Effects of the Mixture of Hydroxyapatite Granules into Bone Chips on the Dynamic Migration of Cemented Acetabular Cups Fixed with Impaction Bone-grafting

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Introduction
The impaction bone-grafting (IBG) technique is a technique that can restore acetabular bone loss in revision total hip arthroplasty (THA), while enough bone allografts are not easy to obtain and the quality is not always sufficient. Thus we mixed hydroxyapatite (HA) granules into bone chips to supplement the volume and the mechanical strength of allografts. To investigate the dynamic migration of cemented cup fixed with impaction bone-grafting, we made acetabular bone defect models and the migration of the cup was traced by a high-speed photography camera during cyclic loading conditions. Four bone/HA ratios were compared.

Materials and Methods
We tested 4 different bone/HA ratio; 100%/0% (HA 0%), 75%/25% (HA 25%), 50%/50% (HA 50%) and 0%/100% (HA 100%). Each group consisted of 6 specimens. Fresh frozen human femoral heads were obtained from patients treated with THA. The size of the bone chips varied from 6 to 10 mm. The HA granules were used. The size of the HA granules varied from 2.0 to 5.0 mm. A dynamic load of 0 N to 1500 N with a frequency of 1 Hz was applied for 15 minutes, followed by a dynamic load of 0 N to 3000 N for the same time period. Then the load was released for 15 minutes. The high-speed photography camera captures 15 images per second thus it enables us to trace the migration of the cup during cyclic loading. The relation between the amount of the cup migration and bone/HA ratio was investigated by Pearson’s correlation coefficient test.

Results
A strong negative correlation (r = -0.71) was observed significantly (P < 0.001) between the amount of the migration and bone/HA ratio (Fig 4). In elastic recoil, statistically significant (P < 0.05) correlation was (r = -0.55) observed (Fig 5). In visco-elastic recoil, there is no correlation between the amounts of the visco-elastic recoil and bone/HA ratio (Fig 6).

Discussion
In the current study, the cup migration was smaller by adding HA granules. Elastic recoil was affected, while visco-elastic recoil was not affected. These results indicated that the mixture of HA granules to bone chips stabilized the cup during loading period and load releasing period.