Quadriceps Rate of Torque Development, Rather than Peak Strength, is Associated with Serum Biomarkers of Joint Tissue Health in Patients with Anterior Cruciate Ligament Injuries

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Disclosures

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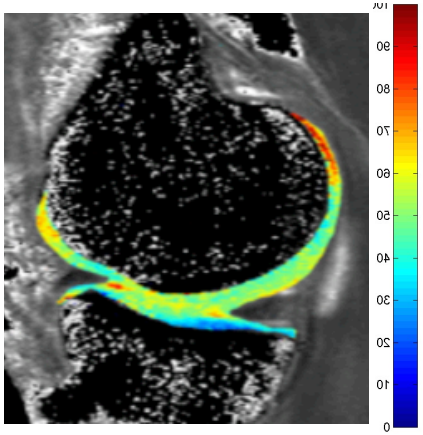
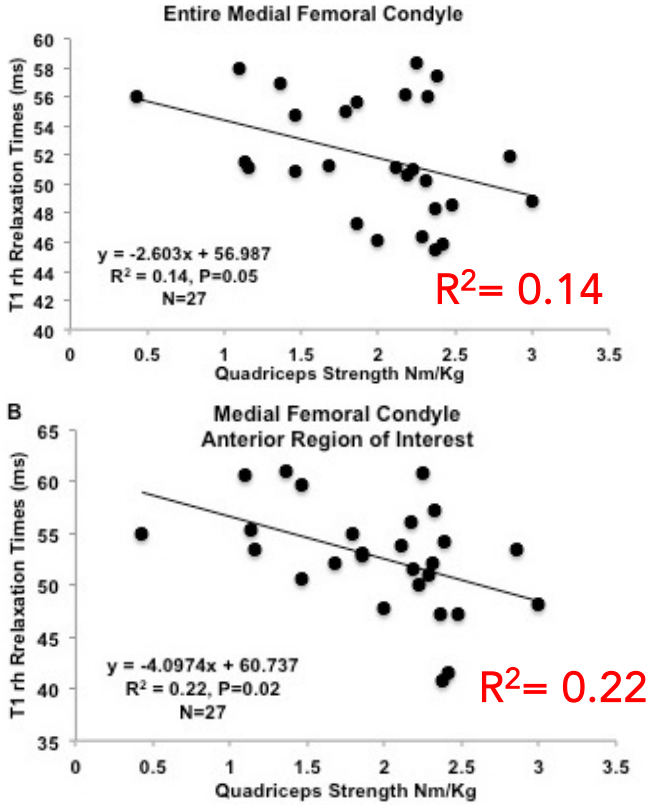
Quadriceps Strength and Osteoarthritis Development

Previous work has demonstrated a link between peak quadriceps torque and outcomes related to knee osteoarthritis development

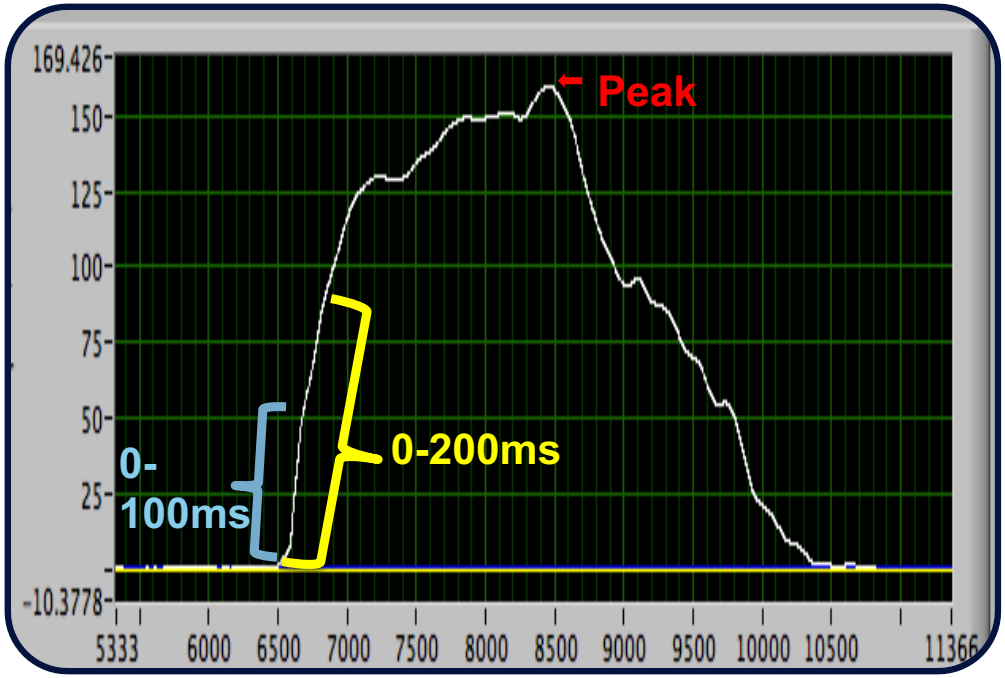


Pietrosimone et al. KSTTA . 2018



Gaps

However, recent studies suggest that the ability to generate rapid muscle contractions may also be critical for attenuating energy throughout the knee at point of initial impact when the foot first strikes the ground during load-bearing activities.



Objectives

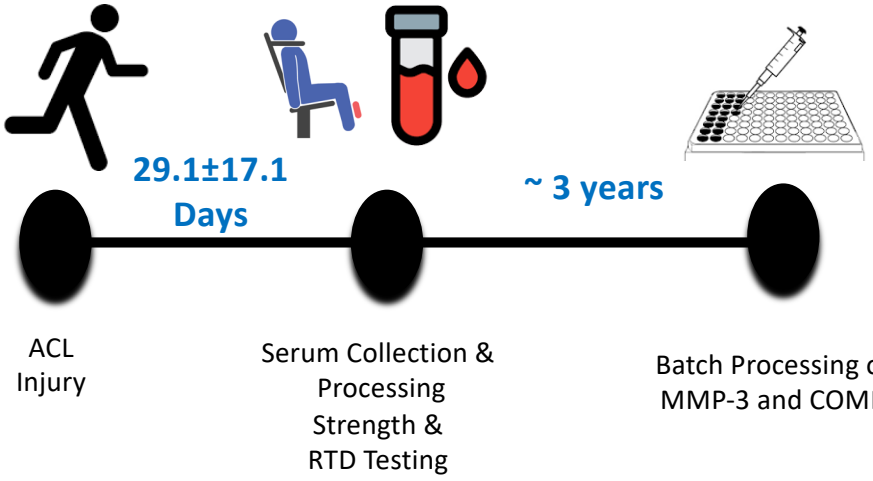
Purpose: Determine the association between quadriceps strength and rate of torque development (RTD) and serum biomarkers of joint tissue breakdown (i.e. cartilage oligomeric matrix protein [COMP] and Matrix metalloproteinase-3 [MMP-3]) in patients with an ACL injury.

Hypothesis: Lesser quadriceps strength and RTD would be associated with greater serum COMP and MMP-3 post ACLR, indicating that lesser quadriceps function early following ACL injury would be associated with more deleterious biological changes linked to cartilage breakdown

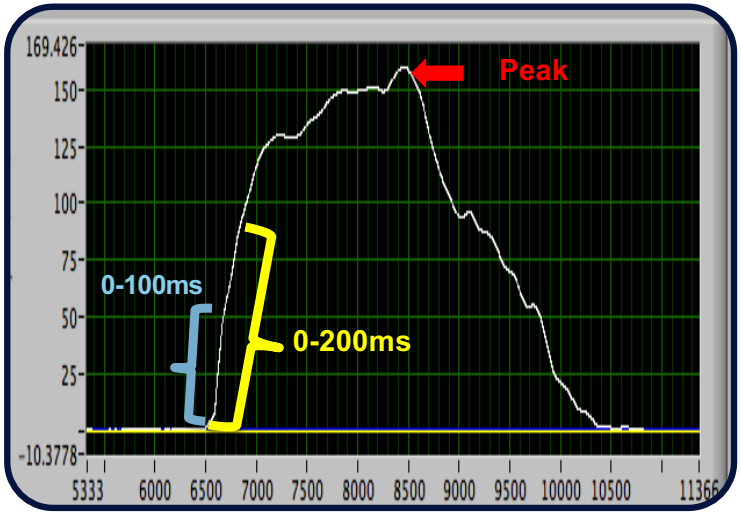
Participant Demographics

Participant Demographics	
Participants (sex)	N= 48 (50% Female)
Age	21.3±4.3 years
Body Mass Index	24.7±4.0
Tegner Score	5.8±3.3
Days between ACL Injury & Testing	29.1±17.1

Methods



- Participant serum were collected at a preoperative visit in the orthopaedic clinic & stored at -80° and batched processed following collection of serum from all participants



- Quadriceps testing was completed isometrically on a Humac isokinetic dynamometer at 90° of knee flexion

- Quadriceps RTD was defined as the slope of the torque-time curve between onset and the first 100 and 200 milliseconds of the maximal voluntary contraction

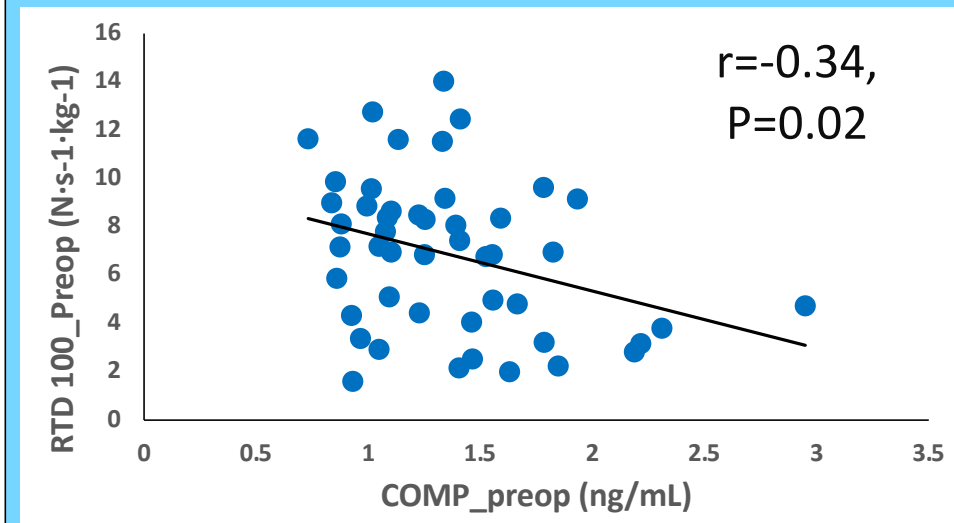
Statistical Analysis

- Separate Pearson Product Moment correlations were used to determine the association between quadriceps peak torque, RTD_{100}, and RTD_{200} with serum COMP and MMP3.

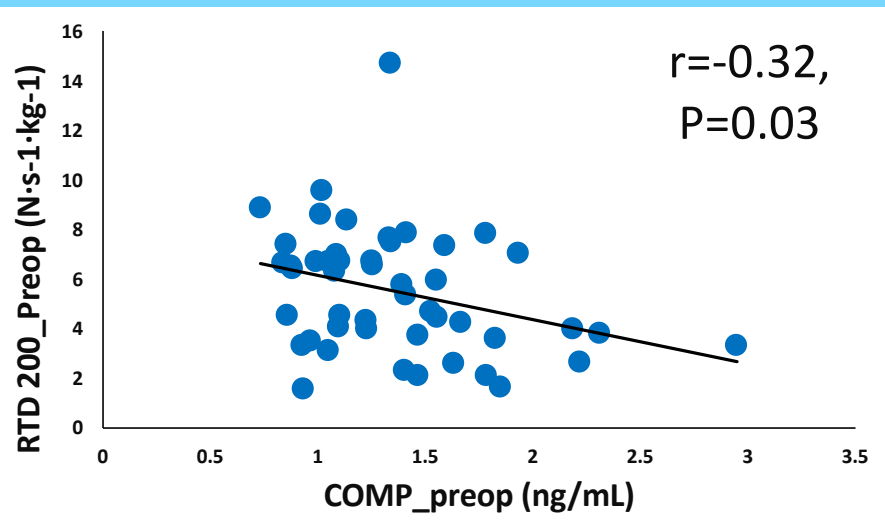
- Statistical significance was set with an alpha level < 0.05

Rate of Torque Development Associated with COMP

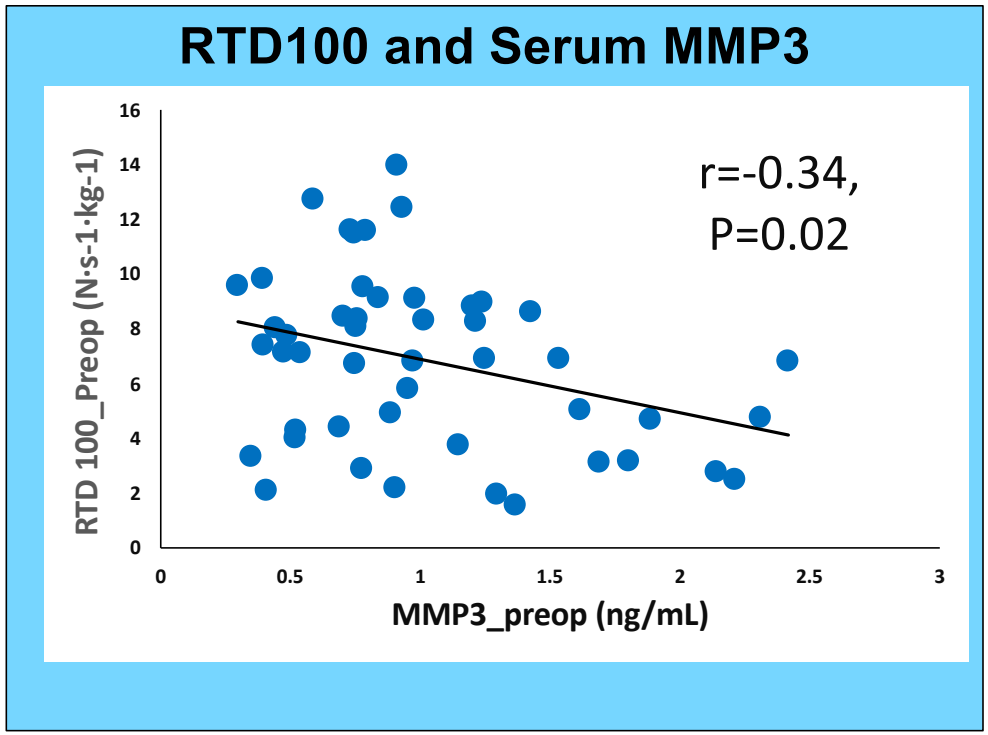
RTD100 and Serum COMP

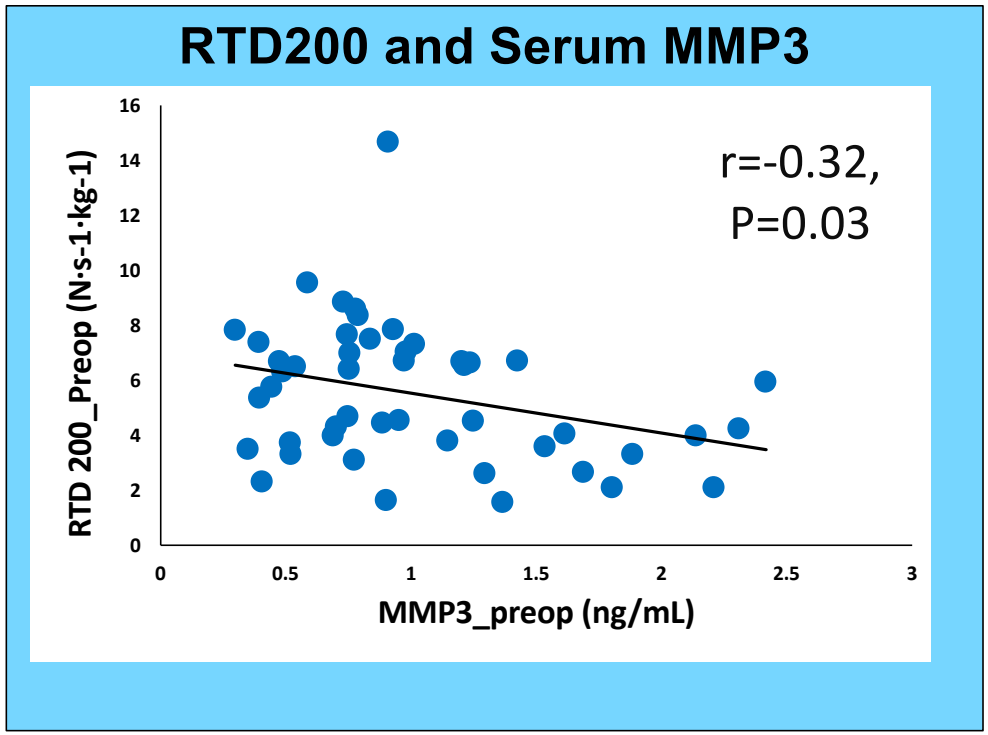


RTD200 and Serum COMP



Rate of Torque Development Associated with MMP3





Strength was NOT ASSOCIATED with Biomakers

- **Peak Strength Not Associated With Biomarkers:** No statistically significant associations between peak torque and serum COMP (r=0.07, P=0.66) or MMP3 (r=-0.03, P=0.82).

Discussion

Scientific "Take Home" Points

- Lesser quadriceps RTD is associated with greater concentrations of COMP and MMP3, serum biomarkers of joint tissue breakdown
- Our results advocate for the assessment of quadriceps RTD in addition to peak torque

Clinical Take Home Points

- Rehabilitation practices should specifically develop methods for counteracting loss of RTD following ACL injury
- Future work should determine if the addition of quadriceps power training, shown to improve RTD, may be more effective for maintaining joint health compared to strength training alone.

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References

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2. Pietrosimone et al. KSSTA. 2018
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5. William et al. Clin Biomech. 2023