

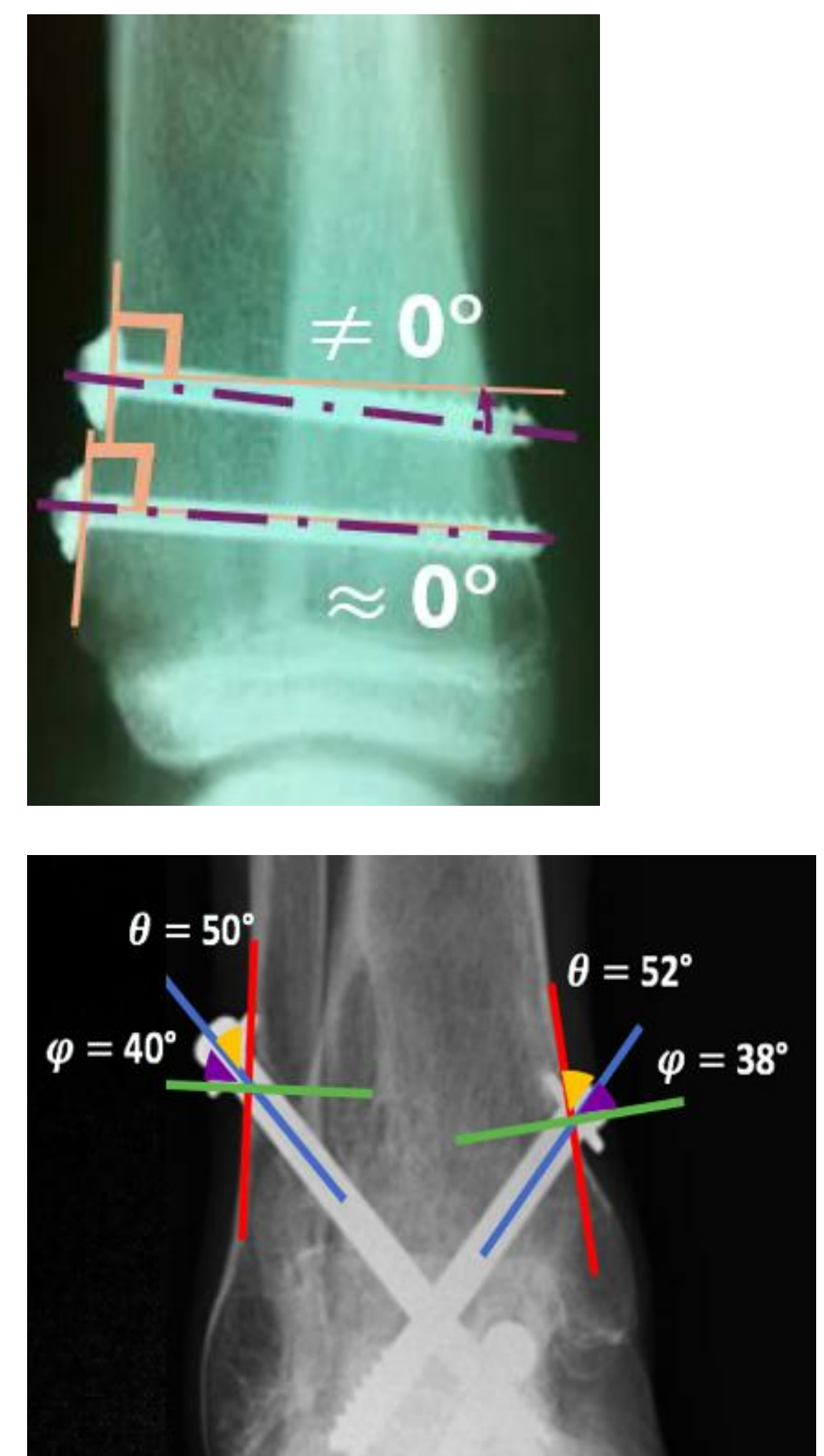


Multi-Axis Force Behavior in Inclined Bone Drilling

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BACKGROUND AND MOTIVATION

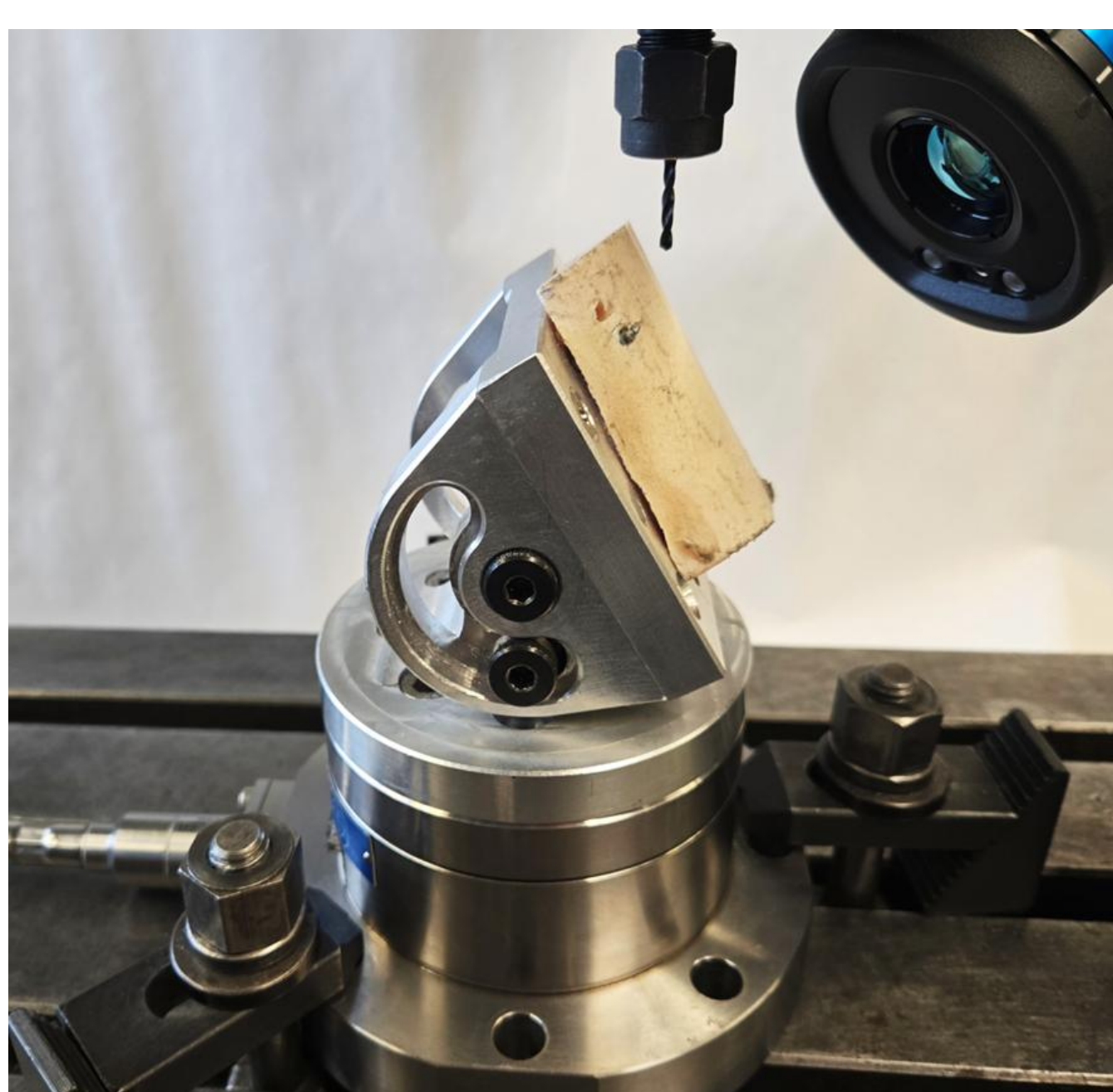
Bone drilling is a critical step in many surgical procedures. Anatomical constraints often require drilling at inclined rather than perpendicular angles, especially in fracture fixation, spinal surgery, and implant placement. However, inclined drilling can increase drill skidding, positional deviation, force instability, and heat generation, which may reduce accuracy and damage surrounding bone tissue. Understanding these effects is important for improving surgical precision and safety.



OBJECTIVE

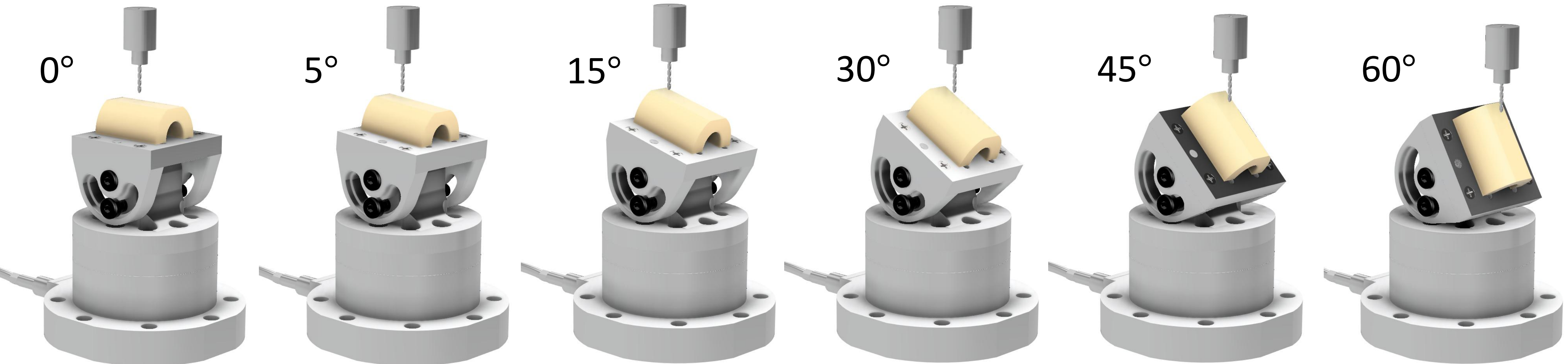
To investigate the effect of surface inclination on bone drilling performance by quantifying forces in the x, y, and z directions.

EXPERIMENT



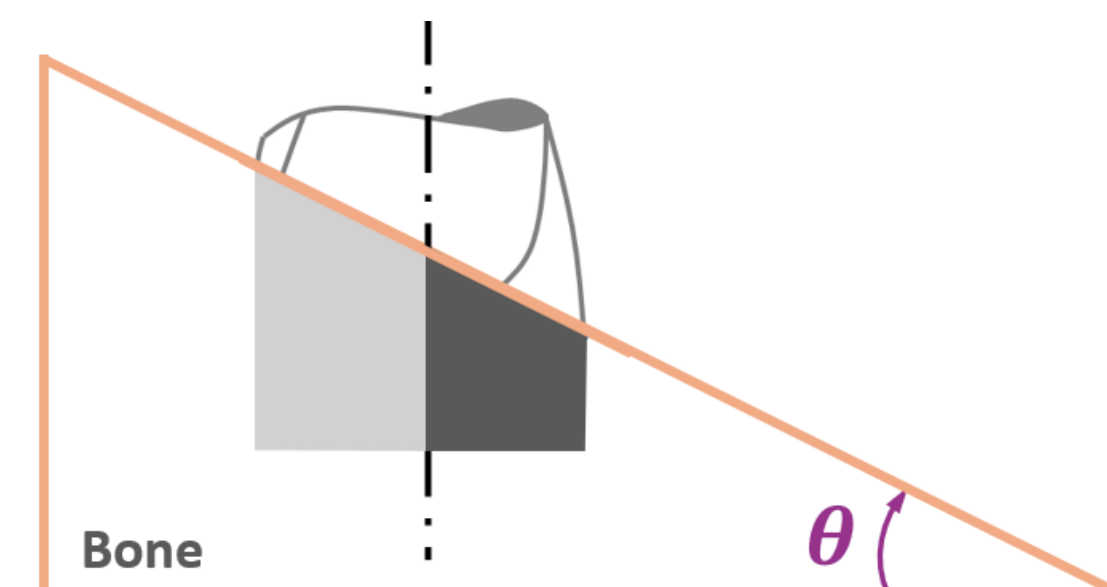
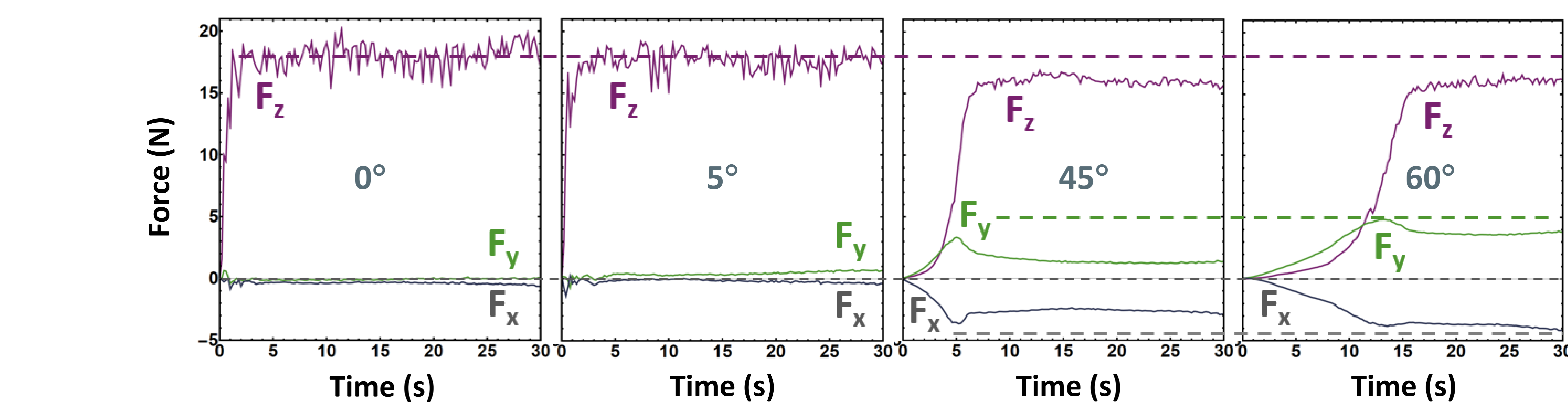
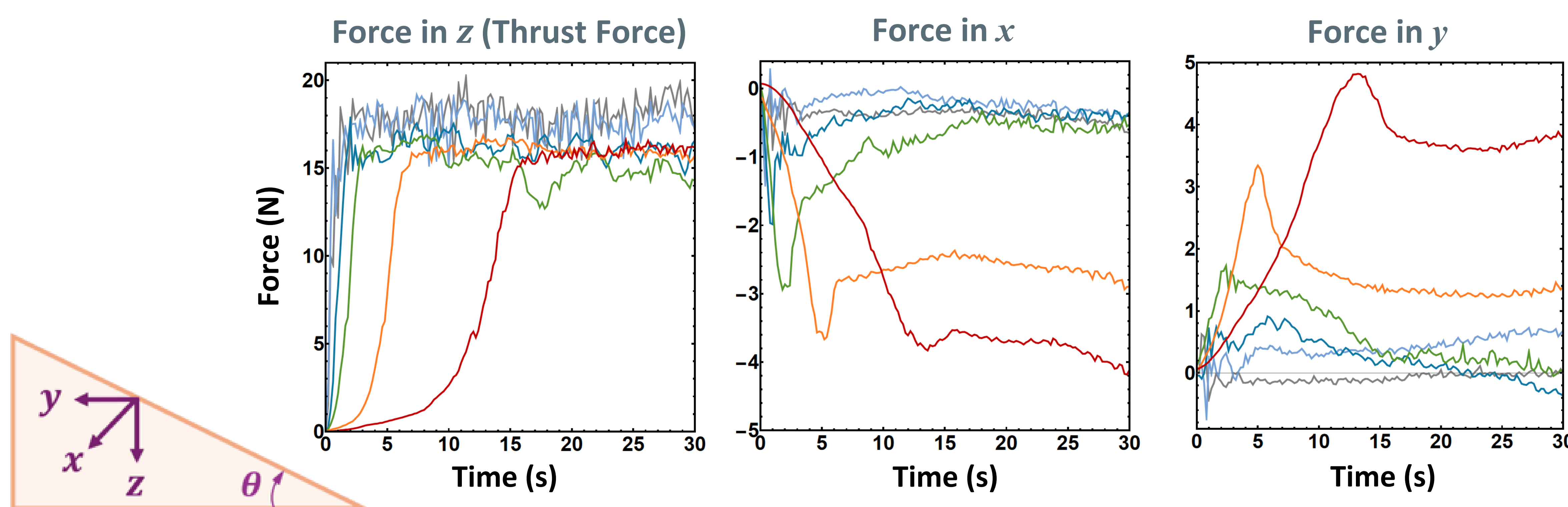
- Input Parameters**
- Drill Bit Diameter: 2.5 mm
 - Spindle Speed: 1000 rpm
 - Feed Rate: 0.01 mm/rev
 - Inclination Angle: 0, 5, 15, 30, 45, and 60°
- Output Parameters**
- Forces in the x, y, and z directions

Inclination Angles Investigated



RESULTS AND DISCUSSION

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Key Findings

- Lateral forces increase with inclination angle, with higher F_x and F_y , indicating stronger asymmetric cutting and greater drill deflection.
- Higher angles show greater initial instability, indicating increased skidding and delayed engagement.
- F_z stabilizes across angles, with delayed buildup at higher inclinations.

ACKNOWLEDGEMENT

We gratefully acknowledge Dr. Joshua Steimel for his guidance on experimental conduct and data acquisition. We also thank our machinist, Colin Wingfield, for providing CNC access and assisting in the design and fabrication of the inclined drilling device.