THE RELATIONSHIP BETWEEN MEASURES OF KNEE LOADING DURING GAIT AND CARTILAGE THICKNESS IN NON-TRAUMATIC AND POST-TRAUMATIC KNEE OSTEOARTHRITIS

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Introduction

Background
• The knee adduction moment (KAM) is a proxy measure for the medial to lateral load distribution within the knee.
• Knee moments measured during gait have shown relationships with markers of knee osteoarthritis progression, including cartilage thickness.
• For instance, cross-sectional studies have demonstrated a relationship between the knee adduction moment during gait and cartilage thickness/volume [1], while other studies have shown no relationship [2, 3].
• Knee osteoarthritis can be classified as non-traumatic and post-traumatic.

Knowledge Gap
• Further investigation is required to determine how gait kinetics impact osteoarthritis-related changes in cartilage.
• The relationship between measures of disease progression (e.g. cartilage thickness) and knee moments might also differ between these osteoarthritis subgroups.
• A greater understanding of the relationship between dynamic gait measures and cartilage thickness would provide insight into mechanisms affecting disease progression.

Objective
• To examine relationships between external knee moments during gait and cartilage thickness, measured with magnetic resonance imaging (MRI), in patients with non-traumatic and post-traumatic knee osteoarthritis.
Methods

Participants
• Participants with non-traumatic (n=22; mean age 60 y) and post-traumatic (n=19; mean age 56 y) knee osteoarthritis were recruited.
• History of knee ligament injury was confirmed on magnetic resonance imaging.
• Radiographic disease severity was assessed with Kellgren-Lawrence scores.

Gait Analysis
• Gait analysis was done using 8 camera motion capture system with reflective markers.
• Participants ambulated at self-selected speeds over an 8 meter walkway for five trials.
• External knee moments were calculated using inverse dynamics about joint coordinate systems.
• Knee cartilage was measured with a 3T MRI system. The sequence was a T1-weighted, 3D sagittal gradient echo sequence with fat suppression. Cartilage thickness was determined using automatic knee cartilage segmentation [4].

Variables
• Group: non-traumatic and post-traumatic knee osteoarthritis
• Gait parameters: peak knee adduction moment, knee extension moment and knee flexion moment
• Cartilage thickness:
  • Medial compartment cartilage thickness
  • Lateral compartment cartilage thickness
  • Medial:lateral cartilage thickness ratio

Statistical Analysis
• Forward linear regression analyses examined relationships between cartilage thickness measures (dependent variable) with gait parameters, osteoarthritis subgroup, and their interaction.
Results

**Relationship between peak knee adduction moment and medial:lateral cartilage thickness ratio**

Peak KAM: Significant ($\beta=-0.66$, $p=<0.01$, $R^2=0.33$)
OA subgroup: Not significant
Interaction: Not significant

Higher peak KAM was associated with a lower medial:lateral cartilage thickness ratio.

**Relationship between peak knee extension moment and medial cartilage thickness**

Peak KEM: Significant ($\beta=-1.04$, $p=<0.01$)
OA subgroup: Significant ($\beta=0.39$, $p=0.02$)
Interaction: Significant ($\beta=1.34$, $p=<0.01$)

Peak KEM was negatively associated with medial cartilage thickness in the non-traumatic OA group, while this relationship was weaker in the post-traumatic OA group.
Discussion

- Increased medial compartments load (i.e. higher KAM) was related to lower medial compartment cartilage thickness cross-sectionally for both OA subgroups.
  - Relationships did not depend on OA subgroup.
  - This provides additional support for dynamic knee loads being a risk factor for OA progression.

- Higher late stance KEM resulted in greater medial cartilage thickness in the non-traumatic OA group. The opposite occurred in the post-traumatic OA group, although the relationship was weak.
  - History of injury could account for this finding.
  - Might alternatively be explained by disease severity.

Clinical Impact

- Mechanical knee loading on articular cartilage potentially differs between patients with non-traumatic and post-traumatic knee OA.
- Having a better understanding of the different walking biomechanics in these groups would provide better insight into the mechanisms affecting disease progression and would dictate whether they should receive similar or different treatments.

References