THE TOTAL CONDYLAR PROSTHESIS

10- TO 12-YEAR RESULTS OF A CEMENTED KNEE REPLACEMENT

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Over a two-year period 104 patients had 130 knee arthroplasties performed with the total condylar prosthesis at the Hospital for Special Surgery. At a 10- to 12-year review 58 patients (74 knees) had survived and were available for detailed clinical and radiographic evaluation. Of these, 38 knees (51.3%) were rated as excellent and 27 (36.5%) good. There were three (4.0%) fair and six (8.2%) poor results. Five of the six had had revision operations. The success of this early pattern of prosthesis supports the continued use of methacrylate cement for knee arthroplasties.

The total condylar knee prosthesis was introduced at the Hospital for Special Surgery in 1974, (Insall et al 1976a; Insall 1984; Ranawat and Sculco 1985; Walker 1985). It is a cemented, semiconstrained, cruciate-sacrificing tricompartmental prosthesis and was designed when component loosening and breakage, instability and patellofemoral pain were relatively common problems with the available arthroplasties (Insall et al 1976b).

This paper gives the detailed results of the earliest arthroplasties included in the survivorship analysis of the larger series reported in this issue on pages 798 to 803 by Scuderi et al (1989).

PATIENTS AND METHODS

From January 1, 1974 to December 31, 1975 at the Hospital for Special Surgery, 104 consecutive patients had 130 primary knee arthroplasties using the total condylar knee prosthesis. All operations were performed or directly supervised by the senior author (JNI), and some of the patients have been included in earlier reports (Insall, Scott and Ranawat 1979; Insall, Tria and Scott 1979; Insall et al 1983).

The indications for this type of arthroplasty have

been refined during the last 10 years. Tricompartmental replacement is most suitable for patients with primary osteoarthritis, osteonecrosis, or rheumatoid arthritis provided they have an acceptable range of motion (greater than 45°); such cases formed our pre-operative cohort.

Osteoarthritis or osteonecrosis was the diagnosis in 100 knees and rheumatoid arthritis in 30. The average age at the time of surgery was 67 years (range 39 to 87 years); there were 82 women and 22 men, their average weight being 76 kg (range 43 to 113 kg). Obesity was not a contra-indication; 10 patients weighed over 100 kg.

Pre-operative deformity and range of motion. Of the 130 knees, 63 had *varus* angulation, 23 with more than 10° of fixed deformity. The maximum was 30°. Fifteen knees had over 10° fixed *valgus* angulation, the maximum valgus deformity being 22°. The other 52 knees had femorotibial alignment between zero and 9° of valgus.

Ninety-five knees had a flexion contracture, over 10° in 76, with a maximum of 45°. Twenty-nine knees with a flexion contracture of over 20° also had either a varus or valgus deformity greater than 10°.

The average range of motion before operation was 88° (range 45° to 144°).

Follow-up assessment. Clinical and radiographic assessments were made at 10 to 12 years. By then, 35 patients (45 knees) had died and two patients (two knees) were lost to follow-up. Nine other patients (nine knees) had been institutionalised for chronic disorders such as a cerebrovascular accident or profound dementia; there were no failed knee arthroplasties in this group but many were unable to walk and had poor general health. This group was excluded from assessment because a meaningful rating of the knee was impossible.

This left 58 patients (74 knees) available for

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0301-620X/89/5170 \$2.00
J Bone Joint Surg [Br] 1989; 71-B:793-7.

assessment at a minimum of 10 years. Five patients did not consent to radiography. We used the Hospital for Special Surgery knee rating scale (Insall, Lachiewicz and Burstein 1982; Insall et al 1983), on which 85 to 100 points represents an excellent result, 70 to 84 a good result, 60 to 69 a fair result, and less than 60 a poor result. By the convention established in earlier reports, knees from which the prosthesis had to be removed, either for arthrodesis or for revision arthroplasty, were rated as zero.

Pre-operative, early postoperative and 10- to 12-year radiographs were reviewed in detail. Most patients also had annual films which were also reviewed. Radiographic technique varied slightly over the 12 years. In most cases, data were obtained from weight-bearing films in 17-inch (43 cm) cassettes. We did not use radiographs that included the hip and ankle.

The prosthesis. The total condylar prosthesis and the surgical technique for its insertion have been previously described (Insall et al 1983) (Fig. 1). Although originally this name was given to a specific knee prosthesis, by usage 'total condylar' has become a generic term to describe a surface knee replacement which provides patellofemoral resurfacing and has a single piece tibial component with a central stem or keel.

RESULTS

Clinical evaluation. The average pre-operative knee score for the 74 reviewed knees had been 45 points (range zero to 97). At review 38 knees (51.4%) were excellent, 27 (36.5%) good, three (4%) fair, and six (8.1%) (including the five that had required revision) were poor. The five knees from which the prosthesis had been removed scored zero points, leaving 69 knees for functional assessment.

Of the 74 knees, 50 (67.6%) were completely pain free. Twelve (16.2%) complained of mild pain and six (8.1%) had moderate pain. One patient with bilateral arthroplasties complained of severe, but vague and undiagnosed pain in one knee after the same side had been affected by a cerebrovascular accident.

Twenty-seven patients (33 knees) were able to walk unlimited distances. There were 10 knees in patients able to walk more than five blocks, 22 knees in patients able to walk between one and five blocks, and four knees in two patients only able to walk one block or less. Poor walking scores often reflected generalised debility. Of two patients (four knees) able to walk only a single block, one was limited by pain of spinal origin and the other, weighing 109 kg, had enjoyed 'excellent' scores for both knees during the first five years. Her scores declined with general infirmity from the age of 70 years.

Some patients, with 35 knee replacements (47.3%), were capable of ascending stairs reciprocally using the banister at most for balance. Other patients, with 31 replacements (41.9%), could mount a step only by pulling

Fig. 1

Total condylar prosthesis mark I.

on the banister, but only two patients with three arthroplasties (4.1%), could not climb stairs at all.

The average range of movement was 91.2° (range 56° to 128°). As regards flexion deformity, 63 knees (85.1%) had none, five knees (6.8%) had less than 10°, and one knee (1.3%) had over 10°. Two knees (2.7%) showed an extension lag.

In all, 60 (81.1%) had less than a 5° arc of instability to varus-valgus stress when tested in full extension. Nine knees (12.1%) had varus-valgus arcs of 6° to 15°. One patient had posterior instability of her arthroplasty in flexion.

Twenty-nine patients (37 knees) walked without using any supporting device. The other 29 patients (32 knees) required some aid for walking; four of them with an average age of 82 years used a walking frame and the others used canes.

The six poor results. One patient with bilateral replacements had an excellent rating on both sides for 10 years until a cerebrovascular accident, which affected his right side. On this side the rating dropped to poor, although the arthroplasty itself was unchanged. The five other knees with a poor rating received scores of zero because revision or arthrodesis had been required. Four of these failures have been previously reported in detail (Insall et al 1983), one due to varus instability and three to tibial loosening. All were due to technical errors such as failure to achieve correct alignment or to balance soft tissues (Fig. 2).

The single new failure since the last report was due to femoral component loosening. Pre-operative valgus deformity had been well corrected at the primary arthroplasty, but pain developed insidiously, and there was a marked, progressive resorption of bone under the femoral component (Fig. 3).

Fig. 2a

Fig. 2b

Tibial loosening was seen in cases with varus tibiofemoral alignment and a varus-sloping tibial cut. Figure 2a - One year after operation. Figure 2b - Loosening by collapse of the overloaded bone of the medial tibial plateau with deformation of plastic tibial component.

Fig. 3a

Fig. 3b

Figures 3a and b - Satisfactory alignment, but some resorption of bone under the anterior flange of the femoral component at five years. Figures 3c and d - Loosening of the femoral component with subsidence and change of alignment.

Fig. 3c

Fig. 3d

Patients who died or were lost to follow-up. The last evaluations for these 37 patients (47 knees) were: excellent in 25 (53.2%), good in 17 (36.2%), fair in one (2.1%), and poor in three (6.4%). One patient with one replaced knee was lost to follow-up and never rated. There was no evidence of component loosening in any of these arthroplasties.

Radiographic analysis. On the early postoperative film tibiofemoral alignment of seven knees was between 10° and 13° of valgus. Five knees had varus alignment ranging from 1° to 5° and four of these needed revision later. The other 57 arthroplasties were aligned in from 1° to 10° of valgus. The tibial components were placed within 5° perpendicular to the long axis of the tibia in all but three knees, which were positioned in up to 8° of varus. The femoral components were positioned within 5° of a 7° valgus position with respect to the long axis of the femur in all but four knees. Except for the knees which required revision for component loosening, there were no changes in the position of any component relative to the bone.

Radiolucent lines and loosening. There was one late femoral loosening and three knees, all implanted with varus alignment, were revised for loosening of the tibial component with complete, circumferential, radiolucent lines.

Thirty knees (46.9%) showed some radiolucency at the tibial bone-cement interface at one year after operation, and 35 (54.7%) had some radiolucency at the 10- to 12-year follow-up. Five knees (7.2%) with no apparent tibial radiolucency had later developed some. Three knees (4.3%) showed an increase in either the width or length of radiolucent zone between the one- and the 10-year follow-up. All others were unchanged over 10 years (Fig. 4).

As previously reported, most radiolucencies were under the medial and lateral tibial plateaux (Insall et al 1983). Nine patients developed a radiolucency bordered

by a sclerotic bony margin on the medial side of the keel. This may represent stress shielding in the proximal tibia. No knee showed complete circumferential radiolucency around the tibial component, apart from those which were revised for tibial component loosening. Pain preceded the development of circumferential radiolucency as an indication of loosening in these patients.

Interpretation of radiolucencies was made difficult by the changes in radiographic projections used during the 12 years. The use of all-polyethylene tibial components probably made it easier to visualise the interface which may be obscured by metal-backed tibial components (Ecker et al 1987).

DISCUSSION

The total condylar knee arthroplasty is a cruciate-sacrificing, cemented prosthesis that was developed in response to shortcomings with earlier designs (Insall et al 1976a). Although we now report a longer duration of follow-up, our results are consistent with those of other authors for this prosthesis (Laskin 1981; Windsor et al 1983; Aglietti and Rinonapoli 1984; Hvid and Nielsen 1984; Nielsen, Hvid and Sneppen 1985; Knutson, Lindstrand and Lindgren 1986; Ecker et al 1987; Goldberg et al 1987; Ranawat and Boachie-Adjei 1987; Schurman, Borden and Wilde 1987).

Loosening of the tibial component is repeatedly cited as the most frequent cause of failure in total knee arthroplasties. We agree that malalignment (Lotke and Ecker 1977) and increased amounts of proximal tibial bone resection (Dorr et al 1985) are the major factors responsible for the loosening of one-piece tibial components. This is supported by the fact that all of the reviewed cases complicated by tibial component loosening had been aligned in varus.

Radiolucent lines continue to pose a problem generally in the assessment of total knee arthroplasties. It is difficult to position the x-ray beam parallel to the bone-cement interface, and expensive to use fluoroscopic imaging at follow-up on every patient.

We consider that radiolucencies shown on conventional radiographs are a poor predictor of future failure of total knee arthroplasty. It is difficult, if not impossible, reliably to quantify radiolucencies unless they are grossly obvious and progressive. We agree with other authors who have failed to find a correlation between radiolucencies, their progression and clinical outcome (Ahlberg and Lindén 1977; Reckling, Asher and Dillon 1977; Ducheyne, Kagan and Lacey 1978; Ritter, Gioe and Stringer 1981; Hvid and Nielsen 1984; Tibrewal, Grant and Goodfellow 1984; Ecker et al 1987). We also believe that sinkage due to bone collapse from overload, and not micromotion, is the more usual mechanism of loosening (Ducheyne et al 1978).

Our study shed some light on one aspect of the controversy surrounding the preservation or sacrifice of

Fig. 4

Radiographs of a total condylar knee prosthesis at one year and at 11 years. A small medial tibial radiolucency has persisted unchanged over this period.

the posterior cruciate ligament. It has been argued that an intact posterior cruciate ligament is necessary to 'spare' the interface between components and bone (Sledge and Walker 1984; Scott and Volatile 1986), but it would seem from our results that this ligament can be expended without causing loosening of the components. Correction of some of the severe deformities encountered in this series was facilitated by excision of both cruciate ligaments.

On the basis of these long-term results, we do not believe that there is a need to develop cementless fixation of knee arthroplasties for patients similar to our study

group. While failure of methacrylate cement may have caused or compounded the loosening of some hip arthroplasties, it is erroneous to draw analogies to the knee. The mechanical demands placed on bone cement in hip arthroplasty differ profoundly from those made in knee arthroplasty.

Although none of the authors have received or will receive benefits for personal or professional use from a commercial party related directly or indirectly to the subject of this article, benefits have been or will be received but are directed solely to a research fund, foundation, educational institution, or other non-profit institution with which one or more of the authors is associated.

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