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

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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 base plate, 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, saggital 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 base plate, approximately 1mm). **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 from tibial bone cut surface 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 approximate 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 high viscosity bone cement may provide good fixation of the tibial component of a TKA when using the finger packing technique.

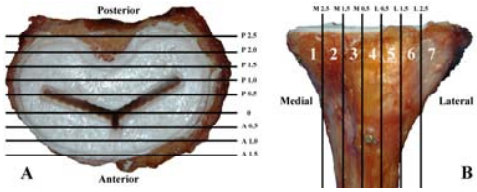

Figure 1. Levels of sagittal sectioning and measurements of the proximal tibia. (A) Top view, (B) Anterior view

Figure 2. Sample images of image analysis measurement tool. (A) Simplex-HV, (B) Palacos-R

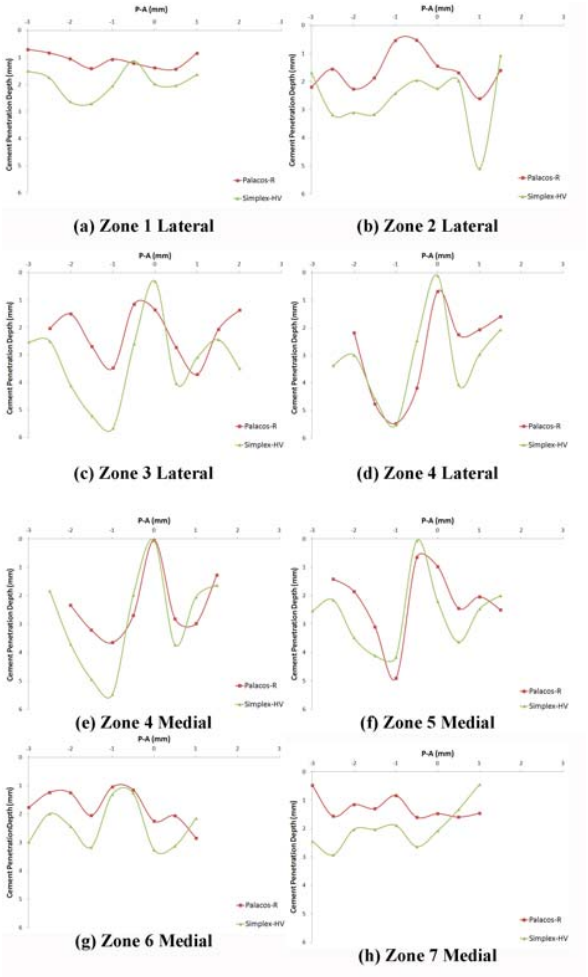

Figure 3. Mean cement penetration depth comparison result for the two bone cements into proximal tibial zones