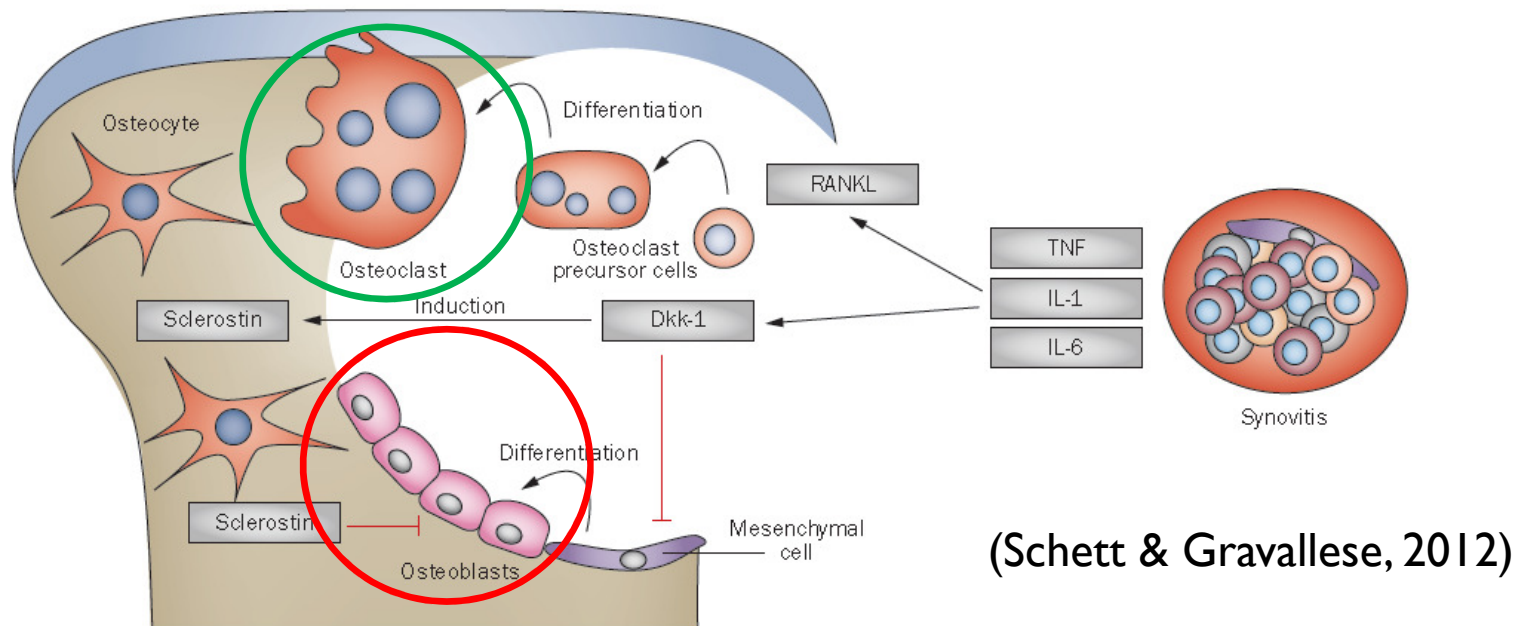


Validity and Reliability of “*Early Erosions in Rheumatoid Arthritis*” (EERA) Software: Quantifying Erosion Size in the Hand

Presented by: Matthew Jessome, BHSc candidate

Erosive Damage to MCP Joints in RA



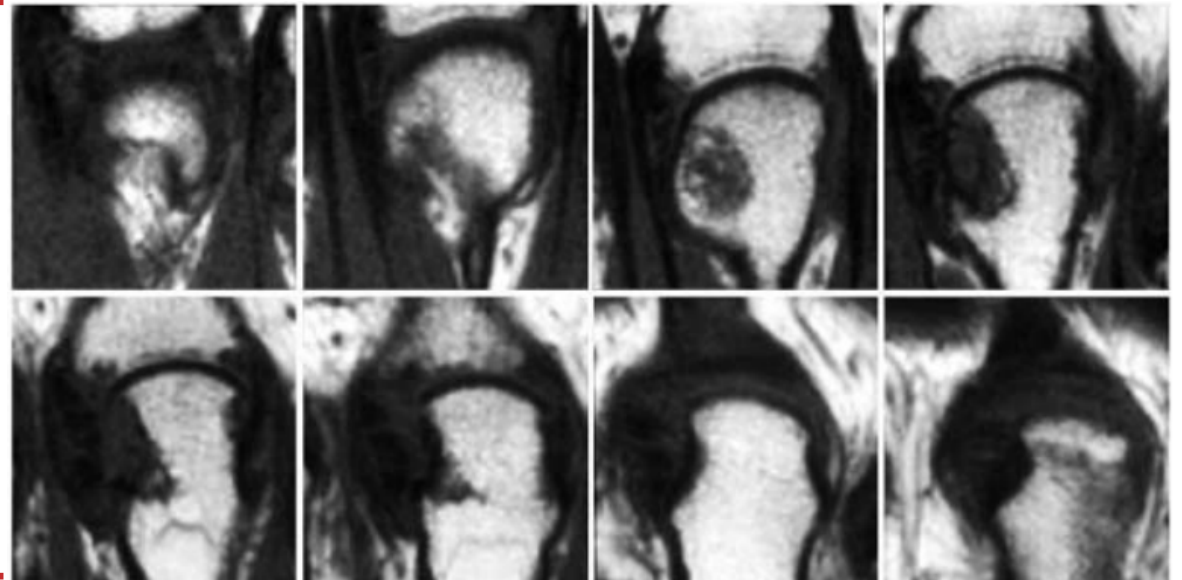
- Bone erosions are a diagnostic feature of RA
- Erosive damage is predictive of disease disability and mortality (Odegard et al., 2006)
- Erosive damage is monitored throughout treatment

RAMRIS: The Current Standard

RAMRIS score of 3

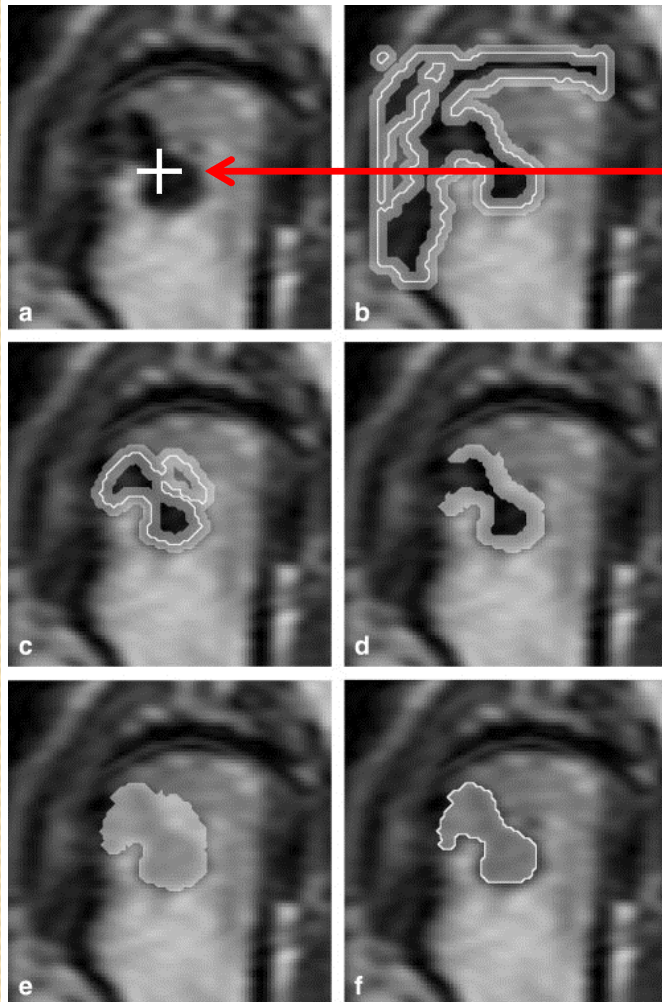
One erosion viewed in
8 consecutive slices

(Conaghan et al., 2005)



- Training & expertise requirements
- Limitation: semi-quantitative
- Moderate Reliability
 - ICC reports ranging from 0.44 to 0.94

Early Erosions in Rheumatoid Arthritis (EERA) Software



- Semi-automated
 1. Reader places a “seed”
 2. Iteratively stabilize the “seed,” using 5 parameter sets
 3. Reader chooses parameter set that best captures erosion
 4. EERA computes erosion volume (mm^3)

(Emond et al., 2012)



Objectives

- *To establish the validity and reliability of EERA used by novice readers by comparing EERA measurements to RAMRIS used by expert readers.*
- Outcomes:
 - Validity:
 - Spearman's ρ : Cross-sectional and longitudinal correlations between EERA and RAMRIS
 - Reliability:
 - Intraclass correlation coefficient (ICC)
 - 95% Limits of agreement (Bland & Altman, 1986)

Methods

71 participants: MRI at baseline



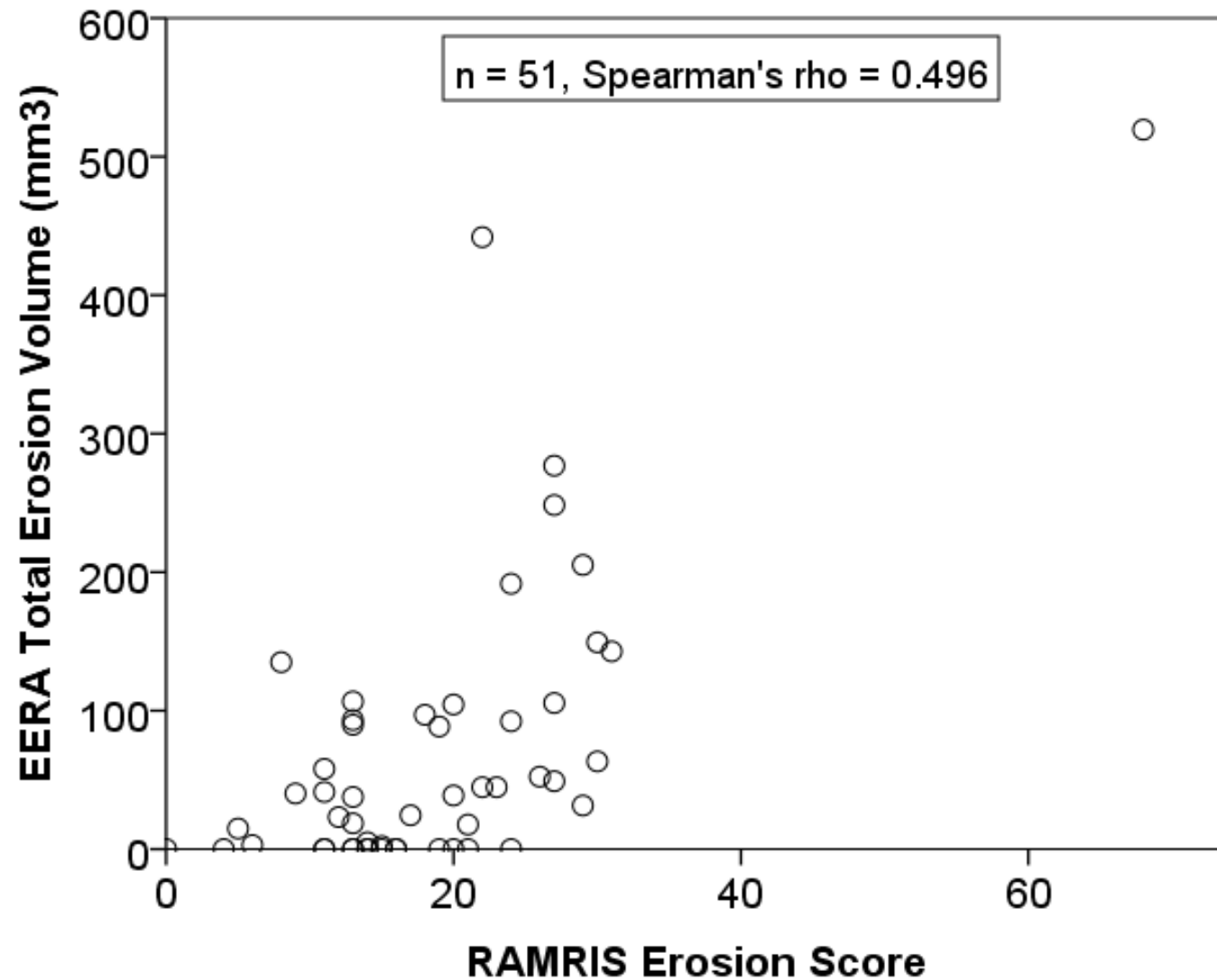
52 participants: MRI at 2 years FLU

71 + 52 = 123 total image sets

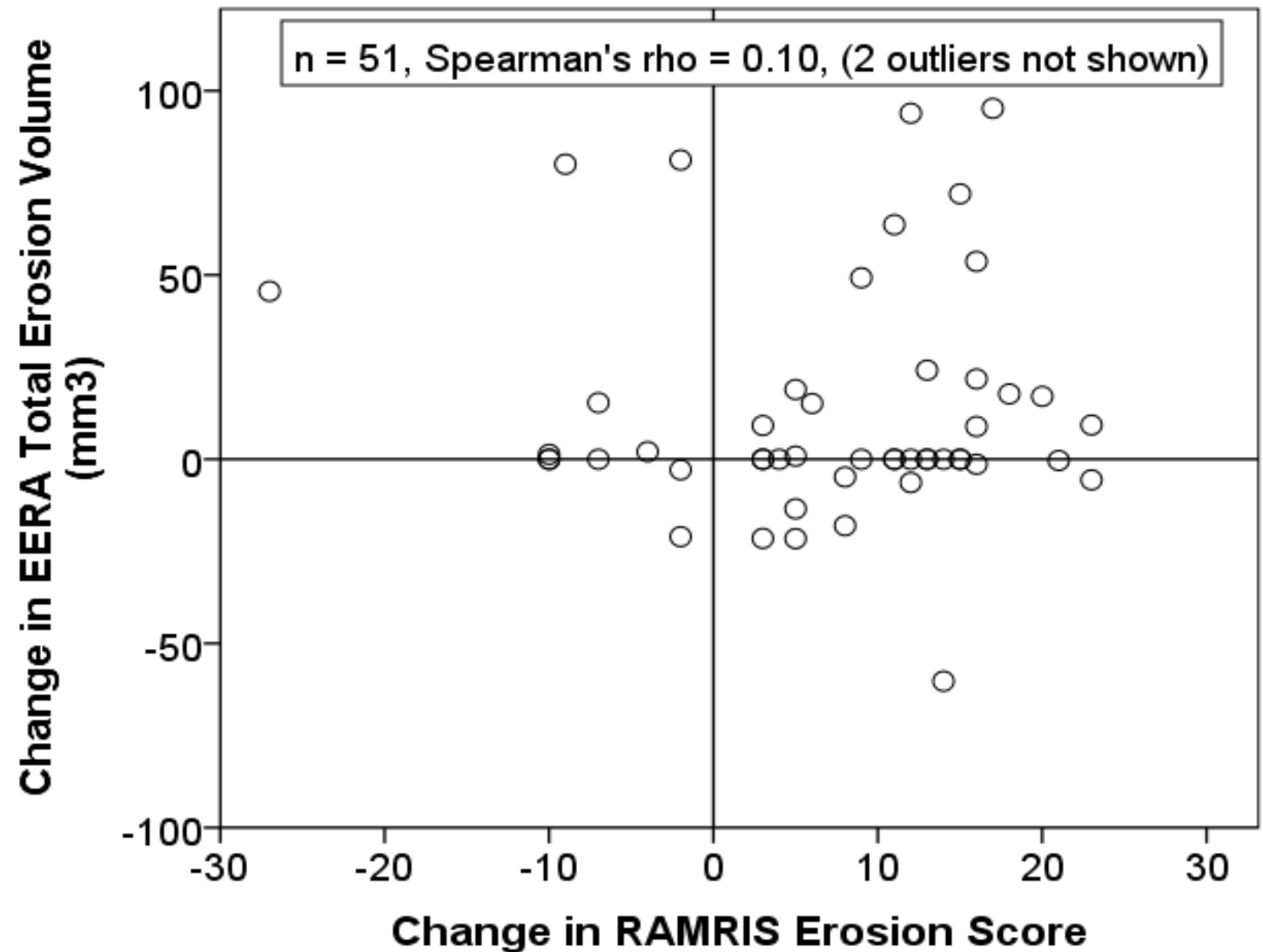
	n=71
Female, %	78
Caucasian, %	72
Age in years, mean (SD)	56.5 (12.8)
Symptom Duration in years, mean (SD)	5.5 (5.7)
DAS28-ESR, mean (SD)	4.4 (1.4)

- 123 image sets scored using RAMRIS by four musculoskeletal radiologists
- Same 123 image sets segmented using EERA by one novice reader
 - A subset of 20 image sets segmented using EERA by two other novice readers

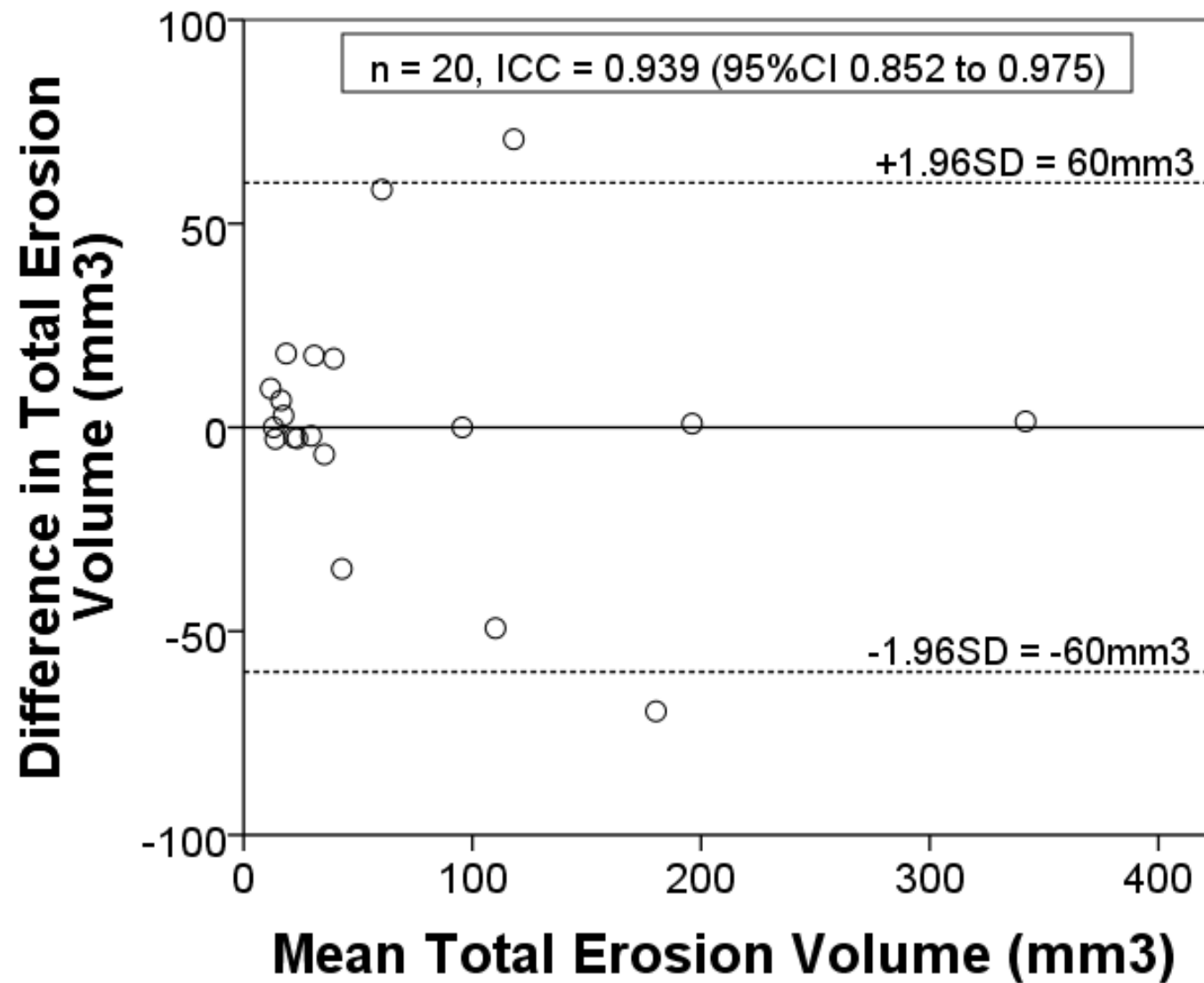
Cross-sectional Convergent Validity: EERA vs. RAMRIS



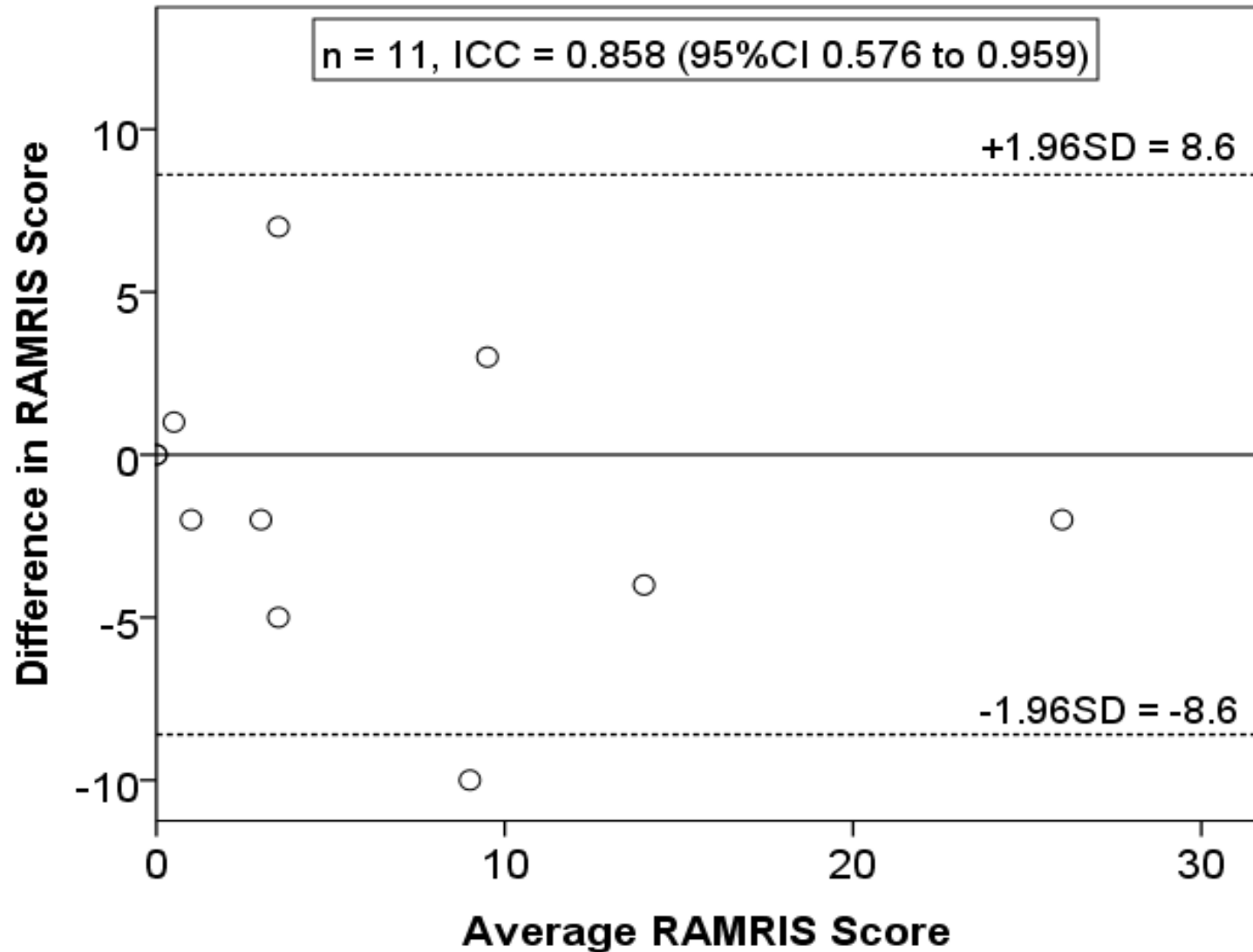
Longitudinal Convergent Validity: EERA vs. RAMRIS



Inter-rater Reliability (EERA)



Inter-rater Reliability (RAMRIS)





Summary

- EERA can be used by novice readers with minimal training
- EERA reliability is excellent, with ICCs exceeding those for RAMRIS
- EERA and RAMRIS correlate moderately cross-sectionally; longitudinal relationship remains ambiguous



Future Goals

- Evaluate, using a sample expected to exhibit erosive progression:
 - Longitudinal validity
 - Sensitivity to change
 - Responsiveness
- Economic analysis
- Potential for use of EERA in clinical practice and research



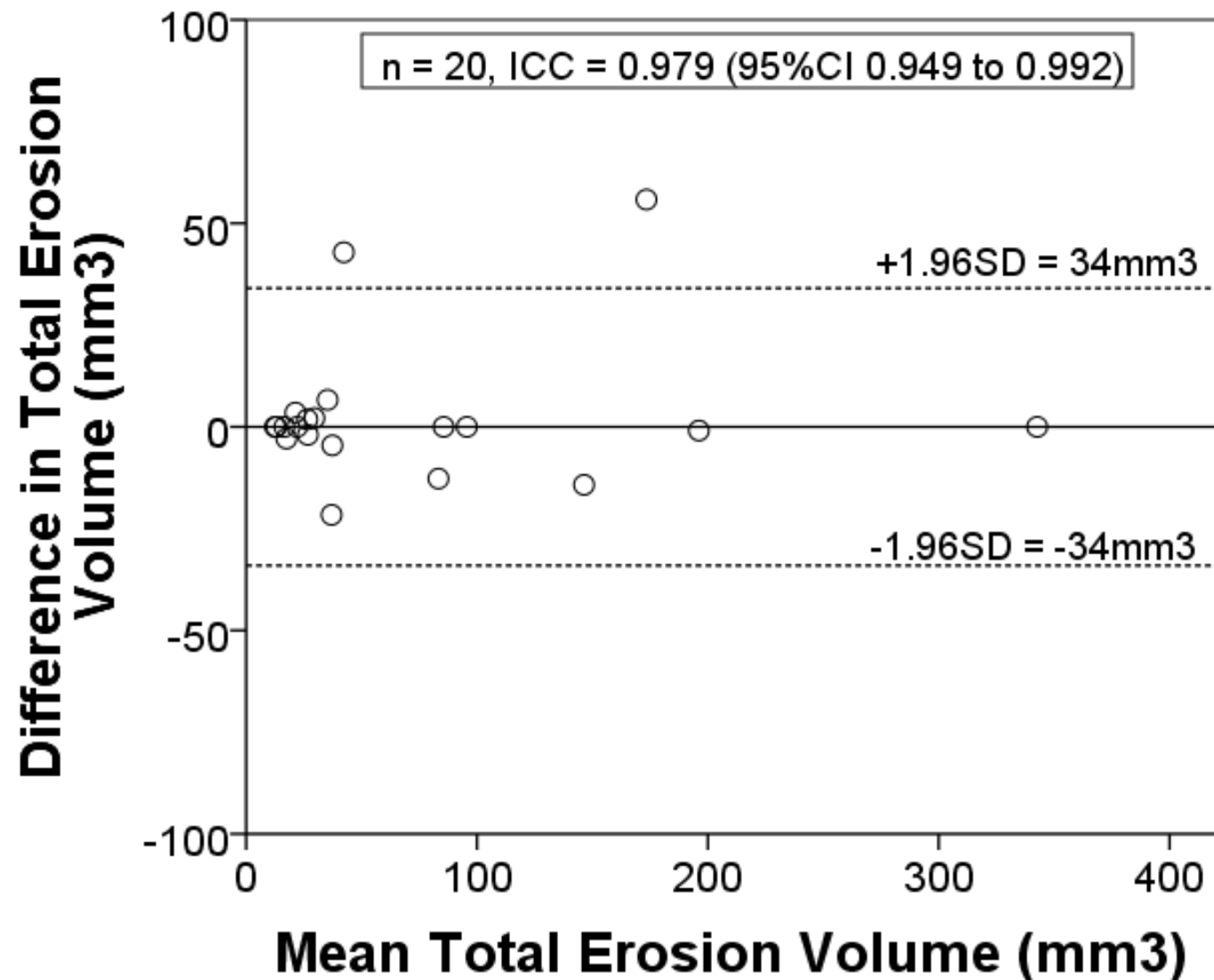
Thank you



References

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2. Ødegård S, Landewé R, van der Heijde D, Kvien TK, Mowinckel P, Uhlig T. Association of early radiographic damage with impaired physical function in rheumatoid arthritis: a ten-year, longitudinal observational study in 238 patients. *Arthritis Rheum*. 2006 Jan;54(1):68–75.
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5. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*. 1986;1(8476):307–10.

Intra-rater Reliability (EERA)



Appendix I: MRI Parameters

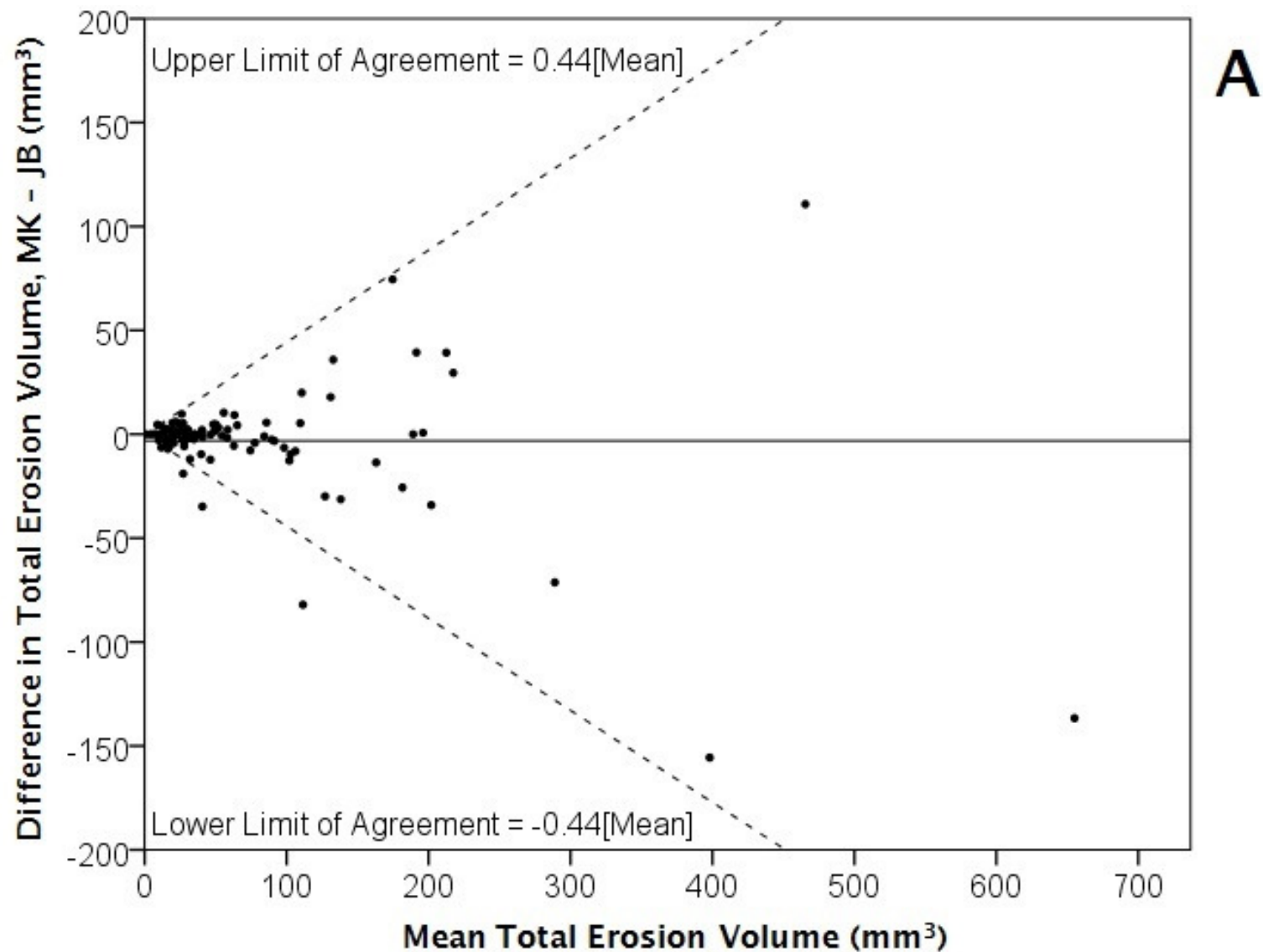
Sequence Type	3D gradient echo
Orientation	coronal
Repetition Time (TR)	60 ms
Echo Time (TE)	6.6 ms
Fat Saturation	no
Inversion Recovery	no
Slice Thickness	1 mm
Interslice gap	0 mm
Number of Slices	40
Field of view	140 mm
Frequency	280 MHz
Phase	140
Minimum TE	yes
Number of excitations	1
Frequency direction	H/F
Flip angle	60.0°
Bandwidth	50 kHz
Echo Train	1
Number of echoes	1

Appendix II: Patient Demographics

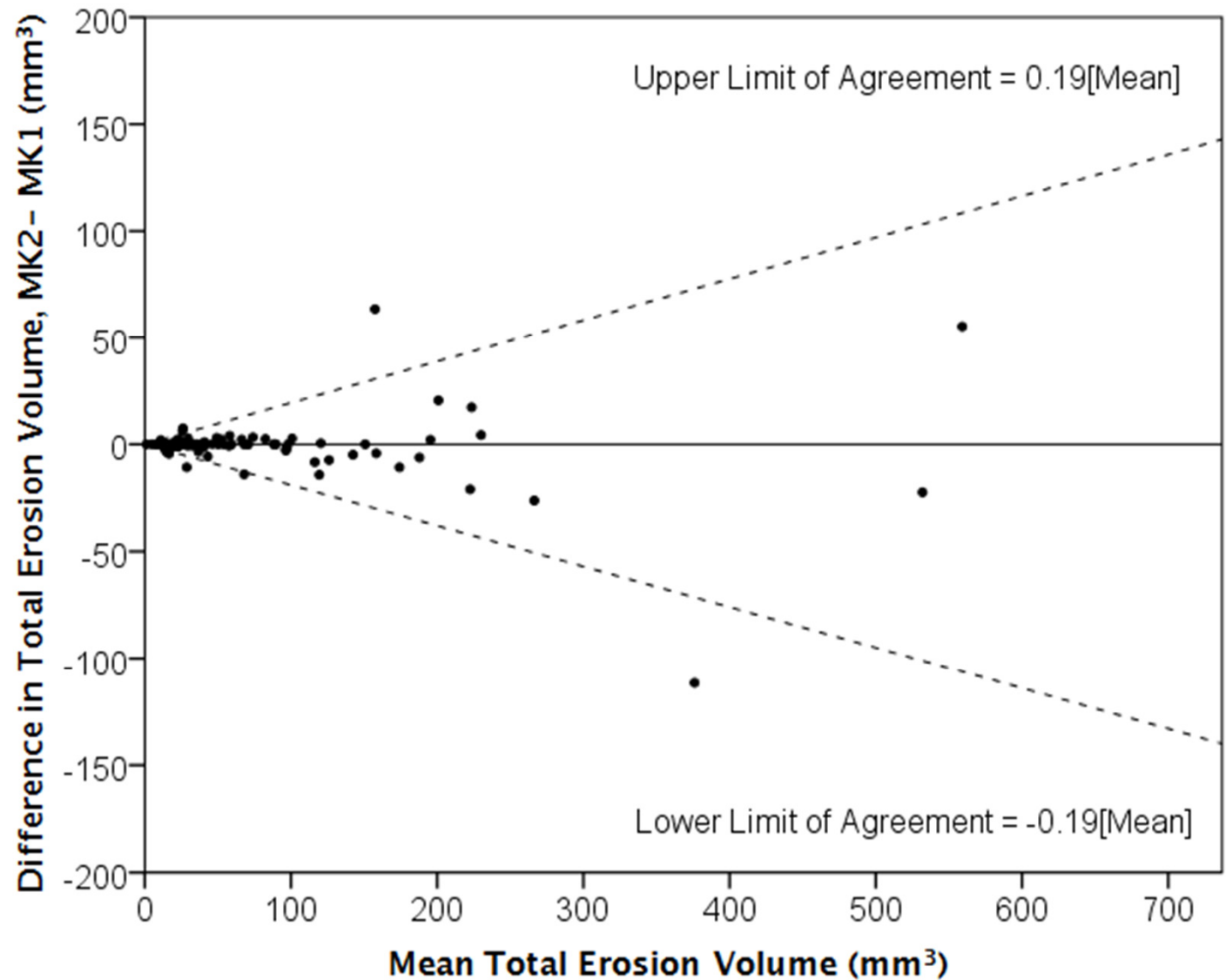
Demographics		Total Patients (n=68)
	n (%)	n measured*
Female	48 (70.6)	n=68
Ethnicity: Caucasian	56 (83.6)	n=67
	Mean (SD)	
Age, years**	57.4 (10.3)	n=66
Weight, kg	79.8 (17.6)	n=63
Height, cm	167.5 (9.7)	n=61

Disease Activity at Time of Image Acquisition		Total Images (n=100)
	Mean (SD)	n measured*
Symptom duration, years	4.8 (4.5)	n=97
Tender joint count – 28	6.7 (6.8)	n=91
Swollen joint count – 28	7.4 (6.0)	n=91
ESR, mm/h	18.1 (14.7)	n=85
DAS28-ESR _{3V}	4.0 (1.5)	n=83
HAQ-DI	0.64 (0.59)	n=58
Medications at Time of Image Acquisition		
	n (%)	n measured
Oral steroid	53 (53)	n=100
OTC medication	83 (83)	n=100
DMARD	87 (87)	n=100

Appendix III: Inter-rater Reliability



Appendix IV: Intra-rater Reliability



Appendix V: 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					
		—	—	—	—	—