## Guest editorial

# Hip arthroplasty revision

In the early years after Charnley's hip arthroplasty had become available for common use, infection and wear of the plastic cup were regarded as serious threats to the procedure. The infection risk was, indeed, real, with several centers in Europe and the U.S.A. reporting a 10–15 percent postoperative infection rate. On the other hand, yearly radiographic measurements in Charnley's material soon seemed to show that a wearing out of the plastic cup was not a serious problem.

Today, after more than 20 years of experience and development, the situation is very different. The risk of infection in primary arthroplasties is well under 1 percent, whereas the overall rate of revision for implant loosening within 10 years is about 10 percent, and even up to 30 percent in certain subjects, notably young males. Two articles in this issue of *Acta Orthopaedica Scandinavica* show that one third of the revised hips fail within 5 years; the prospects of obtaining a long-lasting fixation of the implant are further reduced with every rerevision. In spite of attempts to improve surgical techniques, material, and prosthetic design, implant loosening has emerged as the number one problem in hip replacement.

The etiology of aseptic or mechanical loosening is still not fully understood, but there are many plausible explanations. The reaming procedure and insertion of cement may cause vascular damage. Monomer toxicity, heat, and toxic effects of other components in the cement are additional causes of bone necrosis. Late failure of cemented prosthetic components is related to micromovements at the interface, subsequent cement fractures or fretting of the components against bone, with development of an aggressive inflammatory connective tissue membrane around the implant. Besides the cement itself, metal-cement and cement-bone interfaces are weak links; the causes of aseptic loosening can be both mechanical and biological (Goldring et al. 1986, Jasty et al. 1991).

When an implant has become loose, bone resorption is a serious process, associated with activation of macrophages by metal, polyethylene or cement debris: multipotent histiocytes become bone-resorbing cells and aggressive granulomas are formed. The bone loss reduces the prerequisites for obtaining good primary stability and cement interdigitation at the revision arthroplasty. Extreme bone loss may even make it impossible to insert a new implant.

Patients with a loose hip implant will often experience pain and limp only late, and some have no pain at all. The loosening process and bone resorption can thus pass undetected with severe bone destruction as a result (Carlsson and Gentz 1980, Hodgkinson et al. 1988). Therefore, radiographic evidence of loosening is an important diagnostic sign, notably migration of the prosthesis. Loose and migrating implants can be detected with high accuracy in any plane using stereophotogrammetry (Mjöberg et al. 1986). However, the method is expensive, requires specific equipment, and is not suited for routine use. With the use of conventional radiographic techniques the evaluation of minor subsidence is imprecise. However, migration more than 3 mm of the femoral and acetabular components and a complete progressive radiolucency of more than 2 mm are generally regarded to be clear signs of loosening. Such findings should alert the surgeon to consider a revision even in the absence of clinical symptoms. Other indirect signs of loosening, such as broad, circumferential, and progressive radiolucencies are difficult to standardize and evaluate.

The bone deficiency must be classified to improve the decision procedure before revision and to enable us to compare the results of various treatment modalities. This is emphasized by Strömberg et al. (1992).

To date, the long-term results of revision hip arthroplasty have been disappointing. Young and presumably more active patients have had the worst results, and for every rerevision, the outcome is even worse, as pointed out by Strömberg et al. (1988) and Repten et al. (1992). The age and the activity level of the patient, and also the bone quality and bone deficiencies are important factors that should affect the choice of surgical technique at the revision.

Whether or not cement is used for fixation of the revised components, substantial bone defects will require grafting. There seems to be a consensus that cement can be used in revision of old and more sedentary patients; the initial stability achieved will usually permit immediate and full weight bearing (Kinzinger et al. 1991). In active, young patients, cementless

revision techniques are preferred, especially in the acetabulum; even in a situation with large bony defects requiring major grafting, hemispheric cementless acetabular components fixed with screws have given good and lasting implant stability. However, femoral bone loss creates serious problems at revision. When the femoral canal has developed into a sclerotic tube without cancellous bone, the primary strength of the cement-bone interface is unacceptably low. Nevertheless, cemented revision after meticulous impaction of cancellous allografts in the femur has provided a dramatic reconstitution of the proximal femur with persistent implant stability, for at least 4 years (Simon et al. 1991).

In cementless revision of the femoral component great attention must be paid to ensure rigid fixation of both the graft and the implant in conjunction with maximal canal filling. In such a situation, graft-host bone incorporation may occur, provided there is direct contact between living host bone and the porous implant surface; undersized femoral components and inadequate initial stability will lead to subsidence and failure with resorption of the bone grafts.

Clearly, bonestock deficiencies must be repaired at the revision whether cement is used or not; replacing lost bone with cement constitutes a salvage procedure.

Loosening is not the only complication of revision hip surgery: Retpen et al. (1992) report a high incidence of fractures, dislocations, and infections associated with multiple revisions.

Revision hip surgery is a challenge to the orthopedic profession: a failed arthroplasty entails great suffering for the patient and high costs for the community. The lessons from the prospective Swedish studies (Ahnfelt et al. 1990) are that active patients should be followed indefinitely, and that radiographic risk signs such as migration or progressive radiolucencies should be taken seriously. Pain in the hip is a late phenomenon: bone loss must be identified early, and in most situations surgically addressed by early intervention including bone grafting. Revision surgery can be expected to improve by referral of these high risk cases to experienced centers, active research on bone grafting techniques, and continued reports of the long-term results of massive allografting.

## References


Ahnfelt L, Herberts P, Malchau H, Andersson G B. Prognosis of total hip replacement. A Swedish multicenter study of 4,664 revisions. *Acta Orthop Scand* (Suppl 238) 1990; 61: 1–26.

Carlsson Å S, Gentz C F. Mechanical loosening of the femoral head prosthesis in the Charnley total hip arthroplasty. *Clin Orthop* 1980; 147: 262–70.

Goldring S R, Jasty M, Roelke M S, Rourke C M, Bringhurst F R, Harris W H. Formation of a synovial-like membrane at the bone cement interface. Its role in bone resorption and implant loosening after total hip replacement. *Arthritis Rheum* 1986; 29 (7): 836–42.

Hodgkinson J P, Shelley P, Wroblewski B M. The correlation between the roentgenographic appearance and operative findings at the bone-cement junction of the socket in Charnley low friction arthroplasties. *Clin Orthop* 1988; 228: 105–9.

Jasty M, Harris W H. Salvage total hip reconstruction in patients with major acetabular bone deficiency using structural femoral head allografts. *J Bone Joint Surg* (Br) 1990; 72 (1): 63–7.

Jasty M, Maloney W J, Bragdon C R, O Connor D O, Haire T, Harris W H. The initiation of failure in cemented femoral components of hip arthroplasties. *J Bone Joint Surg* (Br) 1991; 73 (4): 551–8.

Kinzinger P J, Karthaus R P, Slooff T J. Bone grafting for acetabular protrusion in hip arthroplasty. 27 cases of rheumatoid arthritis followed for 2–8 years. *Acta Orthop Scand* 1991; 62 (2): 110–2.

Mjöberg B. Loosening of the cemented hip prosthesis. The importance of heat injury. *Acta Orthop Scand* (Suppl 221) 1986; 57: 1–40.

Retpen J B, Varmarken J E, Röck N D, Steen Jensen J. Unsatisfactory results after repeated revision of hip arthroplasty. 61 cases followed for 5 (1–10) years. *Acta Orthop Scand* 1992; 63 (2): 120–127.

Simon J P, Fowler J L, Gie G A, Ling R S M. Impaction cancellous grafting of the femur in cemented total hip revision arthroplasty. *J Bone Joint Surg* (Suppl I) (Br) 1991; 73: 73.

Strömberg C N, Herberts P, Ahnfelt L. Revision total hip arthroplasty in patients younger than 55 years old. Clinical and radiologic results after 4 years. *J Arthroplasty* 1988; 3 (1): 47–59.

Strömberg C N, Herberts P, Palmertz B. Cemented revision hip arthroplasty. A multicenter 5–9-year study of 204 first revisions for loosening. *Acta Orthop Scand* 1992; 63 (2): 111–119.



**Peter Herberts, M.D., Ph.D.**
*Department of Orthopedics*
*Sahlgren Hospital*
*S-413 45 Gothenburg, Sweden*