Comparative Handling, Intrusion and Antibiotic Elution Characteristics of Simplex HV bone cement

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Disclosures:
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Introduction: Operational efficiencies are receiving greater interest by surgeons and hospital administration. High viscosity (HV) bone cements usually provide a shorter dough time than medium viscosity cements, which may result in surgical efficiencies by allowing surgeons to handle and apply the cement to implants earlier. Some reports indicate that certain high viscosity cements have poorer intrusion compared to medium viscosity cements.¹,² The depth of intrusion of the bone cement into the cancellous bone has been shown to increase the strength of the bone-cement interface.³,⁴ A recent study by Bishop found that pull-out force of tibial base plates from post-mortem tibia increased with an increase of cement penetration,⁵ providing a direct suggestion for improved fixation of the tibial tray. Antibiotic elution is another important property for acrylic bone cement. The purpose of this study was to investigate the handling properties, intrusion, antibiotic elution, and mechanical properties of HV bone cement options.

Methods: Simplex HV bone cement contains 40g polymethyl methacrylate (PMMA) powder and 20ml MMA liquid. Its pre-blended antibiotic version contains 0.8g Gentamicin (0.5g active) (Simplex HV with gentamicin). Palacos R bone cement and its antibiotic version with Gentamicin were tested in this study for comparison. Dough and set times were determined following the ASTM F451-08 and ISO5833 standard method but performed at 18.5°C (65°F). The depth of intrusion (n=16), compression strength (n=6) and bending strength/modulus (n=5) were determined following the standard method described in ASTM F451-08 and ISO5833. A modified Kirby-Bauer technique was utilized where staphylococcus epidermidis was used to detect eluent Gentamicin concentrations per USP Standards (n=54).⁶ The student T test was used to test for statistical differences.

Results: Dough and set times of Simplex HV and Palacos R were shown in Figure 1. The dough time of Simplex HV bone cement is comparable to Palacos R. The average depths of intrusion for Simplex P, Simplex HV and Palacos R were 7.8±1.3, 7.7±1.9, 3.5±1.2mm, respectively (Figure 2). All exceeded ISO minimum requirement for acrylic bone cement, but the depth of intrusion of Simplex P and Simplex HV were significantly larger than that of Palacos R (p<0.05). Simplex HV with gentamicin also demonstrated statistically higher (p<0.05) cumulative Gentamicin elution than Palacos R with gentamicin for a period of 24 hours (Figure 3). Compressive strength and bending strength/modulus of Simplex HV and Simplex HV with gentamicin exceeded ASTM/ISO requirements for acrylic bone cement (Table 1).

Discussion: Under the conditions of this study, it was demonstrated that Simplex HV significantly improved the depth of intrusion without prolonging dough time of the cement. The cumulative Gentamicin elution from Simplex HV with gentamicin was also higher than that from Palacos R for up to 48hrs. The unique properties of Simplex HV may help provide surgeons with the rapid dough time of HV bone cement without compromising depth of intrusion and initial antibiotic elution. Clinical results will be needed to validate these findings.

Significance: n/a
Acknowledgments: n/a

References:

Table 1. Mechanical Properties

<table>
<thead>
<tr>
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<th>Simplex HV (MPa)</th>
<th>Simplex HV w/gentamicin (MPa)</th>
<th>ASTM &amp; ISO</th>
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<tbody>
<tr>
<td>Bending Strength</td>
<td>63.8 ± 1.4</td>
<td>65.2 ± 0.56</td>
<td>&gt;50</td>
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Bending Modulus

- Simplex IV: 2459.9 ± 78.3 (n=5)
- Felecra: 2479.1 ± 45.6 (n=5)
- >1800

Compressive Strength

- Simplex IV: 114.7 ± 2.6 (n=6)
- Felecra: 110.2 ± 2.6 (n=6)
- >70

Setting properties (18.5°C)
Elution of Gentamicin Sulphate

95% CI for the Mean

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<thead>
<tr>
<th>Hours</th>
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<tbody>
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<td>24</td>
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<td>48</td>
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- Simplex HV with G
- Palacos R + G