Polyethylene failure in two total knees

Wear of thin, metal-backed PCA tibial components

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Two women underwent a PCA total knee arthroplasty of the metal-backed type in which the tibial insert was only 4 mm thick in its thinnest portion. After 2 and 4 years, both women had pain on weight bearing due to polyethylene breakdown causing metal-to-metal contact. Such thin polyethylene components should not be used for knee replacements.

Failure of knee endoprostheses is mainly due to polyethylene wear (Jónsson 1981, Hood et al. 1983, Landy and Walker 1985, Wright et al. 1988 a, b). This is particularly true for thin, unicompartmental, all-polyethylene components (Jónsson 1981, Knutson et al. 1981), but has also been reported for total knee tibial components (Ducheyne et al. 1978, Hood et al. 1983, Wright et al. 1988 a, b).

We report 2 cases of polyethylene failure 2 and 4 years postoperatively.

Case 1

In 1984, a 78-year-old woman with gonarthrosis Stage IV (Ahlbäck 1968) underwent a Howmedica PCA total-knee arthroplasty of the primary resurfacing type. The tibial component was of medium size, with a total thickness of 7 mm. The tibial and patellar components were cemented (tibia partly cemented), whereas the femoral component was uncemented. The position of the components, as well as the postoperative alignment of the leg, was satisfactory. The primary postoperative course was excellent; but after 4 years, the patient, rather abruptly, began to have pain on weight bearing that slowly progressed. The painful period was preceded by minor trauma during swimming. Two months after the onset of pain, radiographs were normal, but varus-stress radiographs showed metal-to-metal contact (Figure 1). A revision 1 month later revealed major wear of the medial tibial polyethylene; an anteromedial part, approximately 2 cm in size, had broken loose leaving the metal baseplate exposed to the femoral component (Figure 2). The polyethylene also had signs of pitting and delamination on the lateral side. The synovium was macroscopically normal, but a histologic examination revealed abundant polyethylene inclusions.

Case 2

A woman 70 years of age had the same operation for the same condition as Case 1. The tibial component was uncemented, whereas the other two components were cemented. The size and thickness of the tibial component were identical to Case 1. The position and alignment were satisfactory. The primary course was uneventful; but after 2 years, the patient experienced rather sudden onset of pain on weight bearing that progressed during the months to follow. Plain radiographs were normal including the prosthesis-bone interface. Varus-stress radiographs showed contact between the femoral component and the metal tibial baseplate on the medial side. The operative findings were almost identical to that of Case 1.

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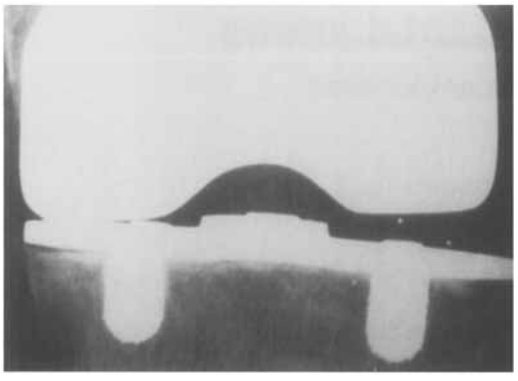

Varus stress radiograph. There is metal-to-metal contact on the medial side. Tantalum balls for roentgenstereophotogrammetric analysis (RSA) are visible in proximal tibia and in the polyethylene.

The fragmented polyethylene.

Figure 1 (Case 1). Polyethylene failure of the partly cemented tibial component 4 years after total knee arthroplasty.

Discussion

To our knowledge, only one previous report of a similar complication has been published (Eng 1988); the patient was a heavy and very active farmer who was operated on bilaterally with two 7-mm-thick tibial components of the same design as in our patients.

Our patients were not particularly heavy or active. The operations were technically well performed, with alignment and component positioning within the acceptable range. Activity level, age, body weight, alignment, and polyethylene thickness have been suggested as important factors influencing polyethylene wear. The exact composition and manufacturing process of the ultrahigh molecular weight polyethylene may also influence the wear properties (McKellop et al. 1981, Weightman and Light 1985, Connelly et al. 1984, Bartel et al. 1986, Wright et al. 1988). One additional factor influencing the severity of wear is the length of time since implantation (Hood et al. 1983, Landy and Walker 1985). On an early date, Charnley and Cubic (1973) acknowledged the problem of polyethylene wear; and they were able to identify a mean wear rate in hip prostheses of 1.2 mm/10 years.

Thin, nonmetal-backed, tibial components have failed because of deformation in both unincompartmental (Jónsson 1981, Knutson et al. 1981) and total (Ducheyne et al. 1978) designs. For this reason, metal trays were introduced to support the polyethylene. In the knee joint, due to grossly different articulating geometry, the contact areas between the metal-on-femur and the polyethylene-on-tibia are diminished as compared with the normal knee with increased load bearing of the polyethylene. This factor is even more pronounced in the latest designs, giving virtually normal articulating characteristics, as well as normal gait parameters (Andriacchi et al. 1982). Further, polyethylene in the knee prosthesis is subjected to deleterious tension-compression-tension cycles, which are encountered in the hip to a much lesser extent (Bartel et al. 1986). Bartel et al. (1985, 1986) have shown that the stresses in the polyethylene are critical for any kind of knee prosthesis, notably when the polyethylene is thinner than 6–8 mm. Both of our tibial components were 7 mm in thickness, and the polyethylene part was only 4 mm thick at its thinnest part. We believe the thin polyethylene to be the main reason for failure in our patients. Although there has not been any evidence of major polyethylene problems in metal-backed total-knee tibial components in the nationwide Swedish Knee Arthroplasty survey, in which to date more than 20,000 knees have been registered, we believe that our observations are well worth consideration. With our experience from these reported patients and the background from the literature, we conclude that the polyethylene part of the tibia component in any total knee arthroplasty should be at least 6 mm thick.

After submission of this manuscript, we have identified similar polyethylene wear in three out of five revisions in a series of 220 PCA unicompartmental arthroplasties presently prepared for publication. Two of these tibial components were 7 mm

thick (polyethylene 4 mm), and one was 9 mm thick (polyethylene 6 mm). The time from primary surgery to revision was less than 5 years. We are aware that tibial components of any design may eventually exhibit wear, but these early findings of wear of thin total and unicompartmental PCA thin tibial components deserve attention.

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