MECHANICAL TESTING OF APAPORE-60 AS A BONE GRAFT EXTENDER IN A FEMORAL MODEL

INTRODUCTION

Hip replacements at revision are often associated with a reduction in bone stock. To compensate a technique known as impaction allografting has been developed; morsellised graft chips are impacted into the femur (or acetabulum) prior to cementing the new implant into position. Clinically some good short-term results have been reported, but others have had problems of subsidence and rotation of the new stem. The allograft is usually femoral heads harvested from primary replacements, which have been stored and tested at bone banks for at least six months, however supply is often limited. To assist with these problems a synthetic bone graft extender, ApaPore-60, has been developed which is designed to be added to the morsellised graft in equal volumes. ApaPore-60 granules are sintered 60% porous Hydroxyapatite, that are available in two size ranges; 2-5mm and 5-10mm. It is possible that inclusion of ApaPore-60 may improve the mechanical properties of the graft. The initial mechanical properties of the graft after adding ApaPore-60 were mechanically tested in Sawbones, and compared with a control of pure allograft. The hypothesis was that the subsidence and rotation observed during mechanical testing in Sawbones would be reduced by the inclusion of ApaPore-60 to the allograft.

METHODS

Twelve large femur Sawbones (Pacific Research) were used in this study, allograft was impacted in half (Group A) and a 50:50 mix of allograft and ApaPore-60 in the one half (Group M). Second generation Sawbones were chosen for their similar mechanical properties to bone. The surgical procedure was intended to mimic as closely as possible that of live surgery. The Exeter X-Change Revision Instruments (Stryker Homedica) were employed together with a modified slap hammer, which could record the impaction forces. The impaction technique of four surgeons had previously been established on nine patients using the modified hammer (results showed: mean Distal Impaction Force range 8.1 to 21.8kN, mean Proximal Impaction Force range 6.1 to 28.9kN). Femoral heads, collected with patient consent, were used for the allograft. The cartilage and soft tissue was removed from the heads prior to grinding in a Noviomagus Bone Mill (Spierings Medisch Technieck). The resulting graft was washed in warm water for ten minutes to remove the fat and patted dry. To prepare the mixed graft, equal volumes of washed allograft were mixed with blood-soaked ApaPore-60 (approximately 1ml of fresh human blood was required for each 5 grams of ApaPore-60). The femoral head was cut off each sawbone and the cancellous bone was cored out to resemble a femur at revision. The graft was impacted into the sawbones using the modified hammer and the forces measured in order to test the consistency of the technique. Once impacted with graft, vacuum mixed cement was used to secure a size 1 Exeter stem into position.

RESULTS

DISCUSSION

The results demonstrated that the inclusion of ApaPore-60 reduced subsidence and rotation of the stem. The modified slap hammer was able to show consistency of the impaction technique and that this was within the current surgical range. The migration of the prosthesis head was larger than the subsidence measured by the LVDT’s and off the x-rays. This was because rotation of the stem, in all planes, was adding to the vertical movement of the head. The low movement of the distal plug may have contributed to lack of axial displacement in this model.

This study indicates that a 50% addition of ApaPore-60 to allograft, will offer better initial stability than allograft alone during femoral impaction grafting. However further research needs to be undertaken to investigate the long-term effects of using ApaPore-60.

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References