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Low- versus high-viscosity bone cement

Fixation of hip prostheses analyzed by roentgen stereophotogrammetry

Sixteen patients were examined by roentgen stereophotogrammetry during the first year after total hip arthroplasty. Eight prostheses were fixed with low-viscosity and eight with high-viscosity cement. Eight acetabular components, four in each group, migrated cranially, and three femoral components, all in the low-viscosity group, migrated distally. Our findings suggest that low-viscosity cement does not improve prosthetic fixation.

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Careful cleaning of the bone surface and pressurization of low-viscosity cement into the bone have been proposed to prevent loosening by improved mechanical interlock at the bone-cement interface (Halawa et al. 1978, Miller et al. 1979, Krause et al. 1982, Noble & Swarts 1983). Roentgen stereophotogrammetry, using tantalum bone markers, permits detection of prosthetic migration within 4 months after surgery (Mjöberg et al. 1986). We compared the migration of total hip components after fixation with low- or high-viscosity cement.

Patients and methods

Sixteen patients with 16 Scan hip prostheses (MITAB, Sjöbo, Sweden) for osteoarthrosis were examined with roentgen stereophotogrammetry during the first postoperative year. The patients were randomized into two groups: In one group the components were fixed with a low-viscosity cement (Palacos E-flow cum gentamicin =Osteopal G=EMD 42522, Merck); and in the second group, the components were fixed with a high-viscosity cement (Palacos R cum gentamicin, Merck). The operative technique included reaming, preservation of most subchondral bone in the acetabulum, brushing, high-pressure lavage, pressurization of the cement into the acetabulum, and injection and pressurization of the cement into a plugged femoral canal. At operation, 5–8 tantalum balls, 0.8 mm in diameter, were implanted in the pelvis and in the trochanter major and minor, respectively (Figure 1); the acetabular components were supplied with tantalum balls by the manufacturer. Two femoral components, both cemented with high-viscosity cement, were excluded because of inadequate bone

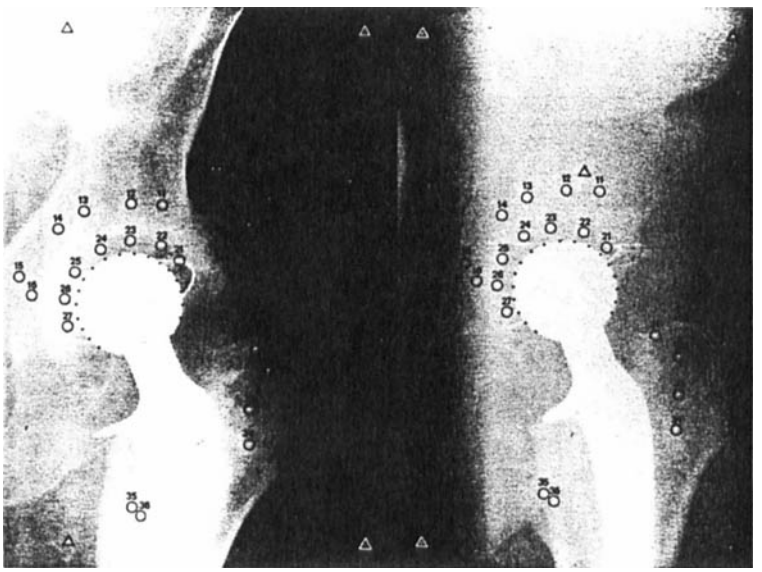

Figure 1. A hip (stereo pair) with tantalum balls (○) positioned in the pelvis in the trochanter major and minor, and in the acetabular component. Reference balls (△) for exact localization of the films.

marking with tantalum balls. All the patients were able to place their full weight on both legs within 2 days.

Roentgen stereophotogrammetry was performed 1 week, 4 months, and 1 year postoperatively. The stereophotogrammetric exposures were made with the hip relaxed and with the patient supine. A detailed description of the technique has been given by Selvik (1974), Baldursson et al. (1979), and Selvik et al. (1983). Migration of the prosthetic components was recorded (Mjöberg et al. 1985). Displacements were not considered significant unless they exceeded 0.4, 0.2, and 0.8 mm for the x-(transversal), y-(longitudinal), and z-(sagittal) axis, respectively (Mjöberg et al. 1986).

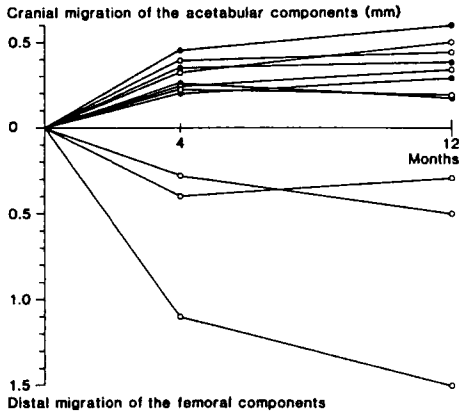

Figure 2. Migration along the frontal axis of the migrating eight acetabular and three femoral components. ○=low-viscosity and ●=high-viscosity bone cement.

Results

One year after surgery, eight of the 16 acetabular components (4/8 with low-viscosity and 4/8 with high-viscosity cement), and three of the 14 femoral components (3/8 with low-viscosity and 0/6 with high-viscosity cement) had migrated (Figure 2). The acetabular components had migrated cranially (0.2–0.6 mm) in all 8 cases, and laterally (0.6 mm) in 1 case. The femoral components had migrated distally (0.3–1.5 mm) in all 3 cases, medially (0.8–0.9 mm) in 2 cases, and dorsally (0.9–2.7 mm) in 2 cases. Eight acetabular and 11 femoral components did not migrate during the observation period. All the migrating prosthetic components showed migration along the longitudinal axis within 4 months after surgery.

Discussion

Biomechanical experiments (Halawa et al. 1978, Miller el al. 1976, 1979, Krause et al. 1982, Noble & Swarts 1983) have indicated that the better penetration of low-viscosity cement into cancellous bone improves prosthetic fixation. This was not confirmed by the present investigation; we found no difference in the pattern of prosthetic migration between the low- and the high-viscosity cement (Figure 2). Loosening of cemented hip prostheses may, however, be a consequence of thermal injury during polymerization (Lundskog 1972, Feith 1975, Huiskes 1980, Huiskes & Slooff 1982, Mjöberg et al. 1984, 1986), rather than of inferior penetration of the cement dough onto or into the irregularities of the bone surface. The less frequent migration of the metallic femoral component, irrespective of type of cement, when compared with the polyethylene acetabular component, may then be explained by the fact that the metal acts as a heat sink (Labitzke & Paulus 1974, Reckling & Dillon 1977, Huiskes 1980).

In cases of thermal necrosis, most necrotic bone will be resorbed during the first 4 months, and this allows for a rather rapid migration (Figure 2). Later, in these cases, the cement is separated from the bone by a fibrous tissue membrane containing macrophages (Willert et al. 1974, Feith 1975, Goodman et al. 1985) that resorb bone upon stimulation by micromovements (Willert et al. 1974, Goldring et al. 1983, Linder et al. 1983). The initial 4-month period after surgery is the optimum period for determination of prosthetic fixation using roentgen stereophotogrammetry (Mjöberg et al. 1986); later on, migration may be slow (Baldursson et al. 1979, Mjöberg et al. 1986, Ryd 1986).

Close contact between viable bone and cement is possible (Charnley 1979, Draenert 1981, Linder & Hansson 1983, Linder et al. 1984). However, once prosthetic fixation has been lost, it probably cannot be reestablished (Linder et al. 1983, Paterson et al. 1986). Thus, migration once begun will probably continue and may subsequently result in clinical failure. Prosthetic components with a slight initial migration will, however, not result in clinical failure for many years (Ryd 1986). Prosthetic components with no initial migration should have an even better prognosis.

Our findings support that roentgen stereophotogrammetry may distinguish between a migrating and a nonmigrating prosthetic component within 4 months after surgery (Mjöberg et al. 1986), and they suggest that low-viscosity cement does not improve prosthetic fixation. Our findings are analyzed further by Mjöberg (1986).

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