Subsidence of the femoral component in the noncemented total hip

A roentgen stereophotogrammetric analysis

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Roentgen stereophotogrammetric analysis was used in the evaluation of subsidence in eight noncemented femoral components of the HP-Garches prosthesis. After 2 years, seven components had subsided 0.6–3.9 mm, i.e., more than observed in some cemented prostheses. No distinct symptoms related to the micromotion appeared.

Ryd (1986) used roentgen stereophotogrammetric analysis to determine positional changes of the tibial components of total knee prostheses; cemented prostheses had only half the subsidence (micromotion with time) and half the instability (micromotion under load) of the noncemented variety. Mjöberg et al. (1985) showed that the migratory pattern, and not the instability under load, constitutes the conclusive evidence of prosthetic loosening in total hip replacement.

We report a roentgen stereophotogrammetric analysis of the migratory pattern of the femoral component of the noncemented HP-Garches prosthesis.

Patients and methods

Eight patients, 5 women and 3 men, participated after informed consent. The diagnosis was arthrosis in 5 patients and rheumatoid arthritis in 3 patients. The median age was 58 (51–80) years; the body weight was 62 (51–85) kg. All the patients had at least a 3-year history of severe pain in the affected hip, limited range of motion, and a marked limp. The Harris hip score was 38 (21–55).

Details of implant. The HP-Garches (Howmedica) femoral component is made of a chrome-cobalt alloy, and is elliptical to ensure maximal filling of the medullary canal. The stem has an antirotational fin that inserts into the greater trochanter to counteract rotation of the stem. Further, the stem has a collar forming an angle of 30° with the horizontal plane (Figure 1). The acetabular component consists of a spherical outer metallic ring and an inner high-density polyethylene cup. The outer metallic ring has four self-tapping threads and a central opening in the bottom. Three sizes of femoral components and five sizes of acetabular components were available (Honnart and Patel 1984).

Operative procedure. The sizes of the components were selected by studying the preoperative radiographs. The posterolateral approach was used. Great attention was paid to the surgical technique. The acetabulum and femur were prepared with special reamers. Further, intramedullary drilling of the femur was done in order to achieve optimal fitting of the femoral component. The threaded acetabular component was considered fully anchored in bone if the surgeon could not achieve any further rotation on the handle. No tapping was made prior to the final fixation of the acetabular component. Postoperative radiography showed that close contact between the collar of the femoral stem and femoral calcar was achieved.

Clinical assessment. Preoperatively and 6 months, 1 year, and 2 years postoperatively, the patients were assessed by the Harris (1969) hip score. The clinical findings were compared with the results of the roentgen stereophotogrammetric analysis.

Roentgen stereophotogrammetric analysis

As developed by Selvik (1974), this method determines accurately the position of implants in the human body. As reference measurement points on the stereoradiographs, tantalum markers implanted in the bones of interest are used. However, the prosthetic femoral head is obscured by the metal of the acetabular component, which does not lend itself to satisfactory marking with indicators. We therefore excluded the acetabular

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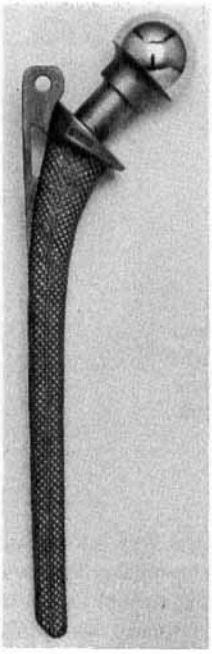

Figure 1

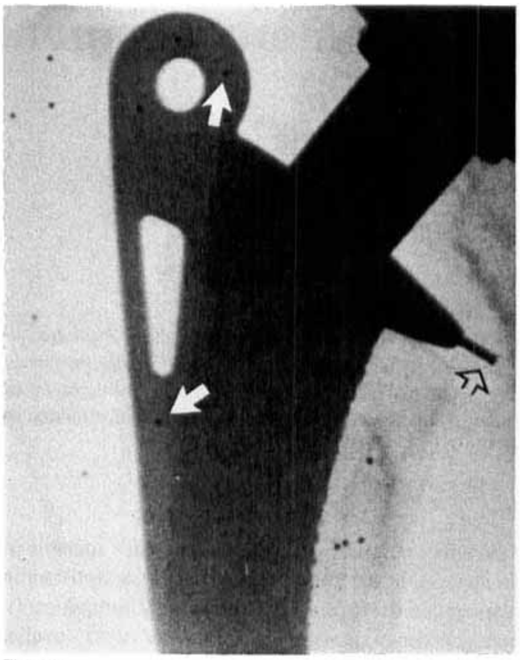

Figure 2

Figure 1. HP-Garches' prosthesis.

Figure 2. Radiograph of proximal part of the femur with an HP-Garches prosthesis. Tantalum balls in greater and lesser trochanter, tantalum wire, and markers , in prosthesis.

component in the present study. The indication of the femoral component was obtained by drilling a hole in the medial aspect of the collar and by attaching a tantalum wire in this hole. Tantalum markers were further introduced in drilled holes in the lateral aspect of the femoral stem (Figure 2). Exact reference points were created in the bone by tantalum balls introduced by a specially designed instrument in the greater and lesser trochanter of the femur (Aronson et al. 1974). The tantalum markers inside the chrome-cobalt implant could be demonstrated by high-voltage radiography. The tip of the indicator wire medially could also be seen if the projections of the prosthesis were not too oblique.

Both roentgen stereophotogrammetric analysis and conventional radiography were performed 1 week, 6 months, 1 year, and 2 years postoperatively.

To test the accuracy of the method, double examinations of patients were performed on 16 occasions. The standard deviation found from these double examinations was 0.2 mm for subsidence. Using the Student's t-test, the minimal significant translation ($P < 0.01$) was 0.6 mm.

Results

In five of the eight femoral components, subsidence was seen 6 months postoperatively, and in one more 1 year postoperatively. After 2 years, seven of eight femoral components had subsided 0.6–3.9 mm (Table 1). A discontinuous radiolucent zone between implant and bone had developed 6 months after surgery in all the femoral components. In six hips, radiolucency was seen laterally at Gruen zones 1–3, and in two hips medially at zones 5–7 (Gruen et al. 1979). Resorption of the calcar femorale beneath the collar of the stem occurred in six hips, mainly during the first 6 months. No further resorption occurred during the following 18 months.

Inside the femur immediately distal to the tip of the stem, increased bone density was found in seven hips. These formations, similar to bone plugs, were detected after 6 months. In two hips the lateral cortex adjacent to the distal stem was hypertrophic.

Two years after surgery, 2 patients occasionally had some discomfort in the hip region, whereas the other 6 patients were asymptomatic. Subsidence was not related to the Harris hip score. Hence, a low Harris hip score was not associated with a high subsidence rate.

Discussion

By roentgen stereophotogrammetric analysis of noncemented low modular porous-coated total hip prostheses (LMPCH, Biomet), Nistor et al. (1987) found a mean migration of 1.6 (0.5–2.5) mm after 1 year in clinically successful hips.

Mjöberg et al. (1985) stated that the best single criterion of loosening is subsidence. Using roentgen ster-

Table 1. Data for 8 patients with noncemented total hips

A	B	C	D	E	F	G	H	I	J	K
1	a	0.3	1.0	1.6	88	+	+	–	+	–
2	a	0.7	0.8	1.3	98	+	–	–	+	–
3	r	2.1	2.6	3.9	84	+	+	+	+	+
4	r	0.8	1.3	2.3	95	+	+	–	+	–
5	a	0.0	0.4	0.3	77	+	–	+	+	–
6	r	0.2	0.1	0.6	93	+	+	–	+	+
7	a	0.6	1.1	1.4	69	+	+	–	–	–
8	a	2.3	2.9	3.5	94	+	+	–	+	–

A case number, B diagnosis: a arthrosis, r rheumatoid arthritis, C, D, E migration in mm at 6, 12, and 24 months after surgery, F Harris' hip score at 2-year follow-up, G radiolucent zone between bone and implant, H resorption of calcar femorale, I hypertrophy of lateral cortex, J "bone-plug" formation, K occasional discomfort in operated leg on weight bearing.

eophotogrammetric analysis, Mjöberg et al. (1986) studied cemented Lubinus femoral components in patients without symptoms of loosening. Out of 20 hips, only three had migration exceeding 0.2 mm (range 0.3–0.6 mm) after 2 years. In our investigation the significant level was as high as 0.6 mm, mainly due to different radiographic equipment and the less distinct images of the markers in the prosthesis. However, our results, without a doubt, showed that noncemented prostheses have subsided after 2 years; in three of our eight hips, subsidence was greater than 2 mm. Two patients complained of occasional discomfort in the hip region, apparently not related to the amount of subsidence (Table 1).

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