Introduction
Impacted morselized bone grafts are successfully used to restore bony defects in revision surgery in the acetabulum and the proximal femur. Bone autografts are the gold standard, but the availability is limited and additional donor site morbidity is created by the harvest procedure. Bone allografts are often used as an alternative.

However, the use of allografts induces an immunogenic response to the graft. Rinsing of trabecular allografts may enhance graft incorporation by washing out immunogenic factors present in blood, marrow and fat. It also has been proposed that impaction of the graft releases biologically active factors, which can provide sufficient activity to stimulate new bone formation (1). We hypothesise that rinsing prior to impaction will favourise bone allograft incorporation, but rinsing after impaction will diminish the incorporation process of impacted bone graft.

Materials and methods
To study the effect of rinsing and impaction of morselized bone grafts on bone ingrowth, an animal study was performed in the goat. Bone conduction chambers (figure 1) were filled with either allograft or autograft. Grafts were divided into three treatment groups, yielding six different implants per goat (table 1).

Grafts were nibbled with a rongeur to a chip size of approximately 2x1x1 mm. Grafts were then rinsed with saline in a sieve during the rinsing with a high pressure nonpulsatile lavage system. A specially designed impaction instrument was used to enable standardized impaction of the grafts. After impaction a graft cylinder was obtained, which fitted into the bone chamber.

Ten mature Dutch milk goats received 3 bone chambers at each side of the cortical bone of the proximal medial tibia. A hole was drilled through the medial cortex, tapped and fixed after 6 weeks. Fibrous tissue was present between the new bone at the bottom and the necrotic, nonvascularized graft remnants at the top of the chamber. New bone formation was higher in autografts (23 out of 30 chambers) compared to allografts (23 out of 28 chambers).

After six weeks, the animals were killed. Specimens were embedded in plastic. Longitudinal sections were made along the axis of the chamber and stained with haematoxylin and eosin. Mean bone and tissue ingrowth distances were calculated by dividing the area of bone or tissue ingrowth by the width of the specimen.

The effects of graft type and graft treatment on the ingrowth distances were analyzed with a 3-way ANOVA for the factors graft type, graft treatment, and goat. Tukey's test was used for posthoc multiple comparison.

Results
All goats showed good recovery after surgery. One loose and one broken chamber were excluded from analysis. All other chambers were still well fixed after 6 weeks. Fibrous tissue was present between the new bone at the bottom and the necrotic, nonvascularized graft remnants at the top of the chamber.

Bone ingrowth

<table>
<thead>
<tr>
<th>Graft Treatment</th>
<th>Autograft</th>
<th>Allograft</th>
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<tbody>
<tr>
<td>Impaction Only</td>
<td>10</td>
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<td>Rinsing and Impaction</td>
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<td>Rinsing, Impaction, Rinsing and Impaction</td>
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Discussion
The present findings show that incorporation of allografts could be improved by rinsing the grafts prior to impaction. Rinsing the grafts with saline resulted in a higher bone and total tissue ingrowth in (allo)grafts compared to nonrinsed grafts.

An advantage of rinsing with saline is that improved strength characteristics and initial mechanical stability have been reported (2, 3). However, these studies were done with small bone graft sizes (3x5 mm). It remains unclear if mechanical stability of larger bone chips (8x8 mm), as used in acetabular reconstructions, will be influenced. Together with the present findings, these data are important for clinical application of smaller sized morselized allografts to create a stable mechanical environment with a successful incorporation of the graft.

A strong reduction in bone formation in grafts rinsed after impaction could not be found. The effect of these biologically active factors might be either too small and therefore obscured by the variation in the results, or not present at all.

New bone and total tissue ingrowth were higher in unrinsed autografts than in unrinsed allografts. Rinsing morselized bone allografts prior to impaction strongly improved bone and total tissue ingrowth in allografts. Rinsing the grafts prior to impaction is an inexpensive and easy method to remove cells, thereby manipulating the incorporation of allografts to obtain results more comparable to that of autografts.

References

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