Histopathological Validation of Imaging Markers of First Carpometacarpal Osteoarthritis

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To assess the sensitivity and specificity of *in vivo* imaging techniques (MRI and Radiographs) for detecting the presence and severity of histopathological findings of first carpometacarpal osteoarthritis (CMC OA).

Background

- First CMC OA is a disabling condition affecting >25% post-menopausal women [1].
  - Cause of significant pain, limited mobility.
  - Trapeziectomy with ligament reconstruction and tendon interposition (Tz w/ LRTI) is common for controlling pain and restoring function.
- Radiographs are gold-standard, but MRI may provide novel information about pathology of soft tissue and bony structures.

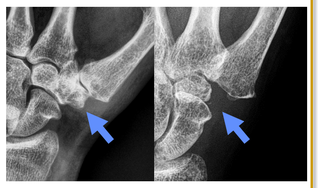


Fig 1. Radiographs before (left) and after (right) trapeziectomy

Aim: Correlate MR and µCT findings with ground-truth standards of radiographs and histopathology to determine if advanced *in vivo* imaging can detect the presence and assess severity of CMC OA pathology.

Methods: Study Flowchart

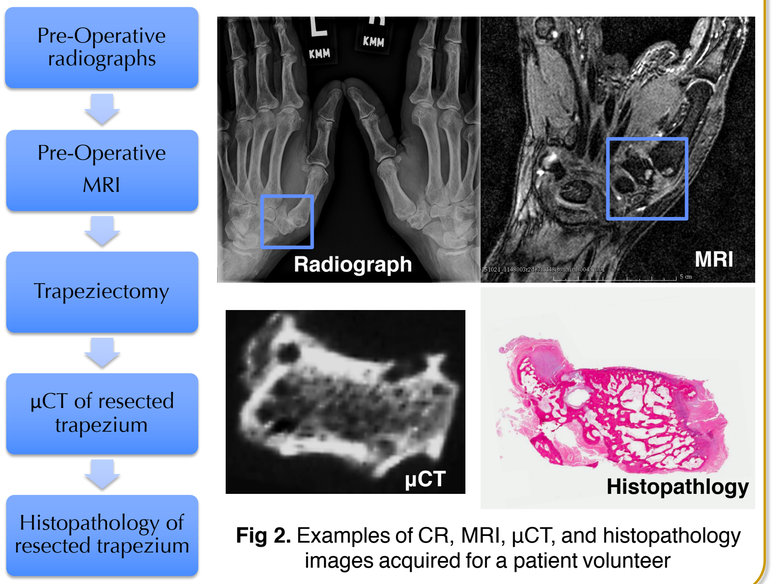
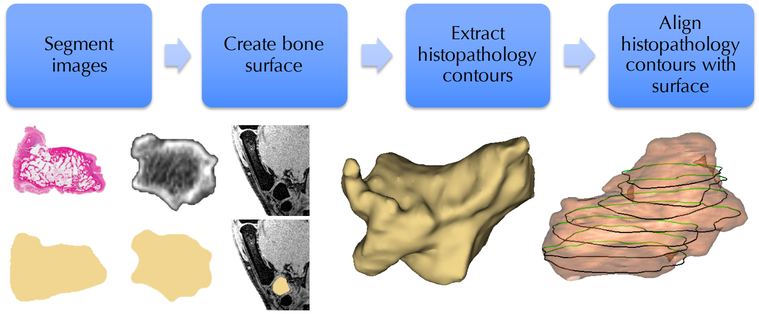


Fig 2. Examples of CR, MRI, µCT, and histopathology images acquired for a patient volunteer

Methods: Imaging-Histopathology Co-registration



Results

- Three women have completed this IRB-approved study. Four have been enrolled.
- Data below are from 3 sets of pre-operative radiographs and MR images evaluated on a 0-3 scale (none, mild, moderate, severe).
- A Modified Eaton score [2] (0-4) was calculated for each patient based on radiography.
- MRIs were scored using the OMERACT Hand OA scoring system [3].

	Parameter	Patient 1	Patient 2	Patient 3
Radiography	Subluxation %	26	20	35
	CMC Erosions	0	0	0
	Cysts	1	2.5	1
	Osteophytes	1	3	1
	Joint Space Narrowing	3	3	2.5
	Fragment Formation	1	1	0
	Modified Eaton Score	3	3	3
MRI	Synovitis	3	2	2
	Erosive damage	1	2.5	1
	Cyst	0	2	2
	Osteophyte	1	1	1
	Cartilage space loss	3	3	3
	Malalignment	2	2	2.5
	Bone Marrow Lesions	N/A	3	3

Table 1. Scoring of radiography and MRI features

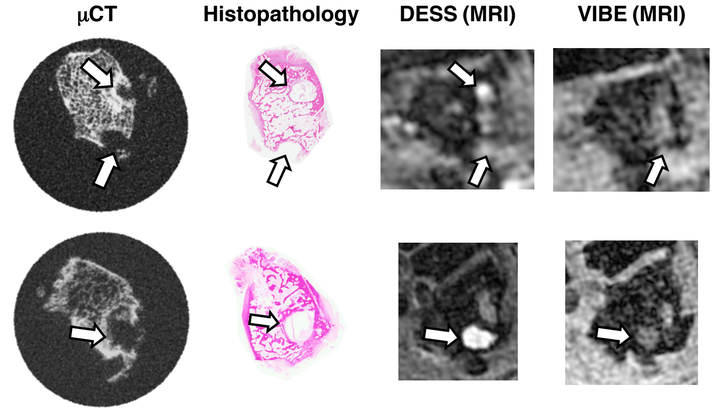


Fig 3. Co-registration demonstrating subchondral cysts in the trapezium

Discussion and Future Plans

MRI has the added benefit of providing information regarding the soft tissues and bone marrow lesions that are difficult to assess via conventional radiographs. MRI also provides valuable information regarding the degeneration patterns of articular cartilage. Findings from MRI are macroscopic and in this study we took the first steps to develop a framework to assess the sensitivity and specificity of imaging findings against gold-standard histopathology.

In the future, we will continue to implement more precise, reproducible, semi-automated co-registration (our goal is an accuracy of <1 mm) between *in vivo* imaging findings and those from histopathology. Recruitment for this study is ongoing.

References

1. Armstrong, A. L., et al. (1994). *J Hand Surg Br* 19(3): 340-341.
2. Ladd, A. L., et al. (2015). *J Hand Surg Am* 40(3): 474-482.
3. Haugen, I. K., et al. (2014). *J Rheumatol* 41(2): 386-391.

Acknowledgements

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