A New Device for Reinforcing a Bivalved Fiberglass Short Arm Cast.

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Introduction

Cutting a short arm cast is an acceptable form of practice for dealing with ensuing edema after sustaining a fracture. An ace wrap is usually applied to hold the cast in place. Zaino et al. compared three methods of cutting the cast in a clinical study and concluded that cutting the cast along with the webril on two sides and spreading the cast eliminates all relevant skin pressure. Ace wrapping has proven to be inconsistent and unreliable at times as well as subject to easy patient modification. The purpose of this study is to test a new device (Castfit™; Clickmedical Inc. Denver, CO) for reinforcing a cut short arm cast and comparing it to the current standard (Ace wrap). Castfit™ uses a wire system that can be wrapped around the cast and the wire length can be adjusted to tighten or relax the cast. We will compare the pressure measurements of Ace wrapping a cast to this new method. We hypothesize that Castfit™ can achieve consistent pressure readings at a specified tension level in the device across all samples.

Methods

Ten cadavers were used to test pressure readings under the cast. Each cadaver served as its own control. Casting and Ace wrap application were done by one registered orthopaedic technologist to minimize technique variability. Pressure readings under the cast were recorded using a method comparable to Zaino et al.'s study by using an empty intravenous fluid bag (100 mL) with its two ends pointing distally. The bag was placed on the dorsal side of the cadaver wrist with its two ends protruding and not covered by the cast. After casting, a calibrated pressure transducer (Deltran®, Utah Medical Products Inc. Midvale, UT) was attached to the bag **(Fig.1)**. Ten milliliters of water were infused in the bag through one of the two ends using a 60 mL syringe to record a baseline pressure, 50 more mL were added to reach a maximum of 60 mL and record a maximum pressure of simulated edema. The cast was cut on two sides along with the webril underneath and spread, and the pressure reading was recorded. Two more pressure readings were taken, one after the Ace wrap was applied and another after applying the Castfit™ device **(Fig.2)**. The Castfit™ was fully tightened on all samples to test its consistency.

All pressure readings were taken after one minute to achieve a stable baseline. Analysis was done using Minitab® software (Minitab Inc. State College, PA) by comparing the variance of the two intervention samples. Levene's test was used to assess hypotheses of equal variance. A paired Student t test was performed to assess significance of pressure changes throughout the experiment. P value of 0.05 was used as a cutoff for significance.

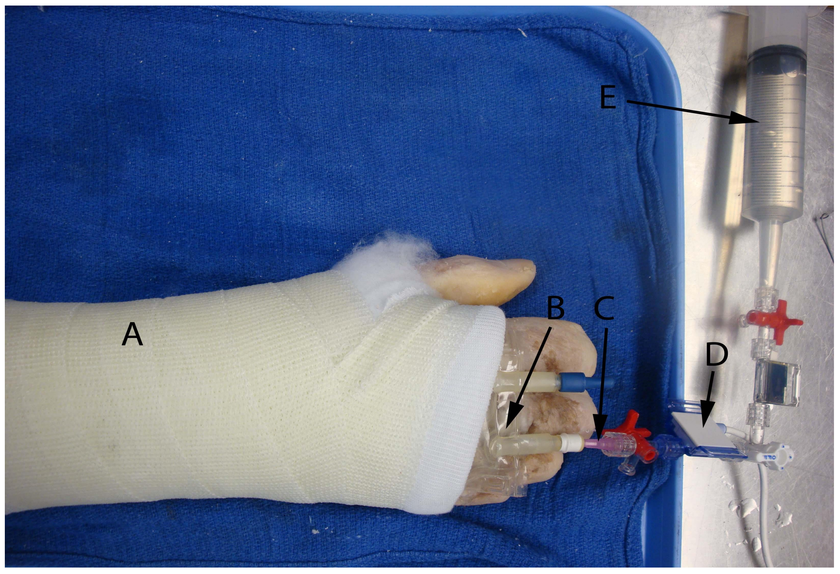

Figure 1: A. Fiberglass cast, B. Saline bag, C. 15 gauge needle, D. Pressure transducer, E. 60 mL syringe.

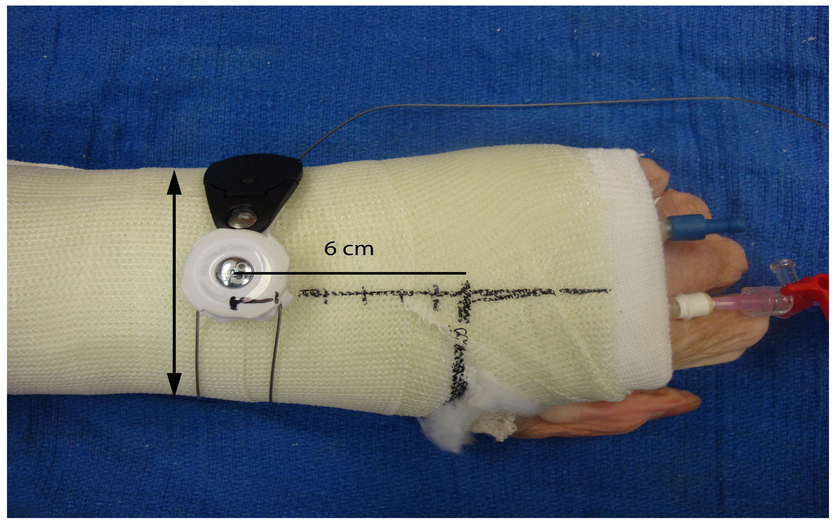

Figure 2: Castfit™ device fasted on a bivalved cast.
The device was aligned with the third metacarpal bone, and was always 6 cm away from the base of the thumb.

Significance

This study tests a new device for reinforcing a forearm bivalved cast, and compare its results to the current standard providing more options to patients and health professionals.

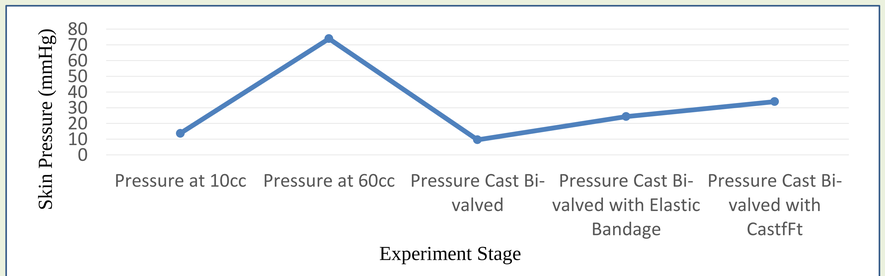

Figure 3: Line graph showing average skin pressure changes under the cast during various stages of the experiment

Results

The average pressure under the cast at 10 mL infused water was 13.7mmHg, and the average pressure increased at 60 mL infused water to 73.9mmHg ($p<0.0001$). After cutting the cast the pressure dropped to an average of 9.6 mmHg ($p<0.0001$) **(Fig. 3)**. Ace wrap caused the pressure to increase to an average of 24.4mmHg and the Castfit at its max tension caused an average pressure increase to 33.9mmHg ($p<0.0001$, $p<0.0001$). The increase in pressure in the two interventions was significantly higher than the baseline, (Ace wrap: $p<0.0001$, Castfit™: $p<0.0001$). Levene's test of Ace wrap versus Castfit™ resulted in a p value of 0.222 showing equal variability in both interventions.

Discussion

This study's experimental data on cadavers shows closely similar results to those of other clinical studies in the literature. The 10 ml pressure of 13.7mm Hg was close to those of other studies that measured pressure under cast. The maximum pressure of 73.9mm Hg was less than what is reported by Zaino et al.'s clinical data (92.5mm Hg) but still high enough to be in the range of the pressure needed to occlude skin microcirculation causing skin necrosis (60 – 75 mm Hg). Finally Ace wrapping the bivalved cast resulted in pressure readings very similar to Zaino et al.'s (our average: 24.4mm Hg, Zaino et al.'s study average: 21.1mm Hg). As our samples cannot gauge "pain" or "comfort" level we relied on pressure readings published in the literature to guide our interpretations.

The Castfit™ can be adjusted (tightened and loosened) to the patient's comfort. We decided to tighten it to its max setting and test its variability, which was the most reliable option on a cadaver model. The Castfit™ showed similarly consistent results to using Ace wrap, but its application is easier and the patient can adjust its tightness to their comfort. And although it's average maximum pressure of 33.9mm Hg resulted in pressure levels in the range of arteriolar capillaries occlusion (30 to 60mm Hg), it is safely under the range of occluding the skin's microcirculation (60 – 75 mm Hg).