A FEMORAL HEAD PROSTHESIS WITH A BUILT-IN JOINT

A RADIOLOGICAL STUDY OF THE MOVEMENTS OF THE TWO COMPONENTS

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Twenty patients each with a fractured femoral neck had a prosthesis with a built-in ball-and-socket joint inserted. Movements at the built-in joint were compared with total hip movement immediately after operation, one month later and three months later. It was found that the built-in joint soon lost mobility and at three months was almost completely stiff. Consequently such joints cannot be expected to prevent the acetabular erosion which is liable to follow femoral head replacement for fracture.

Prosthetic replacement of the femoral head and neck is now almost always the treatment of choice for displaced intracapsular fractures of the neck of the femur in elderly patients. Recent prospective clinical studies (Riley 1978; Søreide, Mølster and Raugstad 1980; Sikorski and Barrington 1981) indicate that this treatment is at least equal to, and probably better than, internal fixation. The most frequently encountered long-term complication is erosion of the acetabulum, which occurs in 25 to 30 per cent of those patients who survive three or more years (Hinchey and Day 1964; Salvati and Wilson 1973; Steen Jensen and Holstein 1975; D'Arcy and Devas 1976). This erosion is generally thought to be caused by friction between the metal head of the prosthesis and the acetabular cartilage.

Since the end of the 1960s, prostheses with an inner bearing have been used. The underlying idea is that movements of the hip should occur mainly in the built-in bearing (because of the lower friction) rather than in the joint between the prosthetic head and the acetabulum, thus sparing the acetabulum. Well-known examples include the Christiansen prosthesis (Christiansen 1969) with a built-in trunnion bearing; and the prostheses described by Bateman (1974), Giliberty (1974) and Monk (1976), which all feature a ball-and-socket joint, as do various other commercially available prostheses. Since January 1981 we have treated intracapsular fractures of the femoral neck, in patients over 70 years of age, by primary implantation of the Variokopf prosthesis. In 20 consecutive patients we undertook a study to collect information about the relative movements of the inner and outer bearings as contributions to the total movement of the hip; the hips were studied immediately after the operation, and one month and three months later.

THE PROSTHESIS

The design of the Variokopf prosthesis (made by Interplanta GmbH) is very similar to that of various others. It consists of a femoral stem with a ball head, articulating with a head piece made of high-density polyethylene covered by a polished metal shell. The non-fenestrated femoral component is available in several lengths of both stem and neck, and with two diameters of the ball (32 and 24 millimetres, the latter only for accepting head pieces with a diameter smaller than 43 millimetres). The diameters of the head pieces range from 39 to 55 millimetres, in one-millimetre steps. The ball-and-socket joint has a "snap-fit", and dislocation of the two components is further prevented by a locking ring (Figs 1 and 2). When using the 32-millimetre ball, flexion of the head piece can occur over an angle of 65 degrees in all directions.

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Fig. 1
Fig. 2
Figure 1—The components of the prosthesis; the head piece has an outer shell of polished metal. Figure 2—Assembled prosthesis: the locking ring preventing separation of the components is not yet fully inserted.
PATIENTS AND METHODS

Twenty consecutive patients with displaced femoral neck fractures (Garden Types III and IV) each had a ball-and-socket prosthesis implanted. An anterior approach was used and the femoral component fixed with acrylic bone cement. Mobilisation and weight-bearing were encouraged as soon as the wound permitted, usually within three days. All patients received antibiotic and anticoagulant cover perioperatively. These were 17 women and three men, with a mean age of 83 years (range 74 to 98).

Radiological examinations, using an image intensifier, were carried out immediately after operation, and at one month and three months later. With the patient supine and the pelvis fixed, the x-ray tube was first positioned above the hip to give anteroposterior projections. Passive and active abduction, adduction and rotation were observed, the total hip excursions were noted, as well as the amount of movement occurring in the two possible bearing sites. Then the tube was rotated so that lateral views could be obtained to study flexion and extension in the same way. In some instances video recordings were made to allow slow-motion projection. It was found that movement started in the built-in bearing, and later continued in the joint between the prosthetic head piece and the acetabulum, but did not occur simultaneously at both sites. This facilitated the measurement of the contributions of each joint to the total hip excursion.

Although rotation in the hip is better observed with the patient lying prone with the knee flexed, this position proved too uncomfortable to use. Rotation was therefore studied by measuring how much the patella rotated from the neutral position.

This method largely conforms to that described by Chen, Sarkar and Pell (1980). The movement in the inner bearing was expressed as a percentage of total hip movement, thus allowing for individual differences in hip excursions.

RESULTS

Table I summarises the amount of movement occurring in the built-in joint, expressed as a percentage of total hip excursion. It can be seen that the built-in bearing is hardly functioning after three months. There were no measurable differences for this phenomenon whether active or passive movements were observed. Statistical analysis showed that only the difference in the abduction movement between the first and the third month was not significant (0.05 < P < 0.1) when Student’s t-test was used. All other differences, between observations immediately after operation and those at one month and at three months, were significant (P < 0.05, or sometimes P < 0.01). Figures 3 to 9 show the "stiffening" of the inner bearing.

Clinically, it was found that after one month, 15 patients were walking independently with or without the support of canes; four patients complained of moderate pain. After three months these figures were 16 and nine, respectively.

DISCUSSION

Since their introduction, femoral head prostheses with an inner bearing have been promulgated as an alternative to the classical one-piece prosthesis (Moore, Thompson) mainly for two reasons: prevention of acetabular erosion; and easy conversion to a total hip arthroplasty by simply detaching the head component and inserting a new prosthetic acetabulum, the femoral component already being in place. Our results indicate that, since the inner bearing becomes almost completely stiff within a short
time, this prosthesis cannot be expected to prevent acetabular wear.

Reports in the literature concerning this point are few and contradictory. Chen and co-workers (1980) demonstrated mobility of the inner bearing after implantation of Monk prostheses in 10 patients. On the other hand, Drinker and Murray (1979), using video-radiography, demonstrated far less movement of the inner bearing than is allowed by the implant itself (the Bateman universal proximal femoral endoprosthesis) after two years, and even more stiffening of the inner joint after 3.4 years. Søreide and his co-authors (1980), using the Christiansen prosthesis, found an overall percentage of acetabular erosion after five years of 24 per cent, comparable to the percentage found when using the classical one-piece prostheses. Meyer (1981) found better clinical results (according to the Harris hip evaluation system) with the Christiansen prosthesis than with the Moore prosthesis. However, Long and Knight (1980) could find no demonstrable advantages of the Bateman UPF prosthesis over the Moore prosthesis.

The cause of the reduction in movement of the inner bearing remains unclear. In one patient (not included in this series), who died 15 days after the operation, some serosanguinous fluid could be found in the reconstructed hip and inner bearing at necropsy. Drinker and Murray (1979) hypothesised that an increase in friction of the inner bearing occurred due to a loss of the lubricant function of the polyethylene. In one other patient, when a revision operation was done for aseptic loosening of the femoral stem, a fibrous structure was found encircling the neck of the prosthesis, making movements of the

Figure 10 — A histological section of the fibrous structure found encircling the prosthesis, showing a collection of foreign-body giant cells containing shards and fibres of strongly birefringent polyethylene debris. (Haematoxylin and Azophloxin, × 225.) Figure 11 — The same section under polarised light.
inner bearing virtually impossible. Under microscopic examination this was found to contain foci of fibrocartilaginous tissue and thick-walled vessels. Inflammatory infiltration was absent. In one section a single well-circumscribed collection of foreign-body giant cells was seen. Shards and fibres of strongly birefringent material were situated inside the cytoplasm of the giant cells and had the appearance of polyethylene debris. Metal and acrylic particles were not in evidence (Figs 10 and 11).

We have no personal experience with conversion to a total hip arthroplasty, nor could we find any reports of this in the literature. Some personal communications indicate, however, that this is by no means an easy operation.

In conclusion, we feel that although hemiarthroplasty definitely has a place in treating intracapsular fractures of the femoral neck, there are a few if any advantages in the use of prostheses with an inner bearing.

REFERENCES


