Mechanical Testing

made using a bone mill (average diameter 2.04 mm SD = 0.49 mm). The human pelvic bones were used, of which two were re-used after testing. The (Howmedica RSA flanged cup) in six pelvic bones. In total, four freshly frozen

Introduction:

Methods:

both experienced with the technique of impaction grafting. analyzed the inevitable variations in surgical techniques using two surgeons bone chips to reconstruct a standardized cavitary acetabular defect. We also stability of a cemented cup when implanted with relatively small or large bone chips to reconstruct a standardized cavitary acetabular defect. We also analyzed the inevitable variations in surgical techniques using two surgeons both experienced with the technique of impaction grafting.

Two experienced surgeons implanted twelve acetabular revision cups (Howmedica RSA flanged cup) in six pelvic bones. In total, four freshly frozen human pelvic bones were used, of which two were re-used after testing. The acetabulae were overreamed and a cavity supramedial defect (type II, AAOS) was made using a 56mm reamer. The grafts (fresh frozen human femoral heads) were prepared in two different ways. The large bone chips were made using a rongeur (average diameter 9.16 mm SD = 0.88 mm). The small bone chips were made using a bone mill (average diameter 2.04 mm SD = 0.49 mm). The components were implanted as pairs, one with small and the contra-lateral side with large bone chips. The acetabulae were completely covered with morcellized bone graft and firmly impacted, thereby recording the total weight of the grafted material. The components were implanted using hand mixed bone cement and the reconstructions obtained were CT-scanned. The distal part of the iliac bone was potted and placed in the MTS-machine with an angle of 30 degrees around the AP axis and 10 degrees around the M/L axis, so that the load was directed in supra-medial direction (Fig. 1). Dynamic loading was applied with a frequency of 1 Hz in two stages, ranging from zero to 750 N and from zero to 1500 N (Fig. 1) Each stage lasted 900 cycles. Eight spherical tantalum markers were attached to the cup and three clusters of three markers were inserted at standard locations in iliac, ischial and pubic bone. At the beginning and at the end of the loading stages, Roentgen Stereophotogrammetric Analysis (RSA) exposures were made to enable determination of the 3-D motions of the cup relative to the bone (Fig. 1).

Results: In general, the cups migrated in cranio/caudal/lateral axis direction with the cranial as their principal migration direction, corresponding to the loading angle applied to the cups. The rotations were relatively small (less than 3 degrees). The size of the bone chips had a significant effect on the migration values. The smaller bone chips led to significant higher total migration at the end of the loading stages (Fig. 2). A closer analysis of the results revealed that the effects of graft size on the migration were solely induced by one surgeon (Surgeon A) who implanted 8 of the 12 acetabular cups. Using the larger bone chips, Surgeon A obtained a cup stability which was very similar to that obtained by surgeon B (Fig. 3). However, when the small bone chips were used the stability of the cup was considerably less for Surgeon A. The surgeon-depend effects may be explained by the grade of impaction. Surgeon B used statistically significant more graft material to fill a defect of the same size (p=0.01), thereby obtaining a more severe impaction grade of the graft material.

Discussion: Similar to findings at the femoral side [4], smaller chips led to more acetabular cup migration than larger ones. The results also showed that surgical technique plays a dominant role in obtaining cup stability, and although both surgeons were experienced and trained in the same center, the grade of impaction appeared to be significantly different. However, despite the different grade of impaction, when using the larger chips the obtained cup stability between the two surgeons was similar, whereas when the small chips were used considerable effects of the surgical technique were found. For clinical practice this means that a more reproducible result in terms of prosthetic cup stability may be obtained with relatively large bone chips. For this reason, we advocate the use of the larger bone chips in acetabular reconstruction.

References:

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