The increase of load-induced serum cartilage oligomeric matrix protein concentration correlates with T2 relaxation time in participants with anterior cruciate ligament injury

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Introduction

- Cartilage oligomeric matrix protein (COMP) is a structural protein binding to collagen I/II and IX and is thereby involved in the organization and maintenance of extracellular matrix of articular cartilage [1].
- Resting serum COMP (sCOMP) is elevated in patients with clinically confirmed knee osteoarthritis (OA) [2,3].
- 30 min of treadmill walking temporarily increases sCOMP in young [4], old [5], anterior cruciate ligament (ACL) reconstructed [6] and people with OA [5].
- Transverse relaxation time (T2) is associated with water content, collagen content and orientation of the extracellular matrix [7].
- T2 was observed to be elevated in participants at risk for of OA and in those with early knee OA [8,9].

→ Association between load-induced sCOMP concentration kinetics and cartilage T2 unknown.

Study aim

To investigate the relationship between load-induced sCOMP concentration kinetics and knee cartilage MRI T2 relaxation time in persons 2 to 10 years after ACL injury compared to healthy control participants in two age groups.

	20-30 years		40-60 years	
	Healthy	ACL injured	Healthy	ACL injured
n (f/m)	24 (12/12)	22 (14/8)	24 (12/12)	11 (7/4)
Age [years]	26.6 ± 3.0	26.2 ± 3.2	49.0 ± 6.1	50.8 ± 5.1
BMI [kg/m²]	22.9 ± 2.0	23.5 ± 2.6	24.7 ± 4.3	24.6 ± 2.4

Table 1: participant characteristics

Methods

- Preliminary analysis of 81 participants of a study with a target population of 96 [10].
- Four subgroups: ACL injured, and healthy controls in the age groups 20-30 and 40-60 years.
- Stress test with blood samples taken after 60 min of rest (t0) and immediately after 30 min of treadmill walking (t1).
- sCOMP concentration was measured using ELISA.
- Segmentation of coronal MRI cartilage in medial/lateral tibia (MT/LT), central medial/lateral femur (cMF/cLF) superficial (upper 50%) and deep zone (lower 50%) cartilage plates.
- Pearson correlation between sCOMP parameters and mean T2 of different cartilage plates.

Results

- Participants characteristics are listed in Table 1.
- No correlations between sCOMP and cartilage T2 in healthy participants (Fig. 1).
- For the ACL injured knee, absolute and relative load-induced ΔsCOMP correlated with lateral tibia superficial cartilage T2 (R=-0.54, p=0.001; R=-0.60, p<0.001; Fig. 1; Fig. 2).
- Association between relative load-induced ΔsCOMP and lateral tibia superficial cartilage T2 was stronger in the age group 20-30 (R=-0.71, p<0.001; Fig. 2).
- To a smaller degree ΔsCOMP correlated with medial and/or lateral cartilage T2 relaxation times in other plates and layers (Fig. 1).

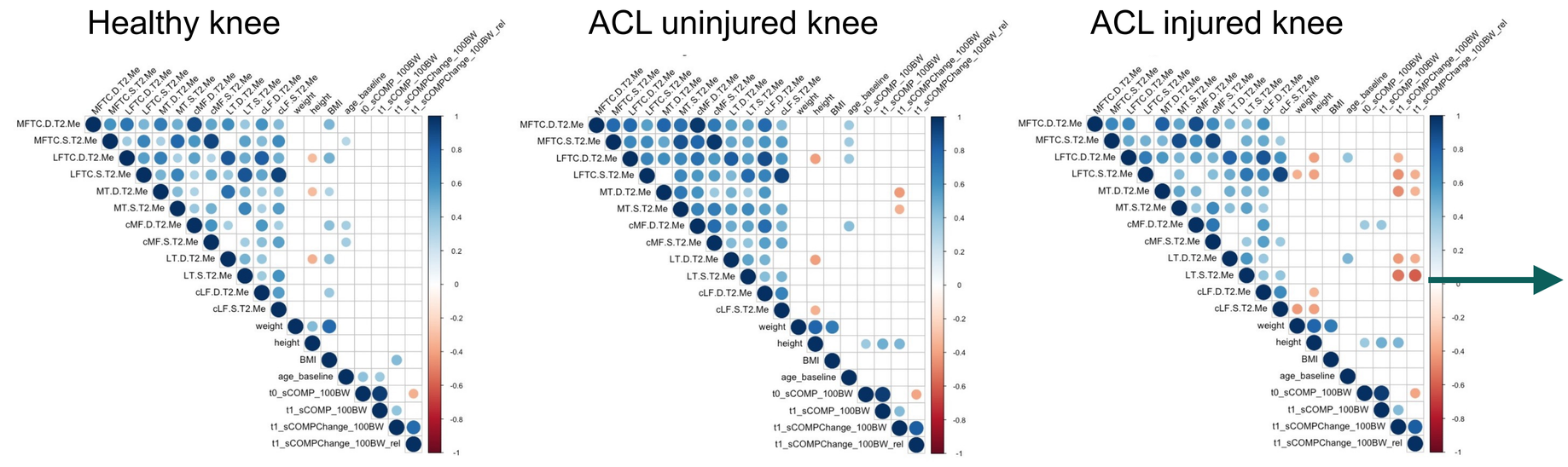

Figure 1. Pearson correlations (p<0.05) for healthy participants ACL injured participants. MFTC–medial femorotibial compartment; D–deep layer; Me–mean T2 time; S–superficial layer; LFTC–lateral femorotibial compartment; MT–medial tibia; cMF–central medial femur; LT–lateral tibia; cLF–central lateral femur; t0_sCOMP_100%BW–sCOMP conc. before walking stress; t1_sCOMP_100%BW–sCOMP conc. immediately after walking stress; t1_sCOMPChange_100BW–t1-t0; t1_sCOMPChange_100BW_rel–(t1-t0)/t0

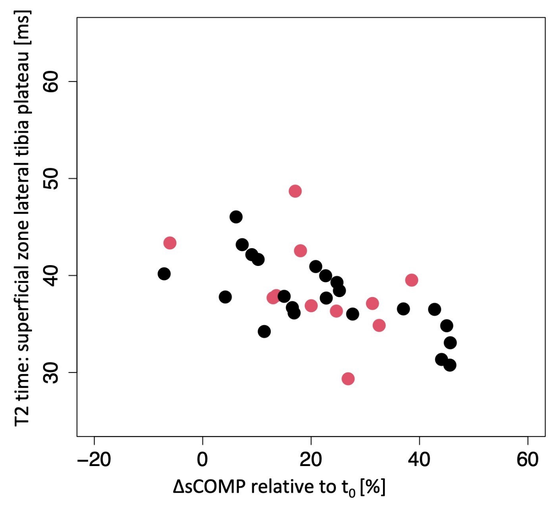

Figure 2. Scatterplot of the relative load-induced ΔsCOMP and mean superficial lateral tibia cartilage T2 for 20-30 (black) and 40-60 (red) year old participants.

Conclusion

- Participants with smaller load-induced sCOMP increase had poorer cartilage quality in the lateral and medial tibia of the ACL injured limb.
- ACL injuries often occur during knee valgus injury where the lateral knee cartilage experiences stress beyond its physiological limits.
- Presence of correlations between sCOMP and cartilage T2 in ACL injured participants and the lack thereof in healthy subjects suggests an altered mechanoresponse of knee articular cartilage after trauma such as an ACL injury.
- Load-induced sCOMP kinetics may reflect an altered metabolic response to mechanical load in patients after ACL injury.

References

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