Correspondence

Impaction bone grafting

Sir—We would like to take part in the discussion on bone impaction grafting between Dr. Per Aspenberg and Dr. Lars Linder (*Acta Orthop Scand* 2001; 72: 198-99). The paper by Lars Linder in *Acta Orthop Scand* (2000; 71: 543-52) is the basis for this discussion, is excellent and provides information on the completeness of incorporation of bone grafts after bone impaction grafting on the femoral side. However, the interpretation and extrapolation of his data to other joints and to younger more active patients should be done carefully. It is noteworthy that in his retrievals of clinically well-functioning femoral reconstructions, the amount of bony incorporation was low at an average follow-up of 38 months after revision. We agree with his conclusion that incorporation is probably not always a prerequisite for good clinical performance, but one should bear in mind that the retrievals were from patients who were, on average, over 78 years old at the time of revision surgery and 81 (73–92) years old when they died. It seems doubtful that these conclusions are applicable in general to femoral bone impaction grafting in younger more active patients. The youngest patient in these 6 retrievals (case 4) who was reported earlier (Ling et al. 1993), had histological findings very similar to those after successful primary total hip replacement. There was complete reconstitution of vital bone at the previous site of the defect that had been filled with impacted bone graft. Moreover, many radiographs are available on the reconstitution of the cortical wall after femoral bone stock loss, and on the reorganization of the proximal trabecular appearance. The radiological trabecular remodeling is particularly difficult to explain if no graft incorporation and remodelling occurred. We have done animal studies on femoral bone impaction grafting with cemented and uncemented stems and we also found complete bone incorporation, particularly in the proximal areas (Schreurs et al. 1994, 1996), which extended up to the cement layer. On the basis of our long-term experience on acetabular bone impaction grafting, we believe that bone incorporation will occur on the acetabular side. We wrote a paper on this subject in *Acta Orthop Scand* (Buma et al. 1996) describing the findings in 9 human biopsies. Recently, we updated our data in humans on acetabular bone impaction grafting and submitted a paper based on 25 biopsies of 24 acetabular reconstructions, taken between 1 month and 15 years after the reconstruction. In general, over 90% of the bone grafts in biopsies, with a follow-up of 8 years and longer were incorporated although, even after such a long period, some areas of necrotic non-incorporated bone graft in a fibrous stroma remained. At least on the acetabular side, we disagree with his view that complete osseous integration of the graft will probably not occur and that complete incorporation may be even harmful for the clinical result. The arguments of Aspenberg are based on two papers, one by Tägil and Aspenberg (2001) in which they compared the compression strength of freshly-impacted grafts to grafts that had been inserted into a bone chamber. In that very short-term (4 weeks) study, the graft was penetrated by fibrous tissue growing in between the graft trabeculae, which doubled the compressive strength. This, indeed, may be an important early phenomenon, which can explain why these impacted bone grafts can withstand the load shortly after the reconstruction. However, even in these bone chambers, after longer follow-ups bone graft resorption and new bone formation will occur. The second paper by Schimmel et al. (1998) was not interpreted correctly in our view. We studied impacted grafts in goat acetabuli and found complete bone incorporation with bone remodeling into vital lamellar bone. This process was more or less complete after 24 weeks. However, after longer observation periods, interface formation and aseptic loosening of the cups were seen. Aspenberg's interpretation was that loosening occurred when the revitalization process reached the bone cement-interface and that this was responsible for the loosening process. However, loosening occurred later and in our view was not directly

related to the revitalization process. We agree with both authors that one should be very careful when interpreting animal data. We postulated in the acetabular goat study more possibilities for failure in this animal model, but we do not believe that these cup failures are due to the incorporation process, as suggested by Aspenberg. In the light of these considerations, we think that growth factors may be useful in stimulating bone graft incorporation, but they should not be used in bone impaction grafting before all effects of these products on the bone incorporation process are fully understood.

Bone impaction grafting is an attractive, but difficult technique both on the acetabular and femoral sides. One should therefore be very careful about modifying the original technique.

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Sir—Thanks mainly to the pioneering work on impaction grafting by of Drs Schreurs and Buma's group, we know that:

1. Impaction grafting has a remarkable clinical success rate.

2. Initially, the implant rests upon necrotic bone fragments that soon become embedded in a fibrous stroma.

3. In many cases, radiographic changes show the formation of new bone within the graft some years later.

Thus, it is clear that a composite of necrotic bone fragments and an armoring fibrous stroma is sufficient for good function during the first postoperative months or years. The question is whether complete osseous remodeling is necessary for good long-time results, i.e., whether there must be host bone all the way up to the cement or implant. Dr. Linder reported that in cases with good results, large parts of the graft can remain a composite of necrotic bone fragments and an armoring fibrous stroma. It thus appears that complete osseous remodeling is not necessary. The number of patients does not permit any conclusions about the effect of age or activity.

Another question is whether complete osseous remodeling is desirable. Here we can only speculate. The osseous remodeling must start in the periphery, where there is living host bone. It can then work its way through the necrotic bone towards the implant. Osseous remodeling includes resorption before the new bone is formed. If this resorptive activity reaches the graft/cement interface, the risk of loosening can not be excluded a priori. The excellent paper by Schimmel et al. (1998) appears to suggest that loosening can occur in this way, although other explanations for their results are possible. Gross loosening was reported already at 24 weeks.

In the study by Buma et al. (1996), only biopsies from 4 patients comprised the graft/cement interface. 3 of these cases showed complete osseous remodelling. 2 of them were loose! A theoretical connection between complete osseous remodelling and loosening can not be refuted on the basis of these data.

I agree with Drs Schreurs and Buma that growth factors should not be added to impacted grafts in humans. Our opinions differ only as regards how optimistic we can be that more research will justify use of growth factors in impaction grafting in future. I think the chances are small, for 3 reasons: 1. The high clinical success rate without any growth factor leaves a small margin for improvement and much to lose if something goes wrong. 2, There is a theoretical possibility that increased graft resorption can cause loosening. 3, A first clinical attempt led to resorption and clinical failures (Höstner et al. 2000).

Although I am not so optimistic, I think it would be nice if Drs Schreurs and Buma prove to be right.

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