RADIOLOGICAL LOOSENING AFTER CEMENTED HIP REPLACEMENT FOR JUVENILE CHRONIC ARTHRITIS

I. D. LEARMONTH, A. W. B. HEYWOOD, J. KAYE, D. DALL

From the Princess Alice Orthopaedic Hospital, Cape Town

We reviewed the results of 14 total hip replacements in patients with juvenile chronic arthritis. The mean age at operation was 16 years (range 12 to 22 years); follow-up was from four to 11 years (mean 8.5 years). Postoperatively pain relief was sustained in all but one hip, while movement generally remained significantly restricted. No hip has as yet required a revision operation, although eight hips (57\%) show radiological changes suggestive of impending failure.

All patients had severe polyarticular involvement with associated restriction of locomotor activity. Potential causes contributing to loosening such as continuing diaphyseal bone growth and increased immunocompetence in adolescence are discussed.

Polyarticular, or systemic onset juvenile chronic arthritis (JCA) may result in progressive widespread joint destruction. The hip has been reported to be involved in 63.5\% of patients (Jacqueline, Boujot and Canet 1961); in 9\%, this joint may be involved within one year of the onset of the disease (Ansell 1978) and its destruction is the most important cause for loss of mobility. In selected cases soft tissue procedures and osteotomy may produce good results, but, when the joint is destroyed, early total replacement may be needed to maintain or regain the ability to walk.

There has been concern about the fate of prosthetic implants in young patients. Bago et al. (1984) reported problems of increased component wear and fatigue, aseptic loosening, implant rejection and other long-term effects on the surrounding tissues. The possibility of continuing growth after arthroplasty presents a further problem, although growth is often stunted, both as a result of the disease and of cytotoxic medication.

Prognosis in terms of survival must also be considered. Barkin (1952) reported a mortality of 20\% over 10 years and others have reported similar rates (Edström and Gedda 1957; Ansell and Bywaters 1959; Ansell 1965). The early restoration of independent mobility is therefore a priority. We now report our experience with total hip replacement in young patients with JCA, with particular reference to the problem of component loosening.

MATERIALS AND METHODS

Fourteen low friction arthroplasties of the hip were performed in seven patients with juvenile chronic polyarthritis. The mean follow-up was 8.5 years (range four to 11 years). The age at operation ranged from 12 to 22 years with a mean of 16 years and a transtrochanteric approach was used in all cases. The hips were assessed clinically on an 18 point scale, using the method of D'Aubigné and Postel as modified by Charnley (1972). The absence of pain, a normal walking distance, and a full range of movement were awarded six points each. All patients were in Charnley's category C with severe polyarticular involvement. Radiographs taken at the time of review were compared critically with early postoperative films.

RESULTS

The mean pre-operative score for pain was 4.0: at follow-up effective pain relief had been sustained with a mean value of 5.5. Hip movement was markedly restricted preoperatively (mean 2.0), but the postoperative score of 3.1 (total range 60 to 100\(^\circ\)) reflects only a slight improve-
ment. Two stems had been placed in slight varus; there was no other significant malorientation of components. Large defects in the cement with poor filling were noted in two femurs, but the cement technique appeared to be entirely adequate in the other early postoperative radiographs.

No hip had yet required a revision operation, but eight hips (57%) had radiological changes suggestive of impending failure (Fig. 1). These all had Grade III acetabular demarcation (DeLee and Charnley 1976) while seven of them showed some degree of cup migration. In four the migration was severe, being over 2 mm. The displacement was upwards in all seven, and four also showed medial migration (Fig. 2). The lucent zone exceeded 5 mm in five hips and was from 2 to 5 mm in a further four hips. Gross acetabular cavitation was seen in three hips (Fig. 3). At the femoral bone-cement interface, five of the eight hips had either progressive or diffuse demarcation zones. Of these, two were at both proximal medial and distal lateral zones while the remaining three were diffuse. The demarcation zone exceeded 5 mm in five cases and was 2 to 5 mm wide in a further five.

The five femoral stems that were radiologically loose all had distal stem subsidence of over 5 mm (Fig. 1), two had associated varus and one was in valgus. There were two cement tip fractures and small single endosteal cysts were seen in five cases. Hypertrophy of the cortex was seen in two cases, but heterotopic bone was not encountered and the trochanter united without problems in all cases.

DISCUSSION

There have been several other reports on hip replacement for juvenile chronic arthritis in patients under 30 years of age (Bisla, Inglis and Ranawat 1976; Singsen et al. 1978; Colville and Raunio 1979; Ruddlesdin et al. 1986). They all discuss the technical difficulties associated with hypoplasia of the pelvis and femur, gross anteverision of the femoral neck and generalised osteoporosis. The reported results are similar to ours and included gratifying pain relief but limited improvement in range of movement. No previous reports, however, have given a detailed review of the radiological findings at follow-up.

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**Fig. 1a**

**Fig. 1b**

**Fig. 1c**

Figure 1a – The pre-operative radiograph. Figure 1b – An early postoperative radiograph shows that the bone-cement interfaces are satisfactory. Figure 1c – Nine years later there is demarcation at the acetabular bone-cement interface and diffuse lucency in all zones around both femoral stems. There is a cement tip fracture on the right.
Radiographs at three months and at eight years postoperatively show loosening of the cup with superior and medial migration.

In patients over 60 years of age, over 80% of good or excellent radiological results have been reported over 10 years after low friction arthroplasty (Older 1986; Wroblewski 1986), and we have reported similar results in such cases (Dall et al. 1986). However, Chandler et al. (1981) reported radiological evidence of loosening at five years in 57% of patients who were under 35 years of age at the time of total hip replacement. This incidence is very similar to that of radiologically determined impending failure at a mean follow-up of 8.5 years in our present series, but most of Chandler’s patients had monoarticular involvement and therefore probably had increased mechanical stress resulting from high activity to account for the high failure rate. Our patients all had polyarthritic involvement; significant limitation of activity must have resulted in some stress protection. The reduced activity level probably accounts for the fact that many patients with loosening of one or both components remained virtually asymptomatic.

What is the cause of the remarkably high “failure rate”? Careful review of the early postoperative radiographs has failed to incriminate technical error. Joint replacement was not considered until the triradiate cartilage and the capital epiphyseal growth plate were closed, but growth does occur subsequently: in the epiphyseal region this is caused by endo-cartilaginous ossification and radial expansion. In the diaphysis, the bone grows by deposition of new layers of periosteal bone on the outer surface and simultaneous osteoclastic resorption of the endosteal surface, thus increasing both the outer and the inner diameters of the shaft. A similar process is encountered in the acetabulum. It is therefore possible that one explanation for the high incidence of loosening in these young subjects is that the bone surrounding the implant actually grows away from it.

Freeman, Bradley and Revell (1982) reported on the interface of bone with high density polyethylene, cobalt chrome and methylmethacrylate and showed that only

At three years postoperatively the cup remains well fixed, but by 10 years it is loose and there is gross superior cavitation.
the cement excited a macrophage response reminiscent of a low-grade inflammation. It is well established that ageing is associated with an attrition of the immune response and it is therefore possible that relatively high immunocompetence at puberty may mediate increased osteoclastic activity in response to methylmethacrylate cement, resulting in early bone–cement lucency and subsequent loosening.

Conclusions. Joint replacement remains a valuable salvage procedure for children crippled by severe bilateral arthritis of the hip. Restoration of independent mobility represents an enormous improvement in the quality of their lives, but our series reveals an alarming incidence of loosening of both components of cemented hip arthroplasties. This is inconsistent with the limited stresses imposed on these hips and warrants further investigation.

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REFERENCES


