

Is the Compression Achieved Via Lag Screws Proportional to Increases in Screw Diameter?

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INTRODUCTION: Screw diameter sizes are often selected based on the perception that larger diameter screws have a proportional increase in compressive strength. Surgeons may choose larger diameter screws based on this perception and potentially increase risk for peripheral fracture. This study aimed to evaluate the compression achieved across a range of screw sizes in oblique fractures. We hypothesized that changes in screw diameter would not be proportional to increases in compression across the fracture.

METHODS: We conducted biomechanical testing using absolute cylinder sawbones models simulating 45° oblique fractures. Stryker cortical screws of 2.4mm, 2.7mm, 3.5mm, and 4.5mm diameters were inserted using the lag-by-technique method. Compression was measured using Tekscan's FlexiForce ELF monitor at 80% max torque for all screw sizes based on preliminary tension-to-failure trials and a common 10Nm torque for all screws (equivalent to 80% max torque of 2.4mm screws).

RESULTS:

At 80% maximum torque, the compression achieved was 23.05 ± 6.38 N for 2.4mm screws, 69.93 ± 6.68 N for 2.7mm, 101.43 ± 27.18 N for 3.5mm, and 109.19 ± 15.77 N for 4.5mm screws. At 10 Nm torque, the compression achieved for the 2.4 mm screws was 18.91 ± 5.03 N, 51.99 ± 9.65 N for 2.7 mm, 52.71 ± 10.17 N for 3.5 mm, and 59.16 ± 6.86 N for 4.5 mm screws.

This represented an increase of compression force 156N/mm of screw diameter increase when comparing 2.4mm vs 2.7mm (p < 0.001), 39.4N/mm for 2.7 vs 3.5 (p = 0.02), and 7.8N/mm for 3.5 vs 4.5mm screws (p=0.56).

DISCUSSION AND CONCLUSION: Although a linear relationship between screw diameter and compression strength would be expected, the screws tested demonstrated a disproportionately lesser increase in compressive strength in larger sizes. This is likely due to the thread pitch, core diameter and properties of the material tested. Although this may vary across manufacturers, surgeons should be aware that larger screws may not yield a predictable increase in compressive strength and a smaller screw could be utilized without potentially risking peripheral fracture. Further research using other vendors' screws will increase generalizability.

