

## Standardized Augmentation of Osteoporotic Bone for Improved Implant Performance

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**INTRODUCTION:** The number of fragility fractures due to osteoporosis will strongly increase in the next decades. Implant fixation in the porous bones of mainly elderly patients is difficult due to the limited purchase given in the weak trabecular network. In the AO Development Institute, we have conducted a number of studies to enhance implant purchase in the osteoporotic bone via augmentation with poly(methylmethacrylate) (PMMA) bone cements. A summary of the studies and their results is presented in this talk.

**STUDIES AND OUTCOMES:** Irrigation of the trabecular bone structure for fat removal was done with 200 to 500 cc of Ringer's solution. This led to significantly better control of cement distribution around a perforated implant (Fig 1.).

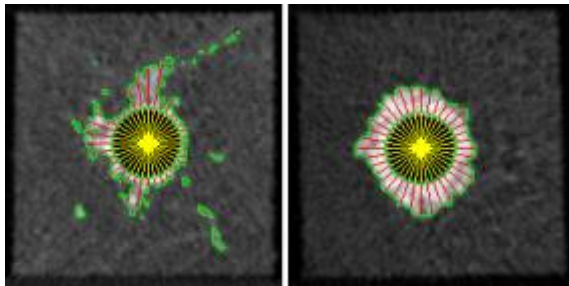


Fig. 1: Left: cement distribution after injection through a perforated implant (green pixels indicate perimeter of cement). Right: the same procedure led to significantly better control of cement distribution after irrigation and fat removal in cancellous bone.

The biomechanical studies of bone augmentation included cyclic testing of human femoral heads instrumented with DHS screws, with and without PMMA augmentation after irrigation in a left-right comparison. Cox regression analysis showed a significantly better performance of the augmented femoral heads, especially at low bone mineral density (Fig. 2 and 3).

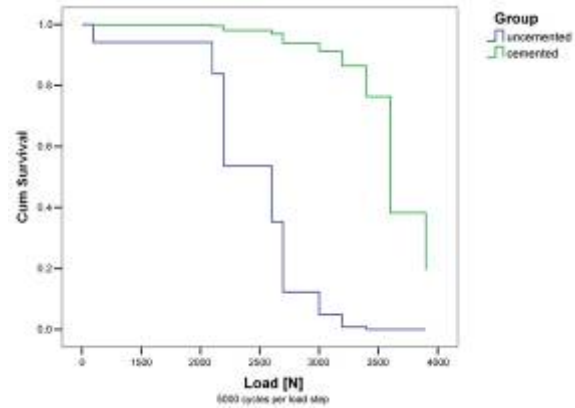


Fig. 2: Survival analysis of cemented and conventionally fixed DHS in femoral heads. There is a significant increase in performance, especially around physiologic loads.



Fig. 3: Typical appearance of a cut-out after mechanical testing. The augmented specimen went through the entire testing protocol (3.0 cc of PMMA cement around screw).

Temperature investigations around implants and setting PMMA cement (3.0 vs. 6.0 cc of cement) revealed the harmlessness of augmentation around a metallic implant.

Table 1: Average max. temperatures measured in different distances from the implant.

	3.0cc PMMA	6.0cc PMMA
PMMA	42.2 °C	45.6 °C
Interface	40.1 °C	41.7 °C
Close zone	39.1 °C	40.5 °C
Far zone	38.3 °C	39.8 °C

**CONCLUSION:** The newly developed standardized augmentation technique for fixation of osteoporotic proximal femur fractures seems to be promising to avoid implant cut-out.