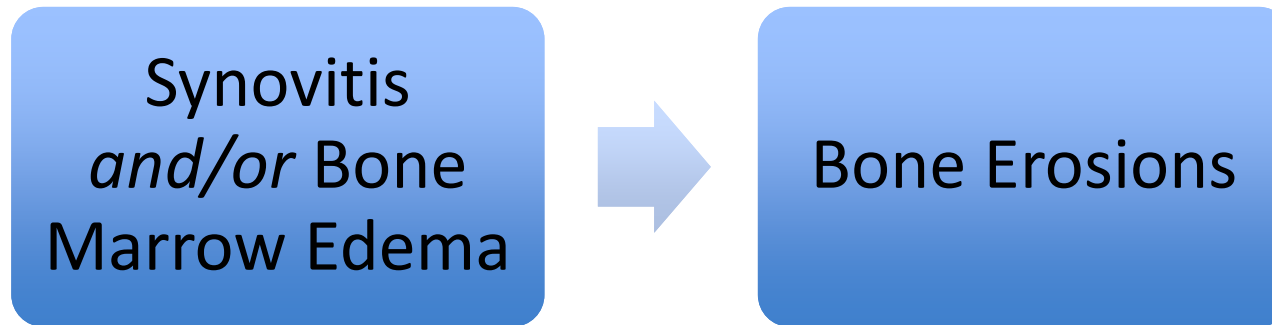


Bone Erosions in Patients with RA: Exploring the Impact of the Anatomy of Interest on the Relationship Between MRI and X-ray Erosion Detection

Michael Tomizza, BSc, MSc Candidate

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Bone Erosions



- Bone erosions are associated with ***long-term functional disability***¹
- Treatment initiation and effectiveness is largely based on ***limiting erosive progression***
- ***Diagnostic imaging modalities***, such as x-ray and MRI, can be used to detect and monitor erosive damage

X-ray vs. MRI

Table 1. Comparing the use of x-ray and MRI for RA diagnostic and treatment-monitoring purposes.

	X-ray	MRI
Strengths	<ul style="list-style-type: none"><input checked="" type="checkbox"/> simple<input checked="" type="checkbox"/> affordable<input checked="" type="checkbox"/> accessible	<ul style="list-style-type: none"><input checked="" type="checkbox"/> 3D<input checked="" type="checkbox"/> can depict soft tissue changes<input checked="" type="checkbox"/> sensitive to early erosions^{2,3}
Weaknesses	<ul style="list-style-type: none"><input checked="" type="checkbox"/> 2D<input checked="" type="checkbox"/> not useful for depicting soft tissue changes<input checked="" type="checkbox"/> difficulty detecting early erosive disease²	<ul style="list-style-type: none"><input checked="" type="checkbox"/> time-consuming<input checked="" type="checkbox"/> expensive<input checked="" type="checkbox"/> limited accessibility

Study Rationale

- While many studies have compared the use of x-ray and MRI for characterizing erosive disease, sources of heterogeneity exist
- One potential source of heterogeneity that is not always considered is the selected anatomy of interest, as the joints assessed by researchers and clinicians may vary
- Given the importance of detecting and monitoring erosive progression, ***the goal of this study was to describe the relationship between these two modalities while taking into account the anatomy of interest***

Study Objectives

1. Pair the data at the ***most precise anatomical level*** possible.

ie. Compared to x-ray, how many metacarpophalangeal (MCP) joints are detected as having erosions using MRI?

2. For clinical relevance, also compare ***anatomical joint groups*** measured by each modality and the ***proportion of patients*** with erosive disease.

ie. Compared to x-ray, how many metacarpophalangeal (MCP) 2-5 joint sets are detected as having erosions using MRI?

Compared to x-ray, what proportion of patients are found to have erosions using MRI?

Methodology

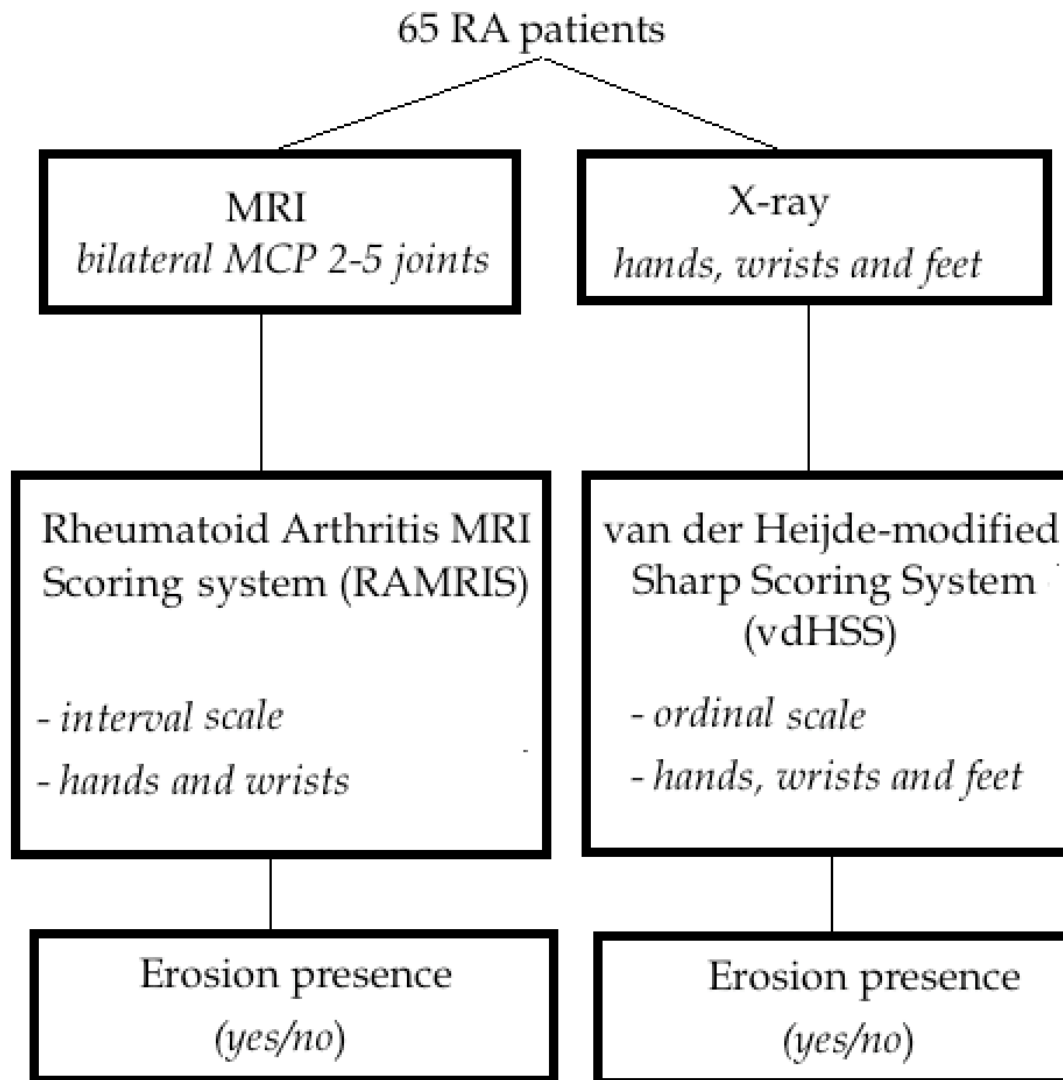


Figure 2. Flow chart depicting the scanning process, including the methods used to analyze the erosive damage captured by each modality.

Results: Demographics

Table 2. Study demographics, n=65 [median (interquartile range)].

Characteristic	Study Population
<i>Age</i>	59.0 (49.0-66.0) years
<i>Sex</i>	83.1% female
<i>Ethnicity</i>	61% Caucasian
<i>Symptom Duration</i>	4.3 (2.6-7.0) years
<i>Rheumatoid Factor Positivity</i>	70.8%
<i>Disease Activity Score (DAS28)</i>	4.5 (3.3-5.7)
<i>Clinical Disease Activity Index (CDAI)</i>	62.3 (32.7-91.6)

Results: Individual Joint Level

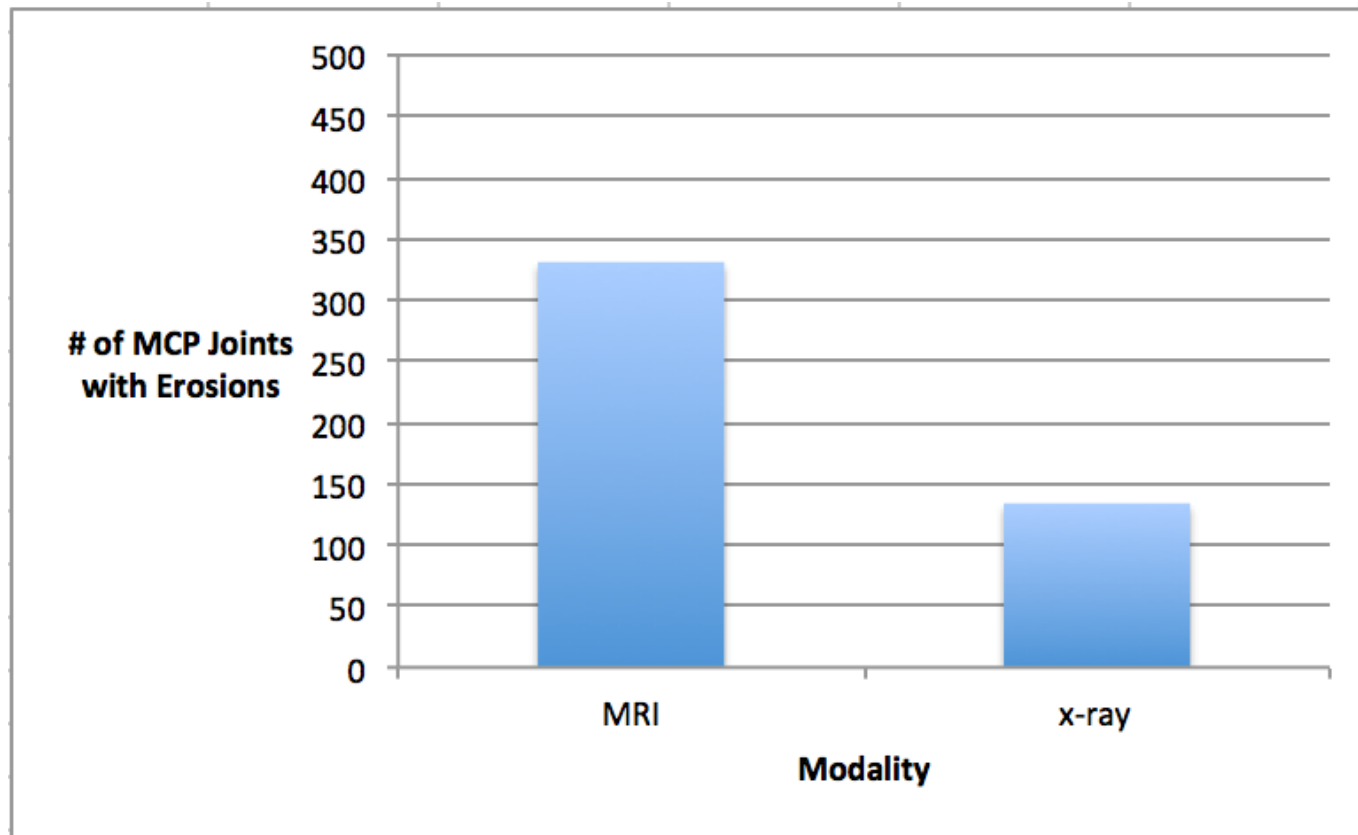


Figure 3. The number of individual MCP 2-5 joints detected as having erosions, with a total of 448 joints assessed by each modality.

Results: Level of Joint Sets

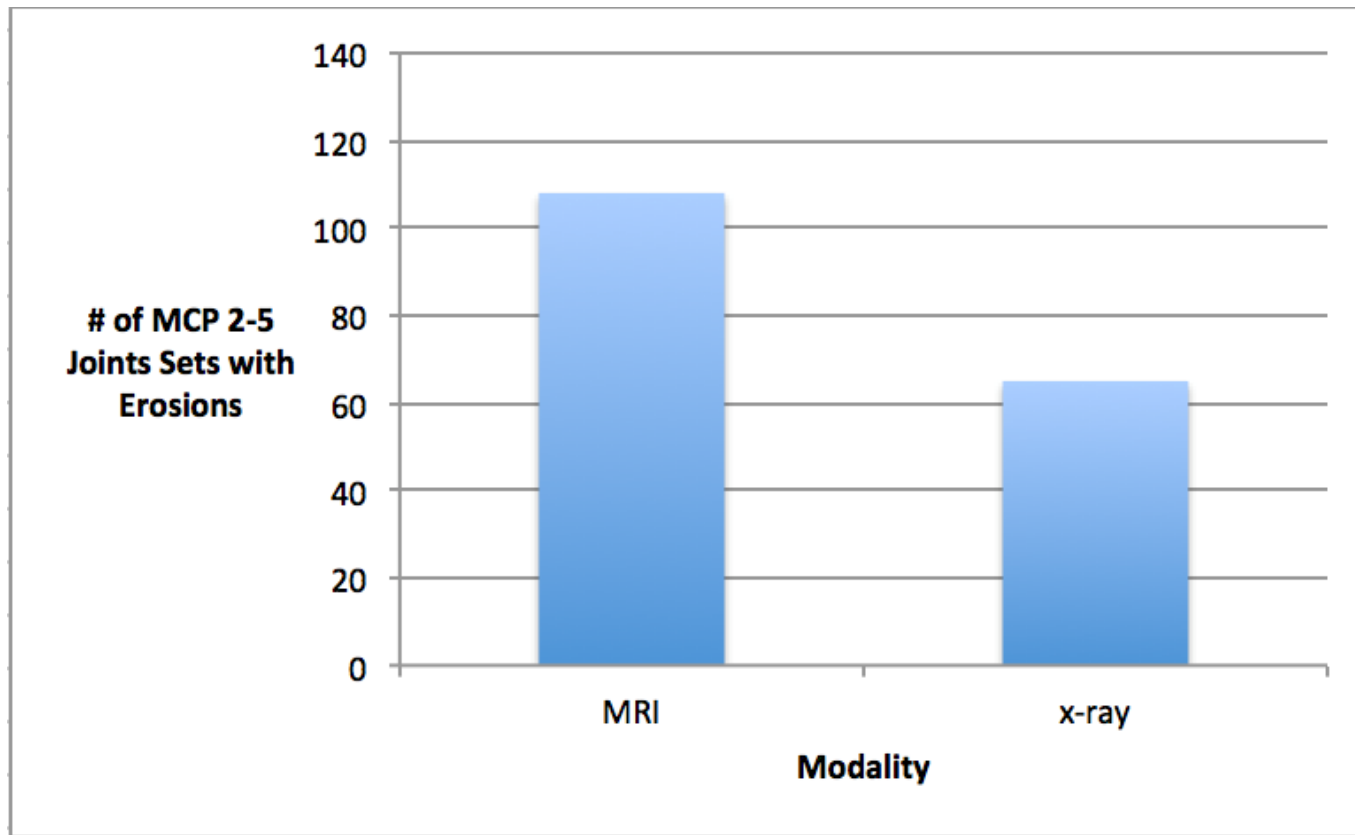


Figure 4. The number of MCP 2-5 joint sets detected as having erosions, with a total of 112 joint sets assessed by each modality.

Results: Patient Level

With bilateral MRI of the MCP 2-5 joints, the proportion of patients with erosive disease was:

1.10-fold the frequency detected on x-rays of the hands, wrists and feet

Limiting MRI to the dominant MCP 2-5 joints, the proportion of patients with erosive disease was:

0.66-fold the frequency detected on x-rays of the hands, wrists and feet

1.00-fold the frequency detected on x-rays of the feet

1.30-fold the frequency detected on x-rays of the hands and wrists

Discussion

- ***Practically***, the results suggest that the relative performance of the two imaging modalities is highly dependent on the anatomy imaged
- ***Technologically***, the findings demonstrate the enhanced capacity of MRI to detect erosive disease
- ***Collectively***, these findings demonstrate the importance of the anatomy of interest in erosion detection and the clinical value of MRI as a tool for identifying RA patients with erosive damage

Thank you

References

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2. McQueen FM, Benton N, Crabbe J, Robinson E, Yeoman S, McLean L, Stewart N. What is the fate of erosions in early rheumatoid arthritis? Tracking individual lesions using x-rays and magnetic resonance imaging over the first two years of disease. *Ann Rheum Dis.* 2001; **60(9)**: 859.
3. Hoving JL. A comparison of magnetic resonance imaging, sonography, and radiography of the hand in patients with early rheumatoid arthritis. *J Rheumatol.* 2004; **31**: 633.

Appendix A: MRI Parameters

Feature	Erosion	Erosion	Edema	Synovitis
Sequence Type	3D gradient echo	Fast spin echo	Fast spin echo	Fast spin echo
Orientation	coronal	axial	coronal	Axial
Repetition time (TR)	60	470	4000	2500
Echo time (TE)	6.6	15.1	15.1	40
Fat saturation	no	no	no	yes
Inversion recovery	no	no	yes	yes
Thickness, mm	1	2	2	2
Interslice gap, mm	0	0	0	0
Number of slices	40	16	16	18
Field of view, mm	140	110	110	110
Frequency	280	256	256	256
Phase	140	192	192	160
Minimum TE	yes	yes	yes	no
Number of excitations	1	2	1	2
Frequency direction	H/F	L/R	H/F	L/R
Flip angle	60	90	90	90
Bandwidth	50	35	35	25
Echo train	1	2	8	4
Number of echoes	1	1	1	1

Appendix B: RAMRIS Erosion Score

Score the following from the articular surface (or its best estimated position if absent) to a depth of 1 cm.

BONE EROSION is scored 0-10, according to the proportion (in increments of 10%) of bone involved:

- | | | | | | |
|-----------|-----------|-----------|-----------|-----------|-------------|
| 0) 0% | 1) 1-10% | 2) 11-20% | 3) 21-30% | 4) 31-40% | |
| 5) 41-50% | 6) 51-60% | 7) 61-70% | 8) 71-80% | 9) 81-90% | 10) 91-100% |

		MCP Joint				Subtotal Score
		2	3	4	5	
Bone erosion (0-10)	Proximal	—	—	—	—	—
	Distal	—	—	—	—	—