Intrusion Characteristics of Two Bone Cements for Tibial Component of Total Knee Arthroplasty in a Cadaveric Bone Model

Justin K. Walden, MD¹, Alexander C. Chong²,³, Nam L. Dinh, MD³, Scott Adrian, MS⁴, Robert Cusick, MD¹, Paul Wooley²,³
¹The University of Kansas School of Medicine - Wichita, Wichita, KS, USA, ²Via Christi Health - Orthopaedic Research Institute, Wichita, KS, USA, ³The University of Kansas School of Medicine- Wichita, Wichita, KS, USA.


Introduction: Aseptic loosening of total knee arthroplasty (TKA) still remains a major cause of failure in cemented TKA, and usually starts with the tibial component. Loosening may be directly or indirectly related to micromotion between the component and the bone. In order to achieve satisfactory long term results, cement intrusion between 3 and 5 mm in depth (included the cement thickness under the tibial baseplate, approximately 1 mm) is needed, in order to balance adequate implant fixation with the risk of osteonecrosis secondary to thermal injury or (in the case of revision procedures) excessive bone resection during implant removal. Simplex-HV is a new bone cement developed to provide adequate cement intrusion using standard finger packing technique while having higher viscosity and short mixing time. The purpose of this study was to evaluate and compare the intrusion characteristics of Simplex-HV bone cement to Palacos-R in cadaveric proximal tibial bone.

Methods: Soft tissues were removed from twelve fresh frozen cadaver proximal tibiae and standard arthroplasty tibial cuts (2±1 mm below the most compromised articular cartilage at the medial tibial plateau with 0° tibial slope) were performed. Two cements (Palacos-R, and Simplex-HV) were prepared according to the manufacturer’s protocol at standard operating room temperature (18°C). Each tibia was randomly assigned to one of the two bone cements for use with positive pressure intrusion cementing (finger packing) technique. A weight of 45 N was applied along the long axis of the tibia during the cement setting phase. Once the cement had cured, sagittal sections were taken (Figure 1) and analyzed using high resolution digital photography (Figure 2) as well as stereoscopic microscope to evaluate cement intrusion characteristics of each of the two bone cements. The cement penetration depth was measured from the tibial bone cut surface (which did not include the cement thickness under the tibial baseplate, approximately 1 mm)

Results: Significant differences were detected in the bone cement penetration into proximal tibial zones between the two cements using the finger packing technique (Figure 3). Penetration into the tibial plateau (Zones 2 and 6) was increased using the high-viscosity Simplex-HV cement compared to Palacos-R. Simplex-HV had an average cement penetration depth of 2.7 mm (range: 2.0 - 3.0 mm) while penetration depths for Palacos-R were 1.8 mm (range: 1.1 - 2.6 mm). These depths approximately to 3.7 mm and 2.8 mm of total cement penetration respectively.

Discussion: There were significant differences in cement intrusion when comparing Simplex-HV to Palacos-R bone cements. The data suggest that the new high viscosity bone cement may provide good fixation of the tibial component of a TKA when using the finger packing technique.

Significance: This study provided better understanding of bone cement penetration depth for current commonly used commercial bone cement as well as the new formulation of bone cement while utilizing a popular cementation technique in a cadaveric model.

Acknowledgments: The authors wish to thank Via Christi Health and Stryker for providing the fresh frozen lower extremities cadavers used in this study. The authors report no actual or potential conflict of interest in relation to this article.

References: None
(a) Zone 1 Lateral
(b) Zone 2 Lateral
(c) Zone 3 Lateral
(d) Zone 4 Lateral