Metacarpal Morphology: Radial Curvature of the Metacarpals and Evaluation of Inner and Outer Diameter

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Introduction

- Metacarpal radius of curvature has not been defined.
- There is a shift in surgical technique towards intramedullary fixation using straight implants such as screws or pins in treating some metacarpal shaft fractures[1].
- We aim to define the radius of curvature of the metacarpals using both inner and outer diameter by analyzing CT scans.
- Understanding the osteology will contribute to better surgical outcomes.

Methods

- We accessed 1mm full body CT scans from the Office of Medical Investigator in New Mexico.
- Skeletal surfaces were generated from the CT scans using Stratovan Checkpoint[2] software.
- The radius of curvature was measured by placing curves along the palmar aspect of the metacarpals (Figure 1) and points along the curve were exported. The radius of curvature was calculated by fitting a circle to the points.
- The inner and outer diameters were measured on a cross-sectional view from the software model (Figure 2).

Figure 1

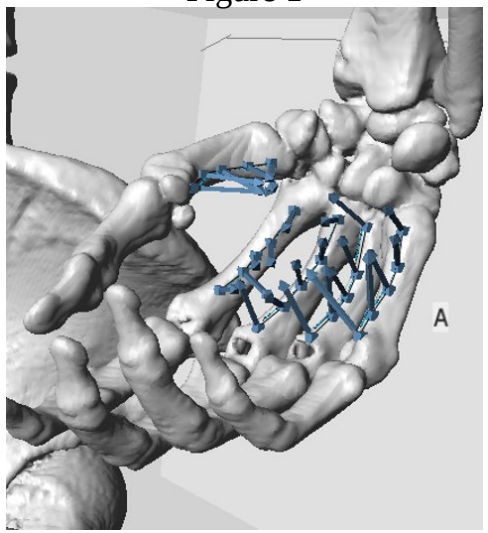

Figure 2

Table 1

Digit	OD Proximal		ID Proximal		OD Center		ID Center		OD Distal		ID Distal		ROC	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Right Thumb	14.6	2.4	8.3	1.8	9.7	1.1	4.7	0.8	13.6	1.4	6.9	1.5	28.5	8.3
Right Index	15.6	1.9	8.6	2.1	9.7	1.2	3.4	0.8	14.5	1.6	8.3	1.9	55.2	7.6
Right Middle	15.5	2.4	7.8	2.0	9.8	1.3	3.4	0.8	14.4	1.7	8.6	2.1	52.4	10.1
Right Ring	12.8	1.7	6.4	1.3	8.2	1.5	2.8	0.8	12.9	1.9	7.2	2.1	40.8	7.5
Right Small	11.7	1.4	6.1	1.2	8.1	1.3	3.2	0.6	12.3	2.2	7.0	2.0	41.3	8.3
Left Thumb	14.7	2.1	7.8	1.4	9.2	1.4	4.9	0.9	13.4	1.3	7.6	1.8	30.0	7.6
Left Index	14.9	1.7	8.7	1.8	9.2	1.3	3.2	0.8	13.7	2.0	8.1	2.3	54.3	8.0
Left Middle	14.5	1.2	7.8	1.6	9.6	1.4	3.6	0.9	14.2	1.5	8.7	1.5	50.7	8.0
Left Ring	12.3	1.2	6.8	1.2	7.7	1.2	3.1	0.6	13.0	1.8	7.8	1.5	43.1	6.8
Left Small	11.3	1.1	6.3	1.8	7.7	1.0	3.1	0.7	12.6	1.5	7.8	1.5	40.6	10.6

Results

- The radius of curvature, as measured here, was greatest for the second metacarpal (index finger) and least for the first (thumb).
- There is quantifiable variance in diameter across the length of the intramedullary canals of all metacarpals from proximal to distal ends (Table 1).
- This data represents a subset of our sample size. We will continue to measure the remainder of the 300 CT scans.

Conclusion

- A method for measuring radius of curvature of the metacarpals was proposed and applied to CT scans of a consecutive sample taken from the New Mexico Office of the Medical Investigator.
- This study highlights the importance of choosing the right type and size of fracture fixation implant to achieve favorable surgical outcomes.

References

1. Hoang, D., Vu, C. L., Jackson, M., and Huang, J. I. An anatomical study of metacarpal morphology utilizing CT scans: evaluating parameters for antegrade intramedullary compression screw fixation of metacarpal fractures. J Hand Surg Am 46 (2021). DOI 10.1016/j.jhsa.2020.08.007
2. Stratovan Corporation. Stratovan Checkpoint [Software]. Version 2020.10.13.0859 WIN x64. Oct 13, 2020. URL: https://www.stratovan.com/products/checkpoint