Polyethylene failure of metal-backed patellar components

111 AGC total knees followed for 7–22 months

Henrik N. Andersen, Carsten Ernst and Peter A. Frandsen

In a series of 111 AGC total knee arthroplasties, eight failures of the polyethylene part of the metal-backed patellar component were seen after a period of 7–22 months. All of these patients experienced a characteristic grating sound as the knee was bent, and skyline radiographs revealed direct metal-on-metal contact. At revision, fracture and separation of the polyethylene part were found together with an extensive, black, thickened synovium and abrasive wear of the naked metal backing of the patellar component. The cemented metal backings were all solidly anchored in the patella. Based on this high failure rate, we have abandoned the metal-backed patellar component in favor of an all-polyethylene component.

Department of Orthopedics, Esbjerg County Hospital, DK-6700 Esbjerg, Denmark
Tel +45-75181900

The theoretic advantages of metal backing in acetabular and tibial prosthetic components, such as uniform transmission of load to underlying bone and less deformation of polyethylene cover, are well documented (Bartel et al. 1985). The same benefits were expected to exist for the metal-backed patellar component; but recently, mechanical failures have been reported (Bayley et al. 1988, Rosenberg et al. 1988, Stulberg et al. 1988, Felmet et al. 1989).

We report a high failure rate of the metal-backed patellar component of AGC total knees.

Patients and methods

Between June 1987 and July 1989, 111 consecutive total knee arthroplasties were performed using the AGC (Anatomic Graduated Component, Biomet®, Warsaw, Indiana) cemented knee system with a metal-backed patellar component. The latter has a single backing peg, and the dome of the polyethylene cover should ensure equal contact with both femoral condyles throughout knee motion. All the operations were performed by the same 2 senior surgeons. Postoperatively, the patients were followed up with clinical and radiographic examinations at regular intervals.

Results

Patellar implant failure occurred in 8 of the 111 patients (Table 1). The mean time from total knee arthroplasty to failure was 15 (7–22) months. Failure was sudden in 5 cases, of which only 1 (Case 3) had a slight knee trauma before symptoms began. All 8 patients noted a loud grating sound and felt a grinding sensation when bending the knee. Radiographs showed metal-on-metal contact between the femoral component and the metal of the patellar component in all the patients (Figure 1). In 3 cases the dome-shaped polyethylene of the patellar component could be seen elsewhere in the knee (Figure 2).

In all 8 cases, the polyethylene was broken and separated from the metal backing, which was still firmly attached to the undamaged patella. All the metal backings of the patellar components showed signs of gross wear (Figure 3), whereas in only 2 cases the femoral component showed slight abrasive wear of the lateral condyle.

All the cases had a characteristic and completely black synovium, documented by microscopic examination, and which was due to metallic debris. In 7 of the 8 cases, the failed patellar components were replaced with an all-polyethylene component, and in 1 case a new metal-backed component was inserted. Debridement of the knee, including total synovectomy, was performed in all the cases.

Table 1. Observations in 8 patients with mechanical failure of the metal-backed patellar component after total knee arthroplasty

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	65	M	78	175	L	1	7	–	+	–	+	–	95	115	0	–	–	M	+	–	–3	–3	+	+	+
2	59	M	129	172	R	2	22	+	+	–	+	–	110	90	0	–	+	M	+	–	–9	–2	+	+	–
3	81	F	56	143	R	2	15	–	+	–	+	–	95	110	0	–	–	M	+	–	–7	1	+	+	–
4	64	M	99	166	R	2	8	+	+	+	+	–	120	100	0	–	–	M	+	+	–4	–2	+	+	–
5	75	F	76	152	L	2	21	+	+	–	+	–	110	90	0	–	–	M	+	–	–12	1	+	+	–
6	67	F	91	166	L	2	9	–	+	–	+	–	110	?	0	+	+	M	+	+	?	–2	+	+	–
7	74	F	72	163	R	2	15	+	+	–	+	–	100	100	0	–	–	M	+	–	–11	–4	+	+	–
8	58	M	78	178	R	2	20	–	+	–	+	+	90	90	5	–	–	M	+	+	–17	–2	+	+	–

A Case
B Age
C Sex
D Weight, kg
E Height, cm
F Side
G Diagnosis: 1 rheumatoid arthritis, 2 arthrosis
H Functional period before failure, months
I Pain: + yes, – no
J Grinding sensation: + yes, – no
K Swelling: + yes, – no
L Grating sound: + yes, – no
M Locking: + yes, – no
N Range of motion after 3 months, degrees
O Range of motion 3 months after revision surgery
P Extension deficit, degrees
Q Lateral release, performed primarily: + yes, – no
R Lateral release, at revision surgery: + yes, – no
S Patellar prosthetic size, M medium
T Metal-on-metal contact on radiographs
U Displaced polyethylene shadow on radiographs
V Preop. femorotibial angle as deviation from 7° valgus
W Postop. femorotibial angle as deviation from 7° valgus
X Black synovium
Y Displaced polyethylene cover
Z Complications after revision surgery

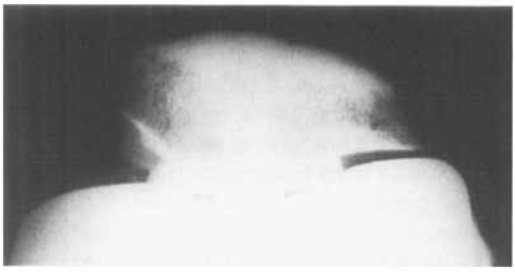

Figure 1. Case 1. Skyline radiograph demonstrating metal-on-metal contact, but with the patella well centered in the groove.

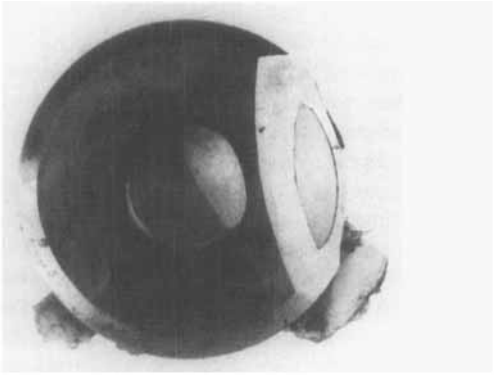

Figure 3. Case 2. A removed metal backing with abrasive wear of the lateral edge.

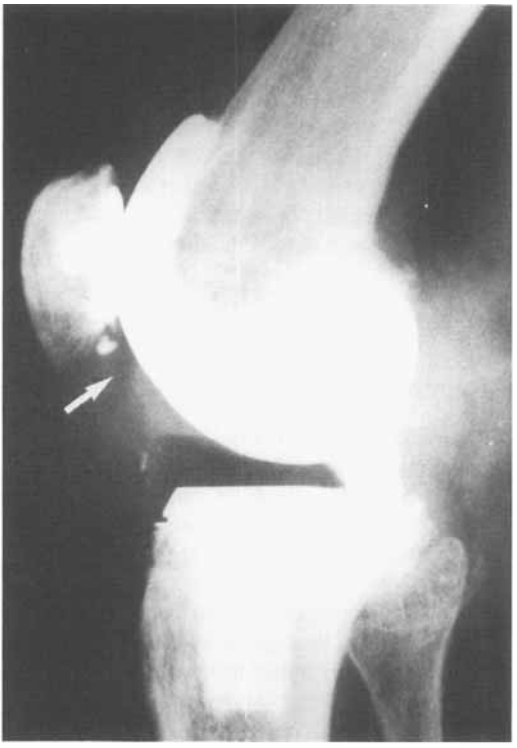

Figure 2. Case 6. Lateral radiograph demonstrating a discrete shadow (arrow) of displaced polyethylene cover.

Postoperatively, 1 patient receiving steroid medication for rheumatoid arthritis had a deep infection, whereas the remaining 7 patients regained their pre-failure status in 3 months.

Discussion

An overall patellar prosthetic failure rate of 7 percent due to dissociation between the polyethylene and the metal backing is very unsatisfactory. We did not find any malpositioning of the patellar component in our 8 patients. Neither did radiographs reveal lateral tilt or malpositioning of the patella prior to failure.

The mere fact that identical failures have been observed in other metal-backed patellar components (Bayley et al. 1988, Rosenberg et al. 1988, Stulberg et al. 1988, Felmet et al. 1989) makes it likely that the reduced thickness of the polyethylene cover over the metal backing may facilitate deformation resulting in polyethylene fracture and separation (Bartel et al. 1985). The dome shape of the patellar component translates eccentric loads to shear force against the sharp edge of the metal endoskeleton. In metal-backed patellar prostheses, there is often only a thin layer of polyethylene in areas where large eccentric loads are likely to wear the polyethylene (Stulberg et al. 1988).

Because we did not observe failures in formerly used all-polyethylene components, we have abandoned the metal-backed patellar prosthesis.

References

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