A mobile MRI field study of the biochemical cartilage reaction of the knee joint during a 4,486 km transcontinental multistage ultra-marathon using T2* mapping

Uwe Schütz, Martin Ehrhardt, Sabine Göd, Christian Billich, Meinrad Beer, Siegfried Trattnig

Table S1: Interrater reliability (Pearson CC) of T2* measurements (n=152)

| cartilage segment | femoral lateral | femoral medial | tibial lateral | tibial medial |
|-------------------|-----------------|----------------|---------------|--------------|
| Cartilage ROIs:   |                 |                |               |              |
| deep-ant.         | 0.892*          | 0.944*         | 0.945*        | 0.943*       |
| deep-central      | 0.931*          | 0.934*         | 0.966*        | 0.903*       |
| deep-post.        | 0.967*          | 0.937*         | 0.953*        | 0.889*       |
| superf.-ant.      | 0.941*          | 0.933*         | 0.940*        | 0.847*       |
| superf.-central   | 0.967*          | 0.940*         | 0.961*        | 0.862*       |
| superf.-post.     | 0.981*          | 0.789*         | 0.954*        | 0.789*       |
| Cartilage layers: |                 |                |               |              |
| deep              | 0.955*          | 0.956*         | 0.884*        | 0.875*       |
| superficial       | 0.975*          | 0.947*         | 0.810*        | 0.564*       |
| Cartilage zones:  |                 |                |               |              |
| anterior          | 0.846*          | 0.927*         | 0.930*        | 0.900*       |
| central           | 0.900*          | 0.948*         | 0.915*        | 0.919*       |
| posterior         | 0.956*          | 0.890*         | 0.835*        | 0.869*       |
| Total segments    | 0.977*          | 0.964*         | 0.883*        | 0.869*       |

* Correlation (Pearson CC) is high (r > 0.8) and significant on a niveau of p<0.01 (two-sided test).

Table S2: Mean cartilage area sizes [mm²] drawn for T2* evaluation in the course of the race (SD).

| cartilage segment | total segment right | total segment left | anterior zone right | anterior zone left | central zone right | central zone left | posterior zone right | posterior zone left |
|-------------------|---------------------|--------------------|---------------------|--------------------|---------------------|---------------------|----------------------|---------------------|
| femoral lateral   | 152.4 (9.4)         | 148.3 (12.2)       | 36.4 (4.5)          | 33.3 (3.6)         | 55.5 (5.4)          | 56.9 (4.7)          | 60.6 (4.2)           | 60.3 (4.7)           |
| tibial lateral    | 160.1 (11.2)        | 167.8 (14.2)       | 44.2 (4.6)          | 43.5 (4.8)         | 69.2 (7.7)          | 74.8 (8.8)          | 46.6 (4.5)           | 49.5 (7.3)           |
| femoral medial    | 180.4 (12.5)        | 183.3 (10.2)       | 38.5 (5.0)          | 42.8 (5.2)         | 72.1 (10.8)         | 70.0 (9.5)          | 69.8 (5.6)           | 70.6 (5.8)           |
| tibial medial     | 165.3 (10.1)        | 165.7 (9.8)        | 35.7 (4.4)          | 39.0 (5.6)         | 71.1 (9.2)          | 67.9 (7.5)          | 58.5 (5.1)           | 58.8 (5.5)           |
| total:            | 658.3 (29.6)        | 656.4 (40.8)       | 154.8 (12.1)        | 158.6 (12.4)       | 267.9 (22.8)        | 269.5 (19.5)        | 235.6 (12.3)         | 239.2 (16.1)         |
Figure S3: Absolute values of T2* mapping ($n_f=17$). right side
Figure S4: Absolute values of T2* mapping (n=17). left side
Table S5: Mean T2* differences [ms] between cartilage ROIs within the same cartilage segment (n=17, univariate ANOVA).

| ROI                        | femoral lateral segment | tibial lateral segment | femoral medial segment |
|----------------------------|-------------------------|------------------------|------------------------|
|                            | right FTJ               | left FTJ               |                        |
|                            | t0  | t1  | t2  | t3  | tx  | t0  | t1  | t2  | t3  | tx  |
| superf.- vs. deep-ant.     | 4.2 | 4.1 | 5.7 | 5.4 | 4.0 | 3.1 | 3.7 | 5.4 | 4.9 | 3.5 |
| superf.-ant. vs. deep-central | 4.1 | 2.5 | 3.8 | 4.5 | 2.2 | 4.2 | 5.4 | 7.7 | 6.5 | 3.3 |
| superf.-ant. vs. deep-post. | 1.2 | -2.7 | 0.6 | -0.1 | 0.2 | 2.4 | 2.0 | 3.4 | 2.6 | 1.4 |
| superf.-central vs. deep-ant. | 8.0 | 13.5 | 13.5 | 13.2 | 9.5 | 5.6 | 9.6 | 9.7 | 9.3 | 9.3 |
| superf.-central vs. deep-central | 7.8 | 11.9 | 11.7 | 12.3 | 7.7 | 6.7 | 11.2 | 12 | 10.9 | 9.1 |
| superf.-central vs. deep-post. | 4.9 | 6.7 | 8.4 | 7.7 | 5.7 | 4.9 | 7.9 | 7.6 | 6.9 | 7.2 |
| superf.-post. vs. deep-ant. | 9.5 | 17.6 | 17.4 | 17.3 | 11.6 | 8.1 | 14.1 | 14.2 | 13.1 | 11.4 |
| superf.-post. vs. deep-central | 9.4 | 16.0 | 15.5 | 16.4 | 9.8 | 9.2 | 15.7 | 16.5 | 14.7 | 11.2 |
| superf.-post. vs. deep-post. | 6.5 | 10.8 | 12.3 | 11.9 | 7.8 | 7.4 | 12.4 | 12.1 | 10.8 | 9.2 |
| superf.-central vs. superf.-ant. | 3.7 | 9.4 | 7.9 | 7.8 | 5.5 | 2.5 | 5.8 | 4.3 | 4.3 | 5.8 |
| superf.-post. vs. superf.-central | 5.3 | 13.5 | 11.7 | 11.9 | 7.6 | 4.9 | 10.4 | 8.8 | 8.2 | 7.8 |
| superf.-post. vs. superf.-central | 1.6 | 4.1 | 3.9 | 4.2 | 2.2 | 2.4 | 4.5 | 4.5 | 3.8 | 2.1 |
| deep-central vs. deep-ant.  | 0.1 | 1.6 | 1.9 | 0.9 | 1.8 | -1.1 | -1.6 | -2.2 | -1.6 | 0.2 |
| deep-post. vs. deep-ant.    | 3.1 | 6.8 | 5.1 | 5.4 | 3.8 | 0.7 | 1.7 | 2.1 | 2.3 | 2.1 |
| deep-post. vs. deep-central | 2.9 | 5.2 | 3.2 | 4.5 | 2.0 | 1.8 | 3.3 | 4.3 | 3.9 | 1.9 |
| superf.-ant. vs. deep-ant.  | 5.1 | 7.4 | 7.5 | 6.6 | 5.4 | 4.3 | 7.0 | 7.0 | 7.2 | 3.8 |
| superf.-ant. vs. deep-central | 5.9 | 7.2 | 9.3 | 7.8 | 6.9 | 6.1 | 10.8 | 10.6 | 10.0 | 6.9 |
| superf.-ant. vs. deep-post. | 1.5 | 0.7 | 2.7 | 1.5 | 2.6 | 2.6 | 5.3 | 4.0 | 4.6 | 1.8 |
| superf.-central vs. deep-ant. | 6.6 | 11.9 | 10.3 | 10.0 | 7.6 | 5.3 | 7.9 | 8.0 | 7.8 | 5.3 |
| superf.-central vs. deep-central | 7.4 | 11.7 | 12.1 | 11.2 | 9.1 | 7.1 | 11.6 | 11.6 | 10.6 | 8.4 |
| superf.-central vs. deep-post. | 3.0 | 5.2 | 5.4 | 4.9 | 4.8 | 3.7 | 6.2 | 4.9 | 5.2 | 3.3 |
| superf.-post. vs. deep-ant. | 9.7 | 15.7 | 15.1 | 13.7 | 9.6 | 8 | 12.1 | 13.4 | 12.3 | 8.9 |
| superf.-post. vs. deep-central | 10.6 | 15.5 | 16.8 | 14.9 | 11.1 | 9.7 | 15.8 | 17 | 15.1 | 12.0 |
| superf.-post. vs. deep-post. | 6.2 | 9.0 | 10.2 | 8.7 | 6.8 | 6.3 | 10.4 | 10.3 | 9.7 | 6.9 |
| superf.-central vs. superf.-ant. | 1.5 | 4.5 | 2.8 | 3.4 | 2.2 | 1.0 | 0.9 | 1.0 | 0.6 | 1.5 |
| superf.-post. vs. superf.-ant. | 4.7 | 8.3 | 7.5 | 7.1 | 4.2 | 3.7 | 5.1 | 6.4 | 5.1 | 5.1 |
| superf.-post. vs. superf.-central | 3.2 | 3.8 | 4.8 | 3.7 | 2.0 | 2.7 | 4.2 | 5.4 | 4.5 | 3.6 |
| deep-central vs. deep-ant.  | -0.9 | 0.2 | -1.8 | -1.2 | -1.5 | -1.7 | -3.8 | -3.6 | -2.9 | -3.1 |
| deep-post. vs. deep-ant.    | 3.5 | 6.7 | 4.9 | 5.1 | 2.8 | 1.7 | 1.7 | 3.1 | 2.6 | 2.0 |
| deep-post. vs. deep-central | 4.4 | 6.5 | 6.7 | 6.3 | 4.3 | 3.4 | 5.4 | 6.7 | 5.5 | 5.1 |

Note: ANOVA, analysis of variance; ROI, region of interest; FTJ, functional joint.
|                      | superf.-post. vs. superf.-ant. | superf.-post. vs. superf.-central | deep-central vs. deep-ant. | deep-post. vs. deep-ant. | deep-post. vs. deep-central |
|----------------------|--------------------------------|----------------------------------|---------------------------|-------------------------|---------------------------|
| superf.-post. vs. superf.-ant. | 8.8  | 11.7  | 9.0   | 11.8 | 5.4 | -0.6 | 7.9 | 2.8 | 0.9 | 8.1 |
| superf.-post. vs. superf.-central | 5.7  | 8.5   | 7.2   | 8.3  | 4.6 | 1.6  | 9.8 | 5.9 | 3.7 | 8.4 |
| deep-central vs. deep-ant.     | -0.6 | -3.6  | -3.7  | -2.3 | -2.9 | -4.6 | -6.8 | -6.4 | -6.3 | -3.2 |
| deep-post. vs. deep-ant.        | 6.2  | 4.7   | 4.0   | 5.6  | 3.1 | -1.6 | 0.6 | -0.2 | -0.2 | 2.1 |
| deep-post. vs. deep-central     | 6.8  | 8.2   | 7.7   | 7.9  | 6.0 | 3.0  | 7.4 | 6.2 | 6.1 | 5.4 |
| superf.-ant. vs. deep-ant.      | 2.8  | 2.8   | 4.3   | 2.8  | 4.5 | 5.4  | 6.1 | 6.0 | 7.0 | 4.9 |
| superf.-ant. vs. deep-central   | 6.5  | 7.0   | 8.8   | 8.0  | 8.0 | 8.5  | 10.5 | 11.3 | 12.6 | 7.8 |
| superf.-ant. vs. deep-post.     | 0.6  | -1.1  | 1.2   | 0.6  | 3.9 | 5.1  | 4.2 | 4.7 | 7.3 | 3.9 |
| superf.-central vs. deep-ant.   | 5.4  | 6.8   | 6.3   | 4.7  | 4.3 | 5.8  | 8.7 | 6.3 | 7.9 | 5.4 |
| superf.-central vs. deep-central | 9.2  | 11.0  | 10.8  | 9.9  | 7.7 | 8.9  | 13.2 | 11.5 | 13.4 | 8.2 |
| superf.-central vs. deep-post.  | 3.3  | 3.0   | 3.2   | 2.4  | 3.6 | 5.6  | 6.9 | 4.9 | 8.2 | 4.3 |
| superf.-post. vs. deep-ant.     | 5.5  | 9.0   | 7.5   | 6.4  | 4.1 | 3.6  | 7.4 | 6.5 | 5.7 | 5.4 |
| superf.-post. vs. deep-central  | 9.2  | 13.2  | 12    | 11.7 | 7.5 | 6.8  | 11.9 | 11.8 | 11.3 | 8.3 |
| superf.-post. vs. deep-post.    | 3.3  | 5.2   | 4.4   | 4.2  | 3.4 | 3.4  | 5.6 | 5.1 | 6.0 | 4.4 |
| superf.-central vs. superf.-ant. | 2.6  | 4.0   | 2.0   | 1.9  | -0.3 | 0.4  | 2.7 | 0.2 | 0.9 | 0.5 |
| superf.-central vs. superf.-ant. | 2.7  | 6.2   | 3.2   | 3.6  | -0.4 | -1.7 | 1.4 | 0.5 | -1.3 | 0.5 |
| superf.-post. vs. superf.-central | 0.0  | 2.2   | 1.2   | 1.8  | -0.2 | -2.2 | -1.3 | 0.3 | -2.2 | 0.1 |
| deep-central vs. deep-ant.      | -3.7 | -4.2  | -4.5  | -5.2 | -3.4 | -3.1 | -4.5 | -5.3 | -5.6 | -2.9 |
| deep-post. vs. deep-ant.        | 2.2  | 3.8   | 3.1   | 2.2  | 0.6  | 0.2  | 1.8 | 1.4 | -0.3 | 1.0 |
| deep-post. vs. deep-central     | 5.9  | 8.1   | 7.6   | 7.5  | 4.1 | 3.4  | 6.3 | 6.6 | 5.3 | 3.9 |

* **Bold fonts** show significant differences (*p*-value<0.05)