

MECHANICAL LOOSENING OF THE FEMORAL COMPONENT IN TOTAL HIP REPLACEMENT, BRUNSWIK DESIGN

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One hundred and sixty-one non-infected primary total hip replacements, Brunswik design, were examined clinically and radiographically. Mechanical loosening defined as a radiolucent zone developing at the proximal, lateral part of the stem occurred in almost 40 per cent during the first few years after the operation whereafter a steady state was reached. Loosening of the stem was more common in men and in patients with a previous femoral neck fracture and significantly related to improper cementing.

Key words: arthroplasty; hip

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Mechanical loosening of the stem prosthesis is, at present, the most frequent local complication after total hip replacement (THR) (Ahnfelt 1980). However, loosening is seldom defined precisely and this makes comparisons between different studies in the rate of this failure difficult.

In the present investigation mechanical loosening of the stem prosthesis was defined as a primary separation between the metal shaft and the cement as a consequence of subsidence and/or varus migration. This separation is visualized in the radiographs as a lucency developing at the proximal, lateral edge of the stem (Carlsson & Gentz 1980) (Figure 1).

The purpose of this study was to evaluate the incidence of stem loosening in the Brunswik total hip prosthesis and also to analyse its causes and consequences.

PATIENTS AND METHODS

The Brunswik total hip prostheses in this material have a 35 mm head and a 13 cm long curved stem with a collar and are manufactured from a chrome cobalt alloy. The cross-section of the stem is wedged. The socket is made of polyethylene and more than half-spherical – e.g. of snap fit design (Figure 1).

Between 1972 and 1974 196 Brunswik total hip prostheses were implanted in 172 patients by 14 different surgeons. All operations were performed with the patient in the lateral position and through a posterior approach without osteotomy of the greater trochanter. Thirty-five hips in 29 patients were excluded for reasons presented in Table 1. The remaining 161 hips in 143 patients were included in this study.

In 1977 and 1978 145 hips were examined by the authors. Five patients had died but not before 1 year after the operation and 11 cases had been revised because of a stem loosening – in such cases the clinical information was collected from the charts.

In 1980 and 1981 116 hips were available for a sec-



Figure 1. A Brunswik prosthesis with a radiolucent zone at the proximal, lateral edge of the stem indicated by the arrow.

ond examination. At this time a total of 17 patients (hips) were lost because of deaths and 21 cases had been re-operated on because of failed stems. Finally, one patient who had sustained a hematogenous infection and six who were not available had to be excluded.

Radiographs of all hips were obtained immediately after the operation, 1–2 weeks post-operatively and thereafter at irregular intervals. The radiographic examination at follow-up was performed in a standardized manner and included an a-p view and a lateral view centered on the hip joint and an a-p view of the

pelvis centered on the symphysis (Carlsson & Gentz 1977).

The entire series of radiographs in each hip was scrutinized by both authors.

The position of the stem was classified as neutral when oriented parallel with the long axis of the femur – otherwise as varus or valgus.

The width of the radiolucent zone at the proximal, lateral part of the stem prosthesis was measured at the level of the stem-neck junction.

If the stem was completely surrounded by cement at least 1 mm thick, the cementing was classified as acceptable – otherwise as deficient. Furthermore, cement deficits at the calcar and around the tip of the stem were registered separately.

The socket inclination and the degree of ante- or retroversion were measured according to a method previously described by McLaren (1973), Fackler & Poss (1980) and Pettersson et al. (1982).

Time of follow-up

The interval between the operation and the first examination was 41 ± 12 months and between the operation and the second follow-up 82 ± 9 months.

RESULTS

Sex and age

Radiographic loosening occurred in 50 per cent of the men and 30 per cent of the women – the difference was significant ($P < 0.01$). The age at the operation did not differ in cases with and without loosening.

Diagnosis and previous hip surgery

Hips operated on due to complications following a femoral neck fracture were significantly over-represented among the loosened cases compared with patients operated on because of primary coxarthrosis ($P < 0.05$) (Table 2). Stem

Table 1. Hips excluded from the original material

Deceased	18
Infected	5
Early revision	1
Previous THR	7
Not available	4
Total	35

Table 2. The relation between coxarthrosis and femoral neck fracture in intact and loosened stems

	Coxarthrosis	Neck fracture
Intact	74	10
Loosened	40	15
$P < 0.05$		

loosening was observed in all six cases previously operated on with a Moore-prosthesis. However, a previous operation with osteotomy was equally common in loosened and intact hips.

The contra-lateral hip

The contra-lateral hip was normal in 44 per cent of the intact hips and 49 per cent of the loosened cases. In about 40 per cent of both intact and loosened hips the contra-lateral hip had been operated on with THR.

Operating time and surgeon

In order to evaluate if the primary procedure was combined with any technical difficulties we recorded the per-operative blood loss and the operating time. No differences was found between intact and loosened hips in these two re-

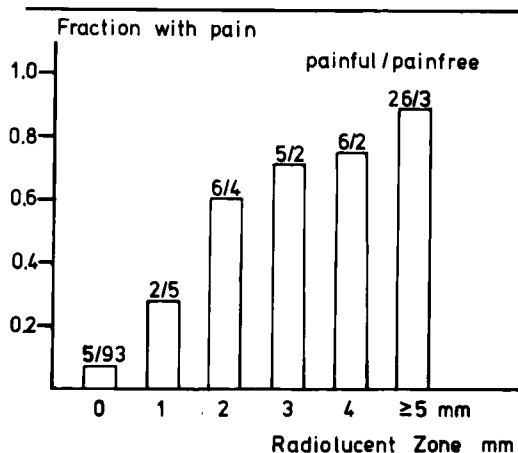


Figure 3. The relationship between pain and width of the radiolucent zone.

spects, neither could loosening be correlated to any specific surgeon.

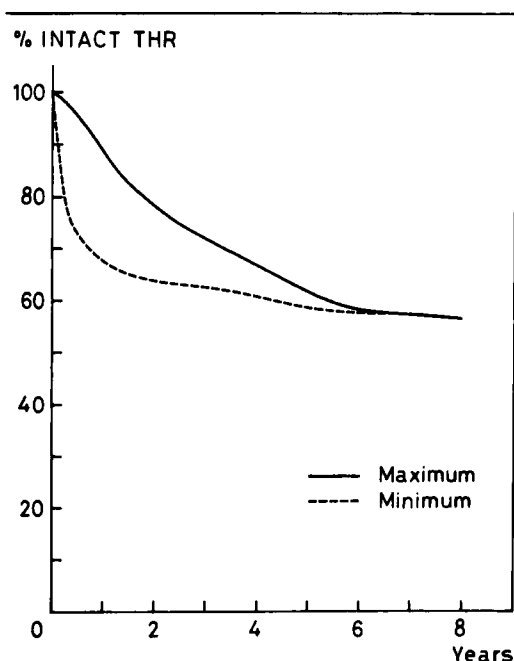


Figure 2. The rate of intact THR observed for each year of the follow-up period. The upper curve shows the actual observations. The lower curve reflects the fact that because of the time interval between radiograms, the radiolucent zone may have existed earlier. After 6 years about 60 per cent of the hips were without radiologic signs of loosening; i.e. radiolucent zone.

Rate and time of loosening

Loosening of the stem – the development of a lateral radiolucent zone – was seen in 61/161 hips (38 per cent) at the first re-examination and 45 of these hips were painful. Between the first and the second re-examination only one additional stem-loosening occurred. Five hips, classified as intact at the first examination and one hip with stem-loosening were “lost” for the second re-examination.

As illustrated in Figure 2 almost all stem-loosenings occurred during the first few years and at both the first and the second examination there were about 60 per cent intact hips.

Degree of loosening and pain

The width of the radiolucent zone at the first re-examination averaged 5.1 ± 3.4 mm. The distribution of painfree and painful hips at the first re-examination is presented in Figure 3. At the first examination 84 per cent and at the second examination 91 per cent of the hips with a radiolucent zone measuring 3 mm or more were painful. Three hips, classified as loosened but painfree at the first examination, had become painful at the second follow-up.

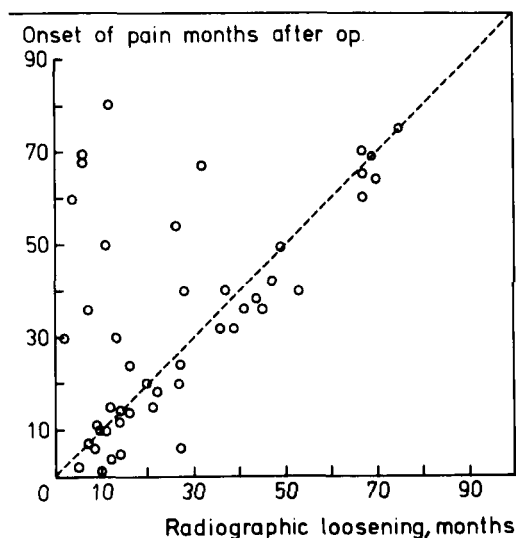


Figure 4. Onset of pain in relation to the appearance of the radiolucent zone.

As demonstrated in Figure 4 onset of pain and radiographic signs of loosening were closely correlated in time in a number of cases. These were mainly patients seeking advice because of pain. In another group radiographic stem loosening could be demonstrated at an early time while the patients were still free from pain. Most of these patients had attended for regular controls.

Stem position and cementing technique

The loose stems had more often been implanted in varus position compared with stable stems. However, the difference was insignificant (Table 3). Thirty-two per cent of the stable hips and 12 per cent of the loose hips had a cement thickness of at least 1 mm around the entire stem. The

difference was significant ($P < 0.01$). Especially the absence of cement around the tip of the stem was demonstrated to be of significance for the process of loosening. Cement deficits at the calcar were equally common in stable and loose cases. The amount of cement distal to the tip of the stem was equal in both groups.

Resorption of the calcar

Resorption of the calcar was significantly more common ($P < 0.001$) in hips with a radiolucent zone. In intact hips only a few cases with resorption of the calcar were recorded.

Socket position

The degree of version and inclination of the socket did not differ in hips with and those without stem loosening.

Various

The width of the femoral medullary canal and the remaining length of the resected femoral neck did not differ in intact and loosened hips. Also, ectopic bone formation was equally common in both groups.

Exchange operation

When this study was completed 21 of the 161 hips (13 per cent) had been operated on with exchange of the stem prosthesis due to mechanical loosening. Another three hips with stable stems had been operated on with exchange of a loose socket. After the second follow-up four additional stems have been exchanged because of loosening.

Table 3. Stem position in intact and loosened stem prostheses

	Neutral and valgus	Varus
Intact	41	59
Loosened	18	43

n.s.

DISCUSSION

In 1977 Visuri et al. reported 2.1 per cent aseptic loosening in 189 Brunswik prostheses. However, the time of observation was short. The rate of loosening reported in the present study – 40 per cent – corresponds to what is reported in other studies with a long time follow-up. Thus Becken-

baugh & Ilstrup (1978) found 24 per cent stem loosening in 255 Charnley THR, Carlsson & Gentz (1980) 36 per cent in 288 Charnley THR and Olsson et al. (1979) 16 per cent in 238 Charnley-Müller THR. Hypothetically a stem prosthesis with a wedged cross-section such as the Brunswik or Charnley-Müller designs should be more prone to loosen.

The majority of the stem loosening occurred during the first few years after the operation whereafter a steady state was attained (Figure 2). The same phenomenon and the same level – about 60 per cent intact hips – was reported by Carlsson & Gentz (1980). All patients with a radiolucent zone – mechanical loosening – do not suffer from pain but as shown in Figure 3 the fraction of painful hips increased with the width of the radiolucent zone and when this zone measured 3 mm or more about 85 per cent of the hips were painful.

Different modes of failure have been described but just as in the present investigation most loosening seems to be related to improper cementing technique (Bocco et al. 1977, Beckenbaugh & Ilstrup 1978, Gruen et al. 1979, Carlsson & Gentz 1980). From a theoretical point of view the stem prosthesis should be oriented along the long axis of the femur. However, this study failed to demonstrate any statistical significance of the stem position in relation to loosening.

In agreement with Carlsson & Gentz (1980) we found that loose stems were significantly more common in men which may reflect a higher load on the hip joint because of high activity and body weight. Why hips with a previous femoral neck fracture were more prone to loosen is difficult to

explain. There is no reason to believe that technical difficulties are responsible whereas inferior quality of the bone stock may be one explanation.

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