Longitudinal biochemical evaluation of the femoropatellar joint during the Transeuropean Foot Race by using zonal T2* mapping

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Target audience

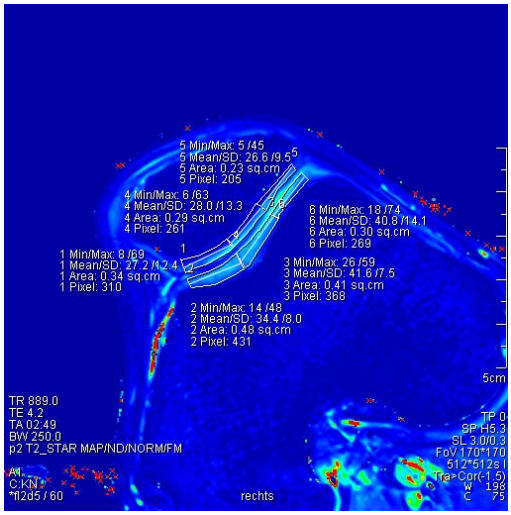
Musculoskeletal radiologists, OA scientists

Purpose

The Transeurope-Footrace (TEFR) is a multiday long-distance ultramarathon, first accomplished in 2003. In 2009, the TEFR started in Bari, Italy and ended in North Cape, Norway. In 64 consecutive days, the competitors had to conquer 4485 kilometers (2787 miles), an average of 70,1 km (43,5 mi) per day. From 68 starters 45 participants were able to manage the whole distance. Running approximately two marathons a day for more than 9 weeks is a tremendous load for the joints of limbs and feet. A mobile 1.5 Tesla MRI, which was transported on a Truck-Trailer, accompanied the run. MRI has a high potential for the non invasive assessment of articular cartilage [1]. T2* relaxation is a potential parameter for the biochemical assessment of the articular cartilage and is related to the collagen network and water content [2]. The purpose of this study was to evaluate morphological and biochemical changes within the patellar and trochlear cartilage during this physically and mentally extreme burden.

Methods

Twenty-two ultra-marathon runners (2 women, 20 men) consented to the study. Both knees of the participants were measured on a mobile 1.5 Tesla whole body MRI using a dedicated 8-channel knee coil: a baseline- MRI examination before the race started and several examinations during the race (4-6 MRI-measurements per runner) were performed. The protocol comprised a PDw TSE fs (TE/TR 31/ 4400) and a T2* multiecho GRE sequence (TE 4.18, TR 889/1120, ST 3). Regions-of-interest (ROIs) of the patellar and the trochlear cartilage were selected manually within two adjacent slices on T2* images. On each slice a medial, central and a lateral ROI was segmented in both, the superficial and the deep layer. The statistical evaluation was performed using SPSS.



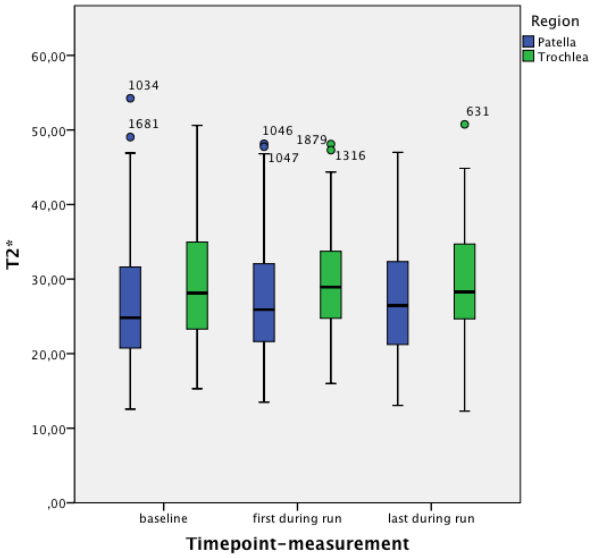


Fig.1: T2* colored map with Region of Interests in the Patella and the Trochlea

Fig.2: Box Plot with T2* values of the Patella (blue) and the Trochlea (green) at baseline measurement (left), during the first (middle) and the last (right) measurement during the run

Results

Nineteen athletes could be considered for the final analysis. Regarding the baseline measurements, a significant change in mean T2* values was found at the first measurement during the ultramarathon in the patellar cartilage (26.4ms ± 7.4ms vs. 27.0ms ± 6.9ms; p = 0.036) with a mean of 23.3 ±7.7 days between baseline and first MR examination, but neither significant differences between baseline values and the last measurement (26.8ms ± 7.1ms) during the run (p = 0.227) nor between the first and the last measurement during the run (p = 0.468). Regarding trochlear cartilage we didn't find a significant change in T2* values over time. In the morphological analysis no patellar and trochlear cartilage defect was found in 5 runners. Nine athletes showed patellar defects, two runners trochlear defects and three had patellar and trochlear pathologies. Four out of the 31 defects showed progression over time and two new defects evolved during the run.

Discussion

Mamisch et al. depicted a difference of T2* values in healthy cartilage compared to repair tissue after microfracturing in the femoro-tibial joint [3]. Compared to this, our study demonstrates that there is almost no change in T2* values of the femoropatellar joint during an immense stress in this unique study population. It seems that the articular cartilage of these ultra athletes has been trained over time in a way, that the articular cartilage is no limiting factor even for that long distance run.

Conclusion

In a well-trained athlete almost no difference in T2* values of the femoropatellar joint during extreme load can be detected.

References

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