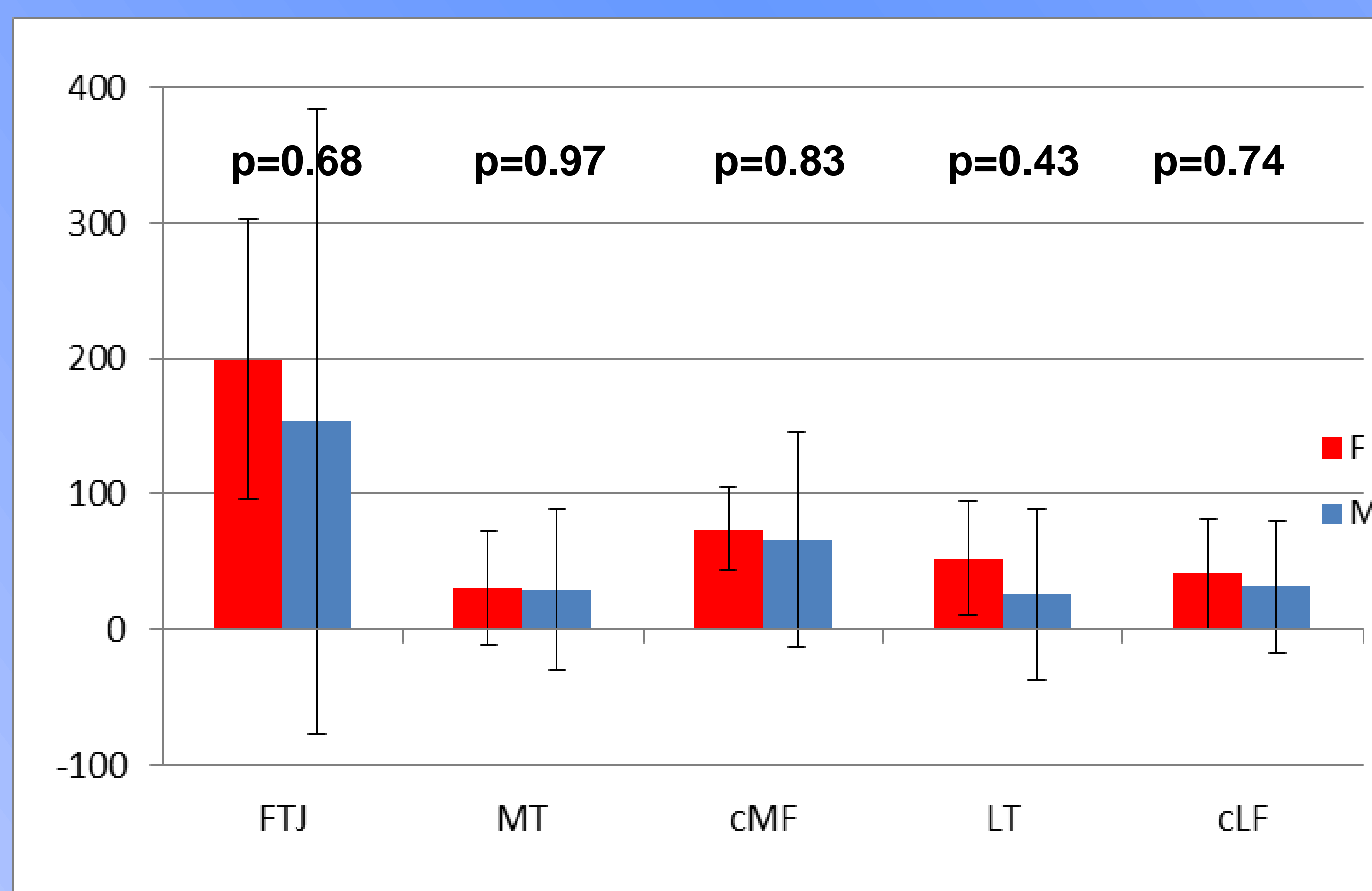


Fig. 2: Adolescent Volleyball Athletes: Bar Graph Showing the Mean Change ± SEM (µm) in Cartilage Thickness in Men and Women
FTJ = total femorotibial joint, MT = medial tibia, cMF = medial weight-bearing femur, MT = lateral tibia, cLF = lateral weight-bearing femur,

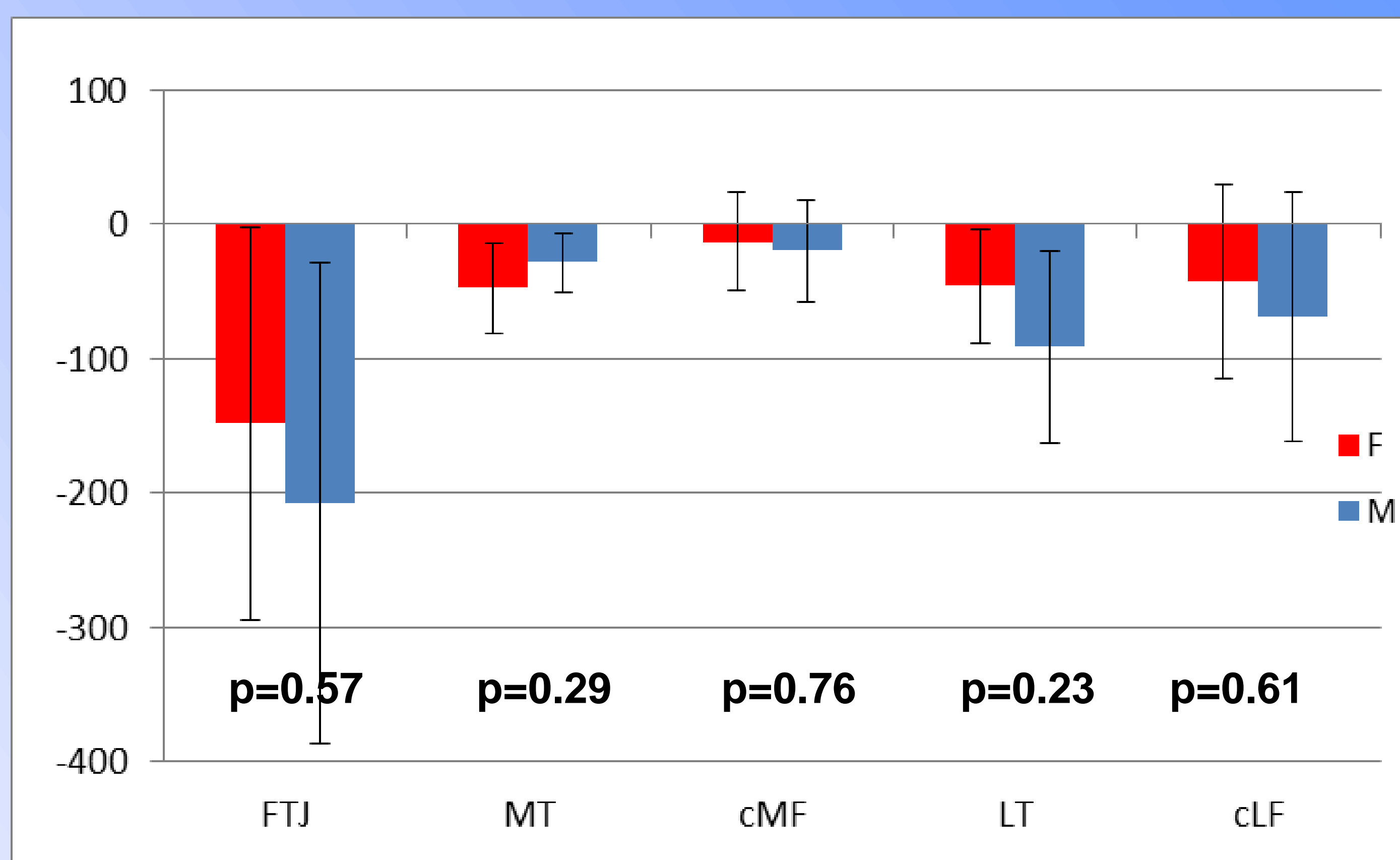


Fig. 3: Mature Volleyball Athletes: Bar Graph Showing the the Mean Change ± SEM (µm) in Cartilage Thickness in Men and Women
FTJ = total femorotibial joint, MT = medial tibia, cMF = medial weight-bearing femur, MT = lateral tibia, cLF = lateral weight-bearing femur,

RESULTS

- The majority of young athletes still showed open tibial and femoral epiphyses at baseline, and closed ones at follow-up (Fig. 1)
- The increase in total femorotibial (FTJ) cartilage thickness in young athletes was +176 µm (95% confidence interval [CI] +64; +289µm), or +2.2% (95% CI: +0.8; +3.7%)
- This increase was +1.8% (-0.9; +4.6%) in boys and +2.8% (+1.4;+4.3%) in girls, with no significant difference between sexes (Fig. 2).
- The increase in femorotibial subchondral bone area was +0.8% in boys (-0.2; +1.7%) and +1.4% (+0.4; +2.3%) in girls.
- The cartilage thickness increase was greatest (>4%) in the medial femur (Fig. 2), particularly in the internal medial femur (>5%), whereas no increase was seen in the medial tibia.
- In contrast, substantial femorotibial cartilage thinning was observed in mature former athletes: -2.1% in women, and -2.4% in men (FTJ; Fig. 3). Cartilage thinning was greatest in the (central and internal) lateral tibia (-4.0% in men, -2.3% in women) and did not differ significantly between both sexes (Fig. 3).

CONCLUSIONS

- ✓ A substantial increase in cartilage thickness and subchondral area was observed in young athletes towards the end of adolescence.
- ✓ This increase should be considered when measuring longitudinal cartilage change in young subjects after ACL/PCL rupture, and a healthy reference cohort of the same age/sex should be included for comparison.
- ✓ Mature former athletes, in contrast, showed rates of lateral cartilage loss that were greater than in patients with knee osteoarthritis [1,3], and greater than those reported in healthy non-osteoarthritis subjects of that age [3].

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