# Intramedullary Screw Fixation and Relevant Diameter of the Proximal Phalanges of the Foot

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## INTRODUCTION

The average intramedullary diameter of the proximal phalanges of the foot has not been well documented in the literature. This dimension has important implications for surgical fixation devices, such as intramedullary screws for the correction of hammertoes. By design, intramedullary fixation devices rely on endosteal fit to provide stability. The precise intramedullary diameter is not readily identifiable on plain radiographs. A better understanding of the average intramedullary diameter of the proximal phalanges of the foot can assist surgeons with surgical planning for appropriate screw diameter selection to provide more satisfactory patient outcomes.

## METHODS

Twenty below-knee cadaveric specimens were dissected to expose each proximal phalanx. A sagittal saw was used to transect the diaphysis at its narrowest portion. The dorsal to plantar and medial to lateral diameters were measured using a digital manometer.

| Table 1. Specimen Characteristics (n=20) | |
|---|---|
| Right-sided | 12 |
| Left-sided | 8 |
| Male | 11 |
| Female | 9 |
| Average Age at Death | 72.1 |
| Average BMI at Death | 22.0 |

## RESULTS

The average diameter dorsal to plantar for each digit was 6.25 ± 2.24 mm, 3.61 ± 1.25 mm, 2.94 ± 0.70 mm, 2.72 ± 0.77 mm, and 2.48 ± 0.80 mm, respectively. The average diameter medial to lateral for each digit was 7.83 ± 2.13 mm, 3.08 ± 0.93 mm, 2.47 ± 0.74 mm, 2.33 ± 0.73 mm, and 2.62 ± 0.69 mm, respectively.

Figure1: A manometer was used to measure the narrowest portion of the proximal phalanx.

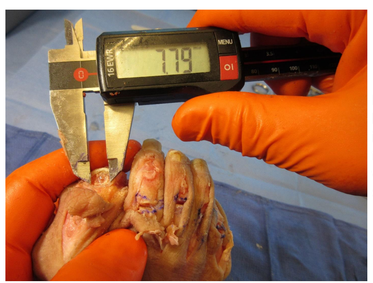


Figure 2: The medial to lateral diameter of the intramedullary canal of the proximal phalanx was measured using a digital manometer.

**Table 2. The proximal phalanx diameters of toes 1 – 5.**

| | 1 | | | 2 | | | 3 | | | 4 | | | 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DP | ML | Avg | DP | ML | Avg | DP | ML | Avg | DP | ML | Avg | DP | ML | Avg |
| **Minimum (mm)** | 2.76 | 4.07 | 3.43 | 1.25 | 1.25 | 1.25 | 1.21 | 0.85 | 1.03 | 1.52 | 1.27 | 1.49 | 1.32 | 1.25 | 1.29 |
| **Maximum (mm)** | 10.21 | 12.01 | 9.78 | 5.95 | 5.44 | 5.70 | 4.08 | 3.96 | 3.57 | 4.43 | 3.85 | 4.14 | 4.82 | 3.97 | 3.77 |
| **Average (mm)** | 6.25 | 7.83 | 7.04 | 3.61 | 3.08 | 3.35 | 2.94 | 2.47 | 2.71 | 2.72 | 2.33 | 2.52 | 2.48 | 2.62 | 2.55 |
| **Standard Deviation (mm)** | 2.24 | 2.13 | 1.95 | 1.25 | 0.93 | 1.04 | 0.70 | 0.74 | 0.66 | 0.77 | 0.73 | 0.71 | 0.80 | 0.69 | 0.63 |

**DP= Dorsal to Plantar; ML= Medial to Lateral**

## DISCUSSION

Published data on the intramedullary diameter of the phalanges is difficult to find. Dipaolo et al looked at the diameter of lesser phalanges for tendon transfer stability. However, they measured the full width at the metaphyseal-diaphyseal junction. The intramedullary diameter was not mentioned. In our study, the lesser phalanges demonstrated smaller diameters more consistently, which are more amenable to a single smaller (2.5 mm) intramedullary device. The hallux proximal phalanx demonstrated a larger diameter overall and a more elliptical shape with slightly greater width than height. This may be more amenable to two side by side screws. Understanding the intramedullary diameters of the proximal phalanges of the foot is a valuable tool when utilizing intramedullary surgical stabilization. Data collected from these 20 cadaveric specimens can provide surgeons with a general expected intramedullary diameter during surgical planning.

## REFERENCES

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