Wait, but Not Too Long: Earlier Cutting of Fiberglass Cast Compared to Plaster Cast is Safe

Annemarie K Leonard, Jay Justin Byrd, Kaeli Samson, Jill E Larson, Matthew Aaron Halanski[1]
[1]Phoenix Children's

INTRODUCTION:

Cast-saw injury is a significant iatrogenic injury in pediatric orthopaedics with significant medicolegal risk. Previous work with plaster casts demonstrated cast-saw injury was minimized by waiting 12-minutes before cast cutting. However, despite more frequent utilization, this safety interval for fiberglass cast removal has not previously been established. This study aimed to determine that interval by comparing plaster and fiberglass exothermic peaks under various conditions and the resultant fiberglass cast removal metrics.

METHODS:

Plaster and fiberglass casts were applied to a pediatric forearm model at variable dip-water temperatures (15°, 22.8°, 37.8°, and 50°C) and the mean time for the casts to reach their exothermic peak under each variable was determined. Thirty-six 8-ply fiberglass casts were then applied to the model at the manufacturer's recommended dip-water temperature (22.8°C) and removed at intervals of 2 (before exothermic peak), 6 (fiberglass's approximate exothermic peak), or 12 minutes (after exothermic peak). All casts were removed by a pediatric orthopaedic surgeon blinded to the cast set-time interval. Cast/blade temperature, downward saw force, blade-to-skin contact, bi-valve, or cast cutting time, peak cast spreading force, and cut completeness (Figure 1) were recorded and analyzed as individual set-time groups and as short (< 6-minutes) or long (≥6-minutes) set-times. All outcome measures were compared with Fisher's Exact tests or linear models using software with statistical significance of $p < 0.05$.

RESULTS:

Fiberglass cast exothermically peaked significantly earlier than plaster at similar maximum temperatures. Fiberglass peaked after 5.2 [IQR=5-5.4] minutes (35.3°C [IQR=32.2-35.8°C]), whereas plaster peaked at after 14.8 [IQR=13.7-15.3] minutes (31.6°C [IQR=31.2-32.3°C]) ($p < 0.0001$) (Figure 2). Within fiberglass casts only, downward force applied during cast removal was significantly lower in the < 6-minute group compared to the ≥6-minute group (average forces of 8.3 [IQR=6.4-10.4] versus 12.9 [IQR=11.1-14.5] N; $p < 0.0001$, maximum forces of 23.2 [IQR=18.9-26.6] N versus 43.8 [IQR=38.6-48.5] N; $p < 0.0001$) (Figure 3a). Bi-valve time and maximum cast spreading force were decreased at the short set-time with 40.5 [IQR=39.2-44.7] versus 44.4 [IQR=40.6-47.3] seconds ($p=0.058$) and 15.5 [IQR=14-18.5] versus 21.5 [IQR=18-26.5] N ($p=0.069$), respectively (Figure 3b, 3c). In total, 76.9% and 100% of casts were spread completely between short and long set times ($p=0.023$). The maximum saw blade temperature significantly increased with cast set-times between short (99.6°C [IQR=98.2-105.6°C] and long (130.6°C [IQR=121.9-141°C]) groups ($p=0.041$) (Figure 4). No significant differences in blade-to-skin touches or touch duration were detected.

DISCUSSION AND CONCLUSION:

Unlike plaster, fiberglass casts cut prior to exothermic peak were associated with less downward force, faster cast bi-valve times, and lower spread force without increased blade temperature or skin contact. This suggests fiberglass can be cut significantly earlier than plaster without increased risk of cast-saw injury; however, care should be taken to ensure spread completeness.

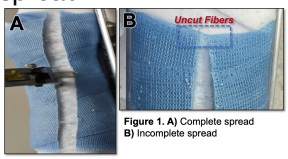

Figure 1. A) Complete spread
B) Incomplete spread

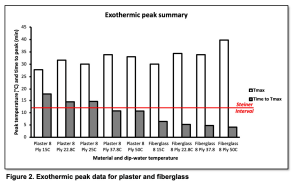

Figure 2. Exothermic peak data for plaster and fiberglass

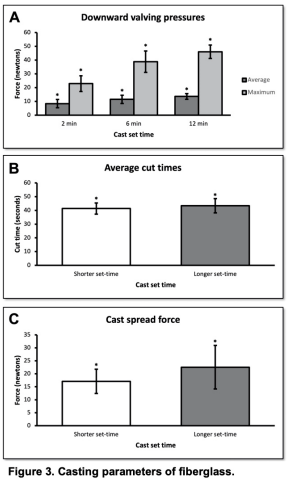

Figure 3. Casting parameters of fiberglass.

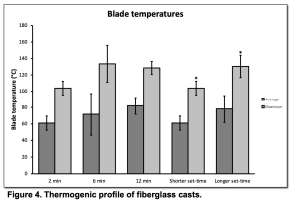

Figure 4. Thermogenic profile of fiberglass casts.