

FACTORS LEADING TO REARTHROPLASTY IN A MATERIAL WITH RADIOGRAPHICALLY LOOSE TOTAL HIP PROSTHESES

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The present project was undertaken in an attempt to analyse factors associated with clinical failure (defined as indication for rearthroplasty) of total hip arthroplasties when radiographic loosening of the femoral component was present. Out of 79 radiographically loose femoral components the rate of failure was 23 per cent. High viscosity bone cement was negatively correlated to clinical failure whereas male sex and high body weight was positively correlated to clinical failure. Signs of loosening appearing early in the period of observation significantly more often led to clinical failure than late appearance of loosening, which was encouraging for the long-term prognosis.

Key words: bone cement; clinical failure; painful hip; radiolucent zone; total hip replacement

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The concept of failure in total hip replacement (THR) consists of both radiological and clinical criteria. Radiological criteria are usually femoral bone resorption, cement fracture and considerable migration of the prosthetic components. Clinical criteria may be moderate to severe pain, severe restriction of motion, recurrent dislocation or evidence of infection in the hip joint, all of which may necessitate revision surgery. The rate of radiological loosening as reported in literature may be in the range of 20 per cent (Beckenbaugh & Ilstrup 1978, Gruen et al. 1979, McBeath & Foltz 1979). However, considerably higher and lower figures occur (Charnley 1979, Hierton et al. 1982). Clinical failure occurs at a much lower rate than radiological loosening and Charnley (1979) reported a revision rate of only 1.5 per cent in his material. A radiographic lucency of 2 mm or more at the femoral cement-bone interface has been reported to correspond to motion of the prosthetic components with manual stress in 89 per cent of cases subjected to revision

surgery where this lucency occurred (Dussault et al. 1977). However, the extent to which this radiographic and mechanical loosening is linked with clinical failure, i.e. selection for re-arthroplasty, has not been generally established. The aim of this project was therefore to analyse factors associated with indication for revision surgery in the presence of radiological loosening of the femoral component.

MATERIAL AND METHODS

A consecutive series of 79 radiographically loose THR was investigated. The patients were randomly operated by several surgeons. The operating theatres had zonal ventilation with about 80 air-changes per hour in the central part of the room. In general, prophylactic antibiotics were not used. An anterolateral approach was the rule (92 per cent of total). Trochanter osteotomy was performed only in selected cases (4 per cent of total). Intramedullary plugs were not used. Patients were permitted to stand up on the day following surgery. A stick or crutches were generally used by the

patients for 6 weeks after the operation and for longer if desired. As a routine procedure, patients attended the outpatient clinic for physical examination including radiogram and ESR 6 months, 1 and 3 years after the operation. A total of 79 radiographically loose hips were included in the study. One of the authors was responsible for collecting data from the records while the other two, together, examined the radiograms. Criteria for radiographic loosening were: a) an increasing radiolucent zone of 2 mm or more around most of the implant, or b) a radiolucency between the prosthesis and the cement, not initially present, or c) a subsidence of the prosthesis of 5 mm or more (Weismann 1981). Doubtful cases were regarded as normal. Criterion for clinical failure was that the patient had been selected for re-arthroplasty or that the condition of the hip strongly indicated revision surgery even if the general condition of the patient contraindicated another operation. The statistical significance between the differences was evaluated by the chi-square test.

RESULTS

The frequency of clinical failure in cases with radiologically loose femoral components expressed as a percentage of cases selected for re-arthroplasty among the cases with radiologically loose femoral components was 23 per cent.

When loosening is used in the following, it refers to radiological loosening of the femoral component and when referring to clinical failure it should be understood that the patient was selected for re-arthroplasty unless otherwise stated.

With regard to the time at which radiological loosening appeared in 3 years after THR, it was noted that among 79 radiologically loose THR, the incidence of lucency at the femoral cement-bone interface at 6 months postoperatively was overrepresented in the group with clinical failure. Cement fracture at 6 months was slightly more common in the hips with clinical failure when compared with loose hips without failure. Radiological loosening of the acetabular component was not significantly increased in the group with clinical failure (Figure 1).

On the other hand, when lucency at the femoral cement-bone interface was present after 6 months, clinical failure occurred in 100 per cent of the four cases and when this lucency was present 1 year postoperatively, failure occurred in 42

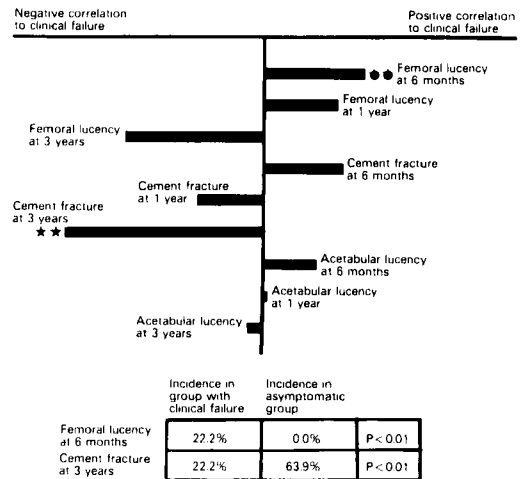


Figure 1. Clinical failure in relation to the time of occurrence or radiological loosening. The length of the bars is based on the relative differences in incidence between clinical failure group and asymptomatic group.

per cent of 12 cases. Three years postoperatively femoral lucency was followed by clinical failure in 10 per cent out of 31 cases. Cement fracture occurring after 6 months was followed by clinical failure in 32 per cent of 25 cases and after 1 year clinical failure resulted in 17 per cent out of 35 cases. Three years postoperatively there was only 7 per cent clinical failure out of 43 cases with cement fracture occurring at this follow up.

Patients with clinical failure significantly more often suffered from pain while moderate to severe pain at rest or on motion occurred in 83 per cent. Clinical infection was observed in the three cases where pain was not appreciable. Patients selected for re-arthroplasty usually needed more external support than those with only radiological loosening. Male sex was positively correlated with clinical failure ($P < 0.05$). A body weight of more than 80 kg was noted in 39 per cent among cases with failure compared to 21 per cent among the others.

Normal physical activity preoperatively occurred in 89 per cent of the cases in the group with clinical failure but only in 67 per cent in the group with only loosening. No correlation was observed for the postoperative ESR, fever postoperatively or other complications.

The prosthetic neck length had no influence on

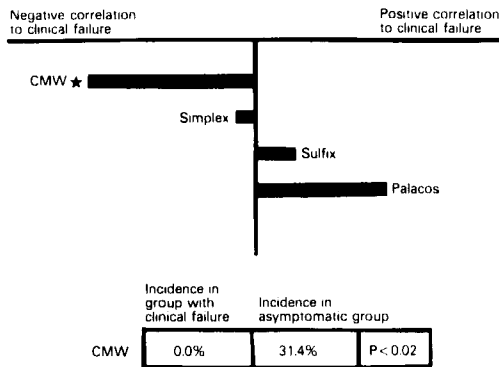


Figure 2. Illustration of the influence of the type of cement on clinical failure. The length of the bars is based on the relative differences in incidence between clinical failure group and asymptomatic group.

the rate of clinical failure. Varus positioning of the prosthesis was not increased when clinical failure occurred. Different malpositions of the acetabular components did not correlate to clinical failure. The cementation appeared to be crucial in that high viscosity cement (CMW 1)* was negatively correlated to clinical failure ($P = 0.02$) (Figure 2).

DISCUSSION

While acetabular loosening may be regarded as the long term result of a change in the distribution of mechanical stress and foreign body granuloma formation (Andriacchi et al. 1976, Willert 1978) loosening of the femoral component is an early event. Early loosening of the femoral component, which has been suggested to be largely the result of poor technique (Hierton et al. 1982), can be described in terms of lucency of the femoral cement-bone interface, cement fracture, migration or subsidence. The factors involved with loosening of the femoral component may be mechanical or biological in nature.

Several recent reports (Amstutz et al. 1976, Beckenbaugh & Ilstrup 1978, Charnley 1979, Hierton et al. 1982) indicate considerable differ-

ences between the radiographic loosening rate and a low revision rate. It is not generally known what importance radiological loosening may have for the prognosis but some investigators believe that the clinical correlation increases with time (Welch 1981). In the present study the percentage of clinical failure was 23 per cent among hips with radiographically loose femoral components. It was found that only the early appearance of femoral lucency correlated to clinical failure. This finding is considered encouraging for the long-term prognosis of THR.

As regard the clinical condition of the patient, it was noted that significant pain did not occur in three of four cases with a clinically diagnosed infection of late onset and clinical failure. This may be attributed to a different pain physiology of infected hips.

Male sex was significantly overrepresented and high body weight and normal physical activity preoperatively tended to be positively correlated with clinical failure. The reason for this is apparently that early increased stresses in male, heavy and active patients lead to early rupture of the bonds between bone and cement and between cement and metal. No influence was observed on the rate of clinical failure with different sizes, necklengths or positions of the prosthetic components. Nor did we find any correlation with post-operative ESR, fever or other complications: this partly reflects the low rate of infections or inflammatory reactions. However, the cementation was negatively correlated to clinical failure and low viscosity cement tended to be more frequent when clinical failure occurred. High viscosity cement is probably associated with relatively fewer thin protrusions which could break and cause erosion of the bone in case of a loose implant.

There are numerous factors of both a technical and a biological nature involved in the failure of a THR. The reparative processes will be exhausted if excessive stresses are applied for long enough and failure will ensue. In recent years the indication for THR has been extended to include younger and more active patients and this may involve one of the greatest risks for mechanical failure. We believe that the orthopaedic surgeon can reduce the rate of failure by both patient selection and patient education.

* CMW Orthopaedic Bone Cement Type 1, CMW Laboratories Ltd, Cornford Road, Marton, Blackpool, UK.

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