



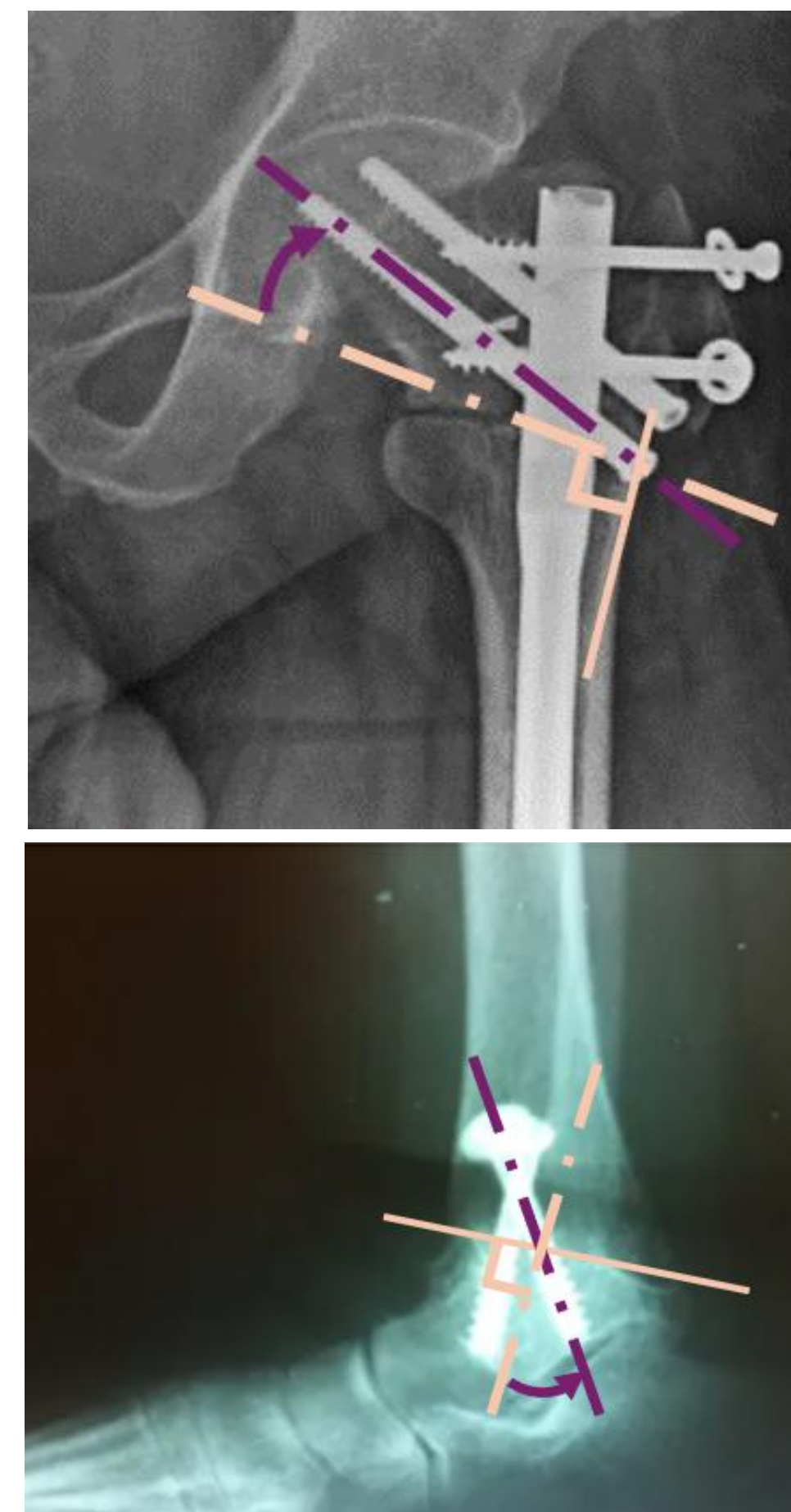
Entry Surface and Hole Path Deviations in Inclined Bone Drilling

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BACKGROUND AND MOTIVATION

Inclined bone drilling is common in surgical procedures where perpendicular access is limited. However, inclined entry leads to drill-bit skidding, delayed engagement, and path deviation. Quantifying both entry surface and hole path deviation is critical for improving surgical accuracy.



OBJECTIVE

To quantify entry surface deviation (Δ) and hole path deviation (δ) and path length (d) in inclined bone drilling.

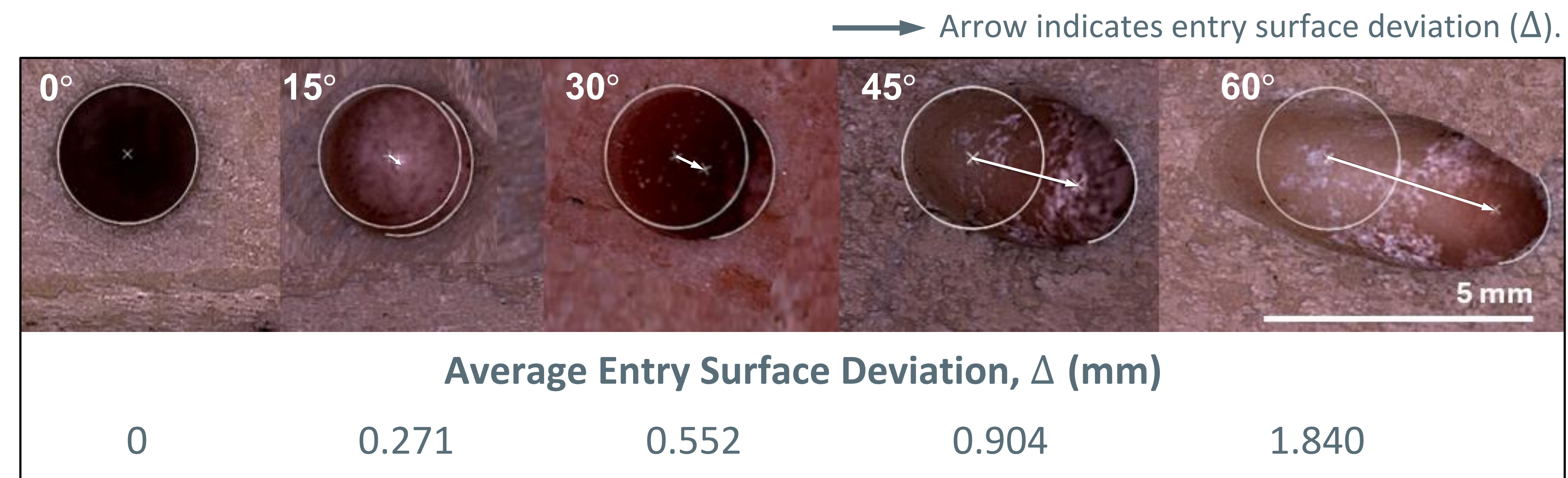
EXPERIMENT

Measurement of Entry Surface Deviation via Image Processing



RESULTS AND DISCUSSION

Entry Surface Deviation (Δ) vs. Inclined Angle in Bone Drilling

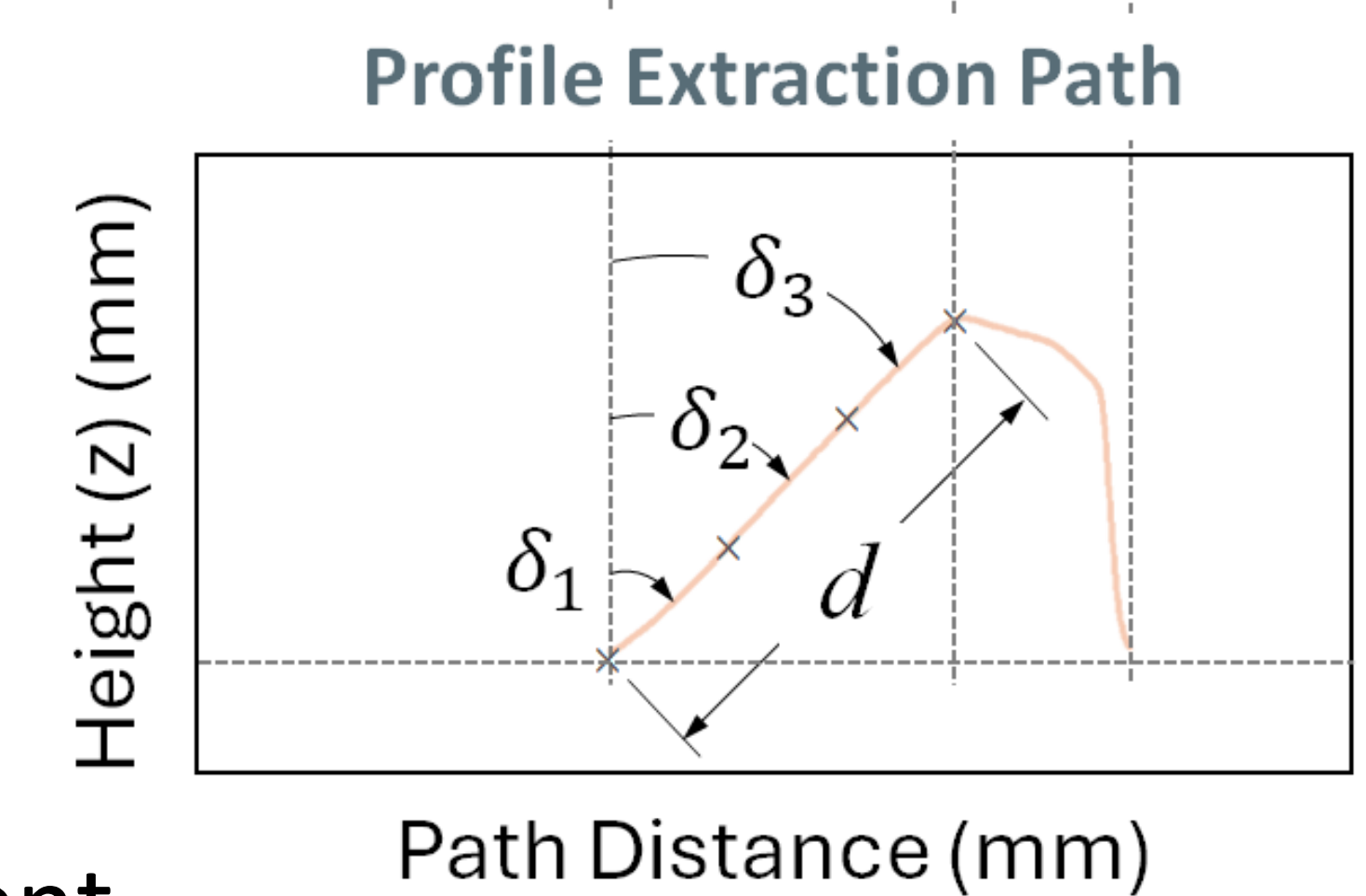
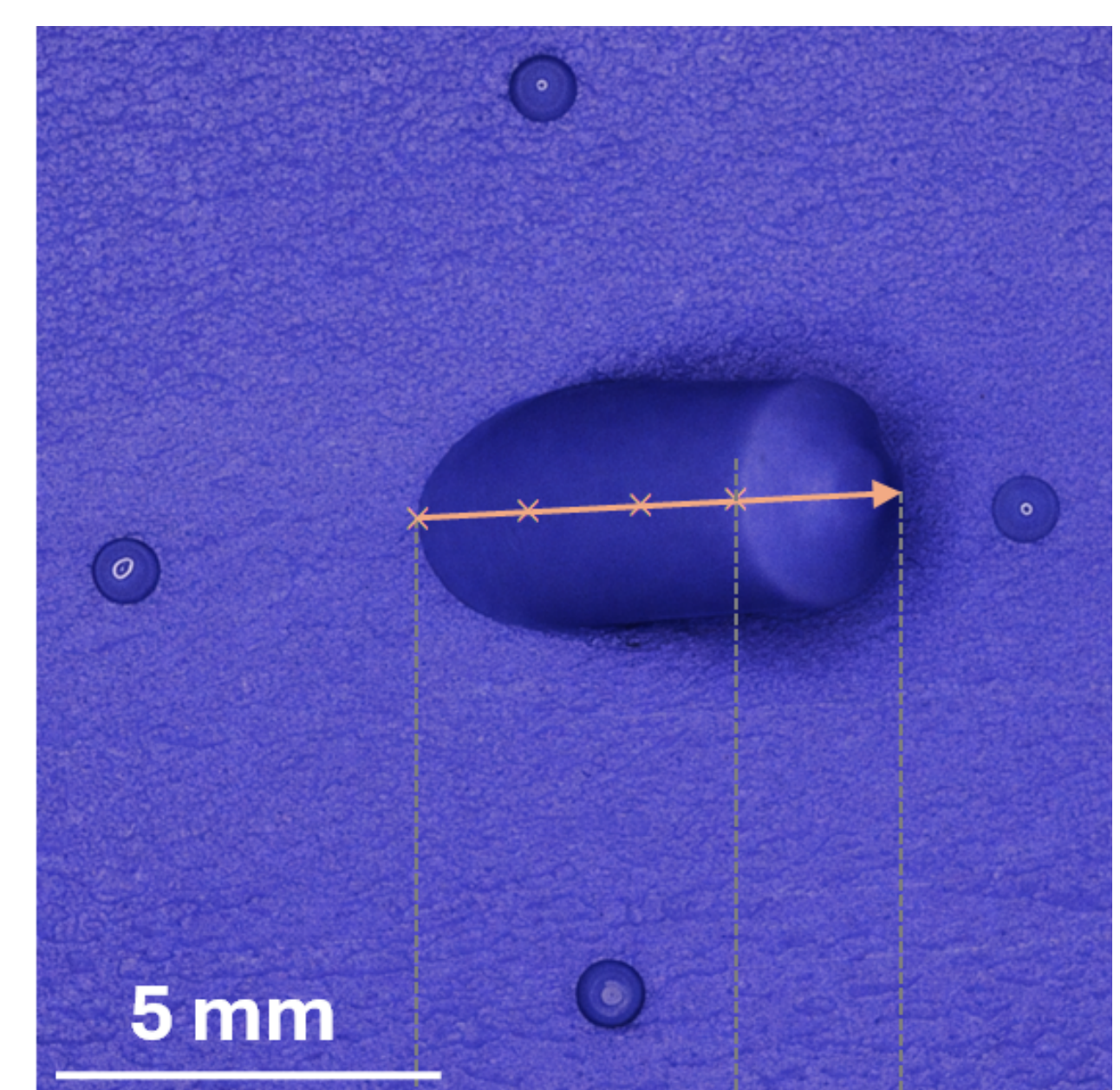


Entry surface deviation (Δ) increases with inclination angle, indicating increased lateral force asymmetry.

Hole Path Deviation in Inclined Bone Drilling

Incline (°)	Avg. δ (°)	d (mm)
0	0	5.00 (Nominal Depth)
15	14.82	4.68
30	29.94	5.12
45	45.10	4.96
60	61.98	5.36

- Hole path deviation (δ) increases with inclination.
- Path length (d) shows no clear trend with inclination angle.
- Indicates axial constraint with skidding and delayed engagement.



$\delta_1 - \delta_3$: local path deviation
 d : hole path length

ACKNOWLEDGEMENT

We gratefully acknowledge Dr. Joshua Steimel for his guidance on developing the molding technique for hole path deviation measurement. We also thank our machinist, Colin Wingfield, for providing CNC access and assisting in the design and fabrication of the inclined drilling device.

Hole Path Deviation via Molding and Image Processing

