

Immediate Negative Effects of Marathon Running on Overweight People's Knee Articular Cartilage – A Quantitative Magnetic Resonance Relaxation Time Analysis

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Objective: This study aimed to investigate the intermediate effects of marathon running on the biochemical composition of the knee articular cartilage, and whether runner's body weight and BMI are related to the biochemical composition change after marathon running.

Materials and Methods: MR scans of 18 non-professional marathon runners (mean age: 29.3, range: 23-51 years; 16 males, 2 females, height: 1.71±0.06 m, weight: 65.44±7.39 kg, BMI: 22.2±2.2) were included before and right after running a full-length Shanghai marathon. Three-dimensional (3D) model of the knee articular cartilage was reconstructed by structural MR scans (Amira, Thermo Fisher Scientific, Rockford IL, USA). The 3D models were then applied to the T2 maps to calculate the T2 values in different region-of-interests. The mean values of T2 relaxation times in each ROI before and right after the marathon were compared. The correlation between T2 relaxation time alternation and the runner's body weight and BMI was calculated.

Results: Patellofemoral cartilage had significantly ($p = 8.1 \times 10^{-6}$) higher T2 values after marathon. In tibiofemoral cartilage, medial tibial cartilage showed significantly ($p = 0.0130$) higher T2 values compared to other regions. Specifically, the anterior part of medial tibial and femoral cartilage contributed the most to the elevation of T2 relaxation times. Both lateral ($p = 0.0001$) and medial femoral ($p = 0.0001$) condyle cartilage were significantly lower T2 values after running a marathon. T2 values alteration after running a marathon in the anterior medial part of tibiofemoral joint cartilage correlated with body weight ($R = 0.6746$, $p = 0.0324$) and BMI ($R = 0.7089$, $p = 0.0217$).

Discussion: We found that running a marathon led to short-term biochemical changes in the knee joint cartilage. The highest T2 value elevation was found in the anterior medial part of tibiofemoral cartilage. Regional increases of T2 relaxation times in cartilage were shown to be associated with cartilage matrix damage, particularly the loss of collagen integrity and water content increase [1]. T2 value elevation in the anterior medial part of tibiofemoral cartilage was strongly correlated with body weight and BMI, suggesting a higher risk of the knee degeneration in overweight and obese runners. Although Mosher et al. [2] reported that the level of physical activity does not influence the T2 response time, the intensity of the selected physical activities, jogging for 30 minutes, was much lower than marathon running.

Clinical Relevance: This study suggested that running a marathon has a short-term adverse effect on the knee joint cartilage, especially the anterior medial part of the tibial cartilage and the medial patellar cartilage. Cartilage in these regions are in line with the onset of medial tibiofemoral OA, runners with higher BMI should decrease the running intensity. Further study on the long-term impact of a marathon on the knee joint cartilage is warranted.

Keywords: Articular cartilage; marathon; T2 mapping; knee

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