

LONGITUDINAL CHANGE IN KNEE CARTILAGE THICKNESS AND SUBCHONDRAL BONE AREA IN ADOLESCENT (AND MATURE) ATHLETES

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Only few studies have thus far studied cartilage thickness in children and adolescents and focused on cartilage “volume” [1,2]. It is hence unclear, whether knee joint cartilage thickens during growth, whether such thickness changes differ between girls and boys, whether they are associated with growth of the subchondral bone area, and to what extent such changes may depend on exercise (i.e. the biomechanical environment, or “loading history” [3]).

OBJECTIVES

- To analyze 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 explore the individual association of thickness change with the growth of the subchondral bone areas
- 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 participants of the Olympiastützpunkt several years ago,
- One had to be excluded due to limited image quality, one because of missing follow-up data, and hence data were available for:
 - 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 (1.5 mm slice thickness; 0.31 mm in-plane resolution) (Fig. 1)
- Cartilage thickness and subchondral bone areas of the medial/lateral tibia (MT/LT) and medial/lateral femur (cMF/cLF) were computed after segmentation (Fig. 1), using proprietary software (Chondrometrics GmbH) [4]; (FTJ = total femorotibial joint = sum)
- Differences between men and women were evaluated using unpaired t-tests, without correction for multiplicity, given colinearity

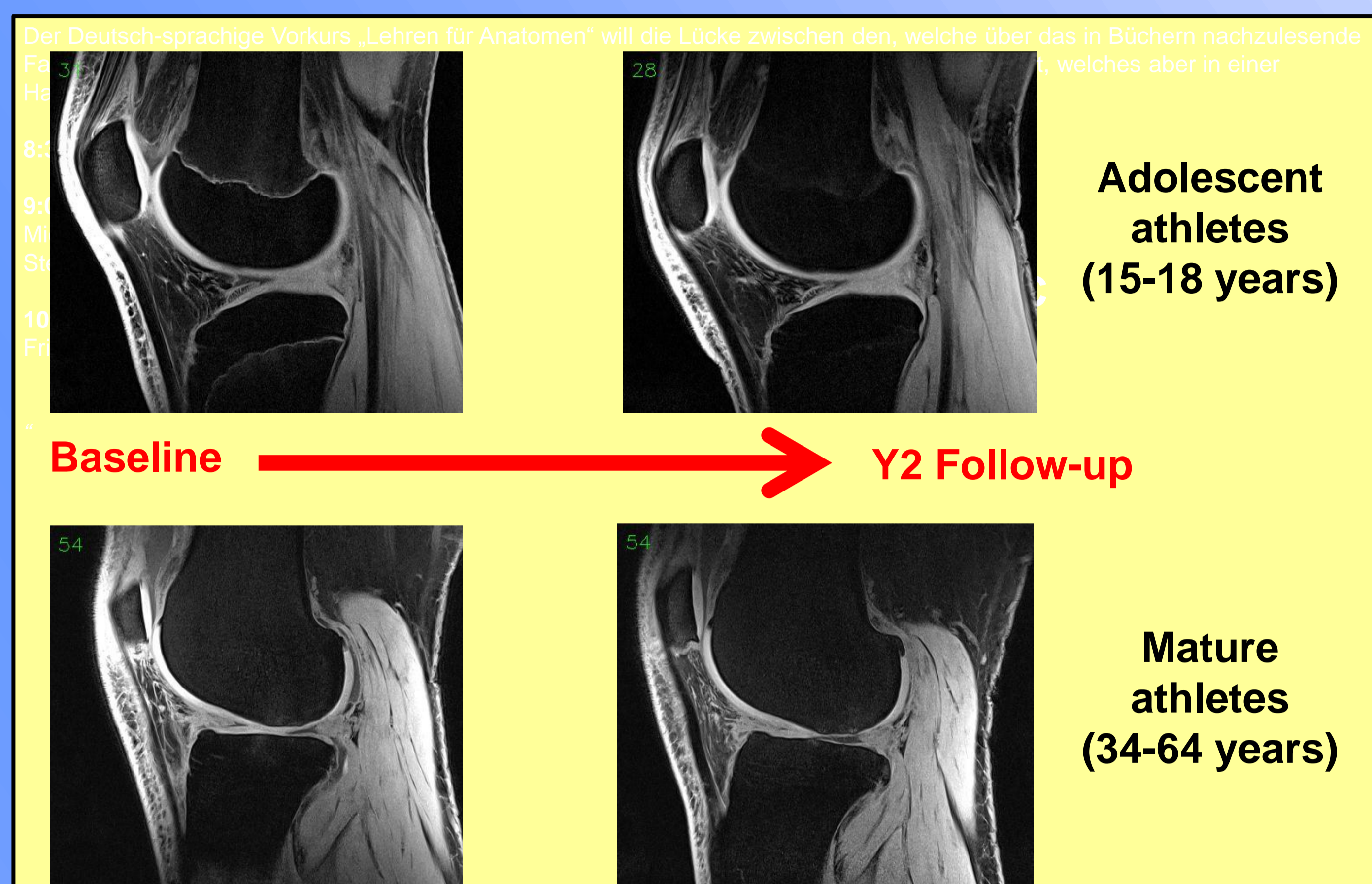


Fig. 1: Study design (top) and methods (bottom)

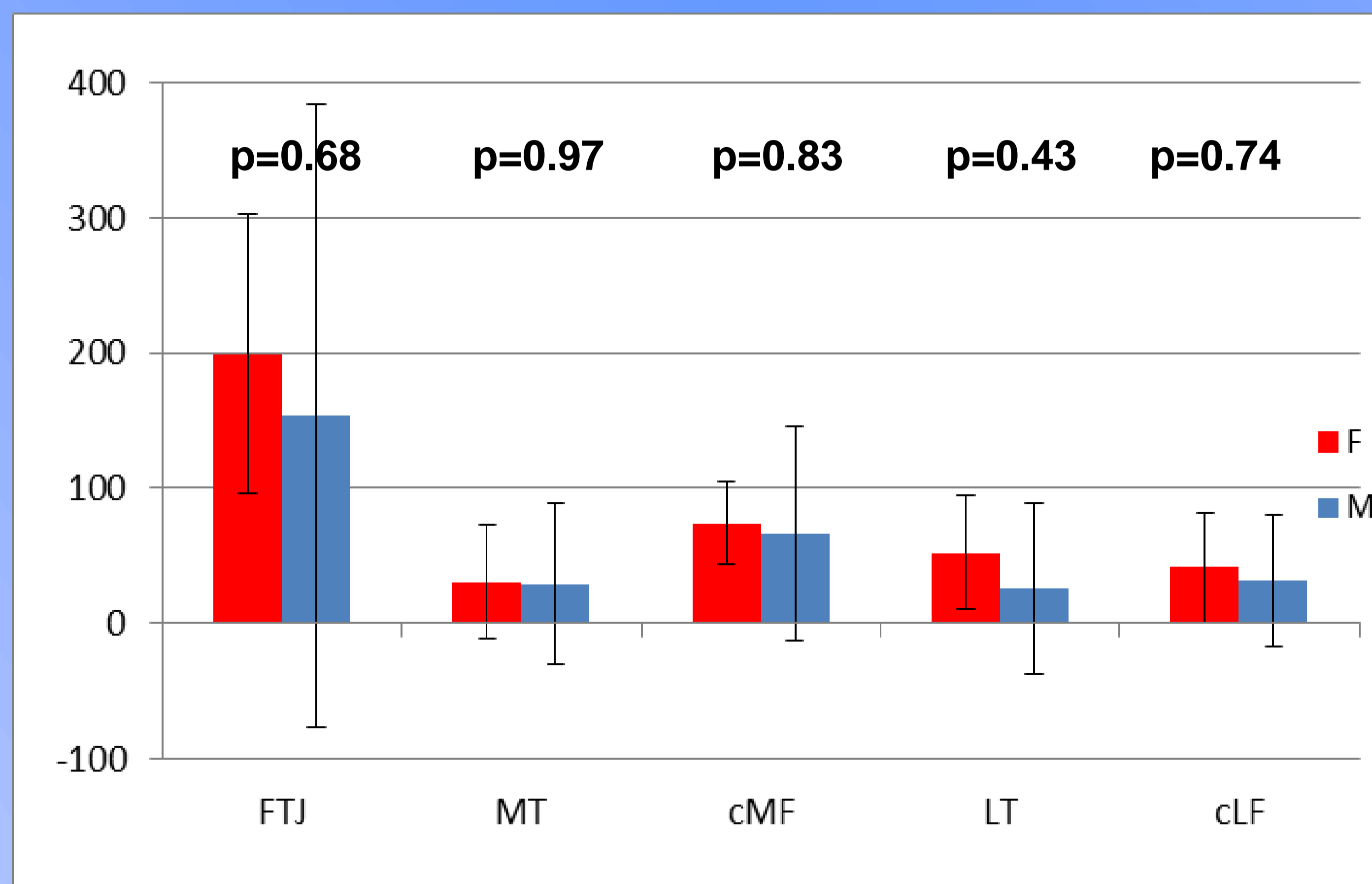


Fig. 2: Adolescent Volleyball Athletes: Bar Graph Showing the Mean Change ± SEM (µm) in Cartilage Thickness in Men and Women
FTJ = total femorotibial joint, MT = medial tibia, cMF = medial weight-bearing femur, MT = lateral tibia, cLF = lateral weight-bearing femur,

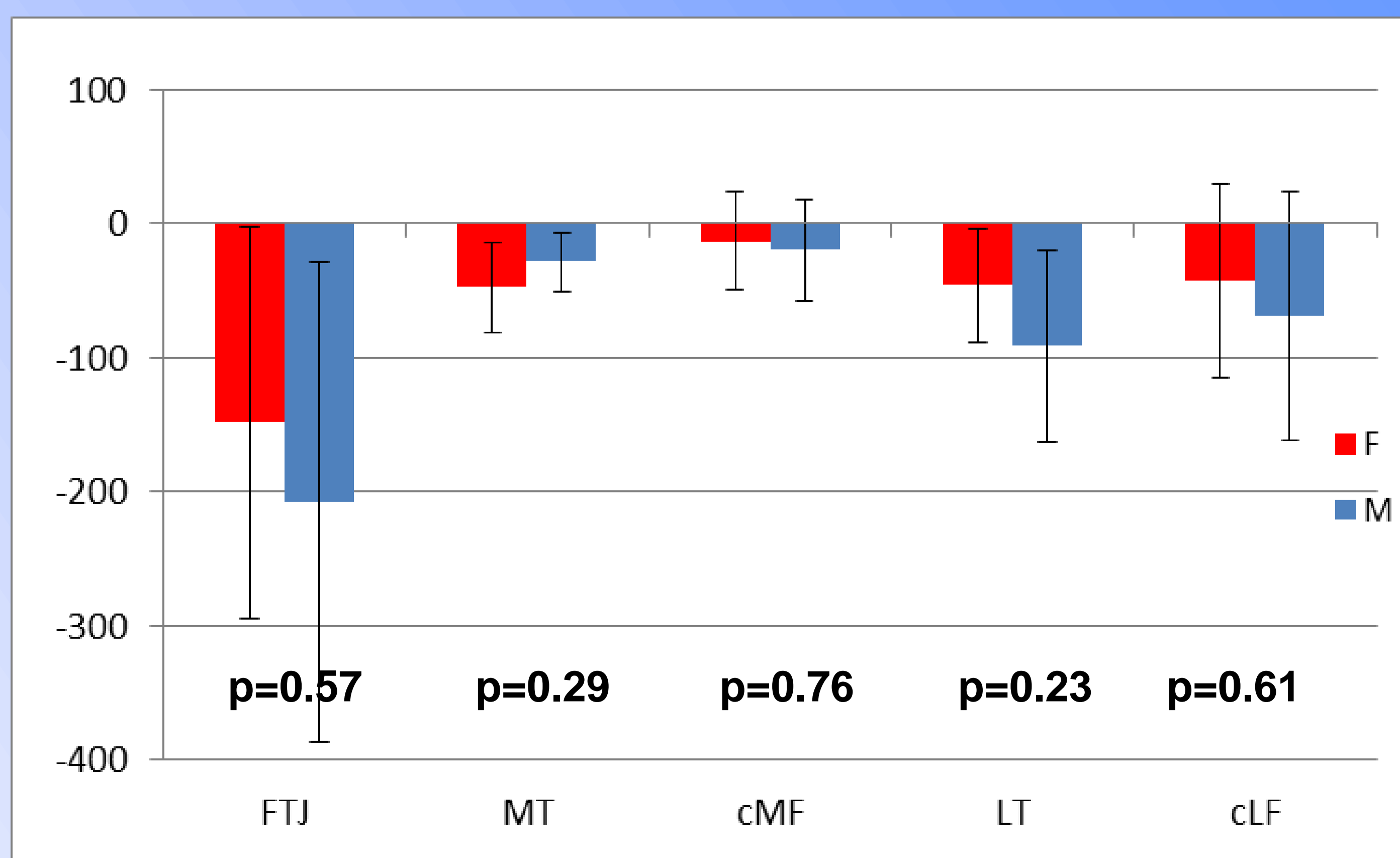


Fig. 3: Mature Volleyball Athletes: Bar Graph Showing the Mean Change ± SEM (µm) in Cartilage Thickness in Men and Women
FTJ = total femorotibial joint, MT = medial tibia, cMF = medial weight-bearing femur, MT = lateral tibia, cLF = lateral weight-bearing femur,

RESULTS

- The 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%)
- The increase was +1.8% (-0.9; +4.6%) in boys, and +2.8% (+1.4;+4.3%) in girls (Fig. 2); these rates were not significantly different between both 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; these rates were not significantly different (p=0.56).
- The variability in cartilage thickness increase was not associated with that in subchondral bone area (r= -0.06; not significant)
- The cartilage thickness increase appeared to be greatest in the medial femur (Fig. 2)
- In contrast, substantial femorotibial cartilage thinning was observed in mature former athletes: -2.1% (-4.2; -0.03%) in women, and -2.4% (-4.5; -0.3%) in men (Fig. 3).
- The cartilage thinning appeared to be greatest in the lateral tibia and did not differ significantly between men and women (Fig. 3)

CONCLUSIONS

- ✓ A substantial increase in cartilage thickness and subchondral area was observed in young athletes towards the end of adolescence
- ✓ The increase was greatest in the medial femur, did not differ significantly between boys and girls, and was not associated with the change in subchondral bone area
- ✓ Mature former athletes, in contrast, showed rates of cartilage loss that are similar to those observed in patients with knee osteoarthritis [5], and greater than those reported in healthy non-osteoarthritis subjects of that age [5]

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