Low-friction arthroplasty of the hip using alumina ceramic and cross-linked polyethylene

A TEN-YEAR FOLLOW-UP REPORT

B. M. Wroblewski, P. D. Siney, P. A. Fleming

From Wrightington Hospital, Wigan, England

We report the results of our continued review of 14 hip arthroplasties using alumina ceramic femoral heads with cross-linked polyethylene cups.

There have been no complications and a very low rate of penetration. This was 0.02 mm per year after an initial 'bedding-in' period of two years. There has been no change in the mean rate between our earlier study at six years and the current results at 10 to 11 years.

The use of these bearing surfaces appears to reduce the potential amount of polyethylene debris and may provide the next logical stage in the development of the Charnley low-friction arthroplasty.

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In 1996 we described a simulator study of the wear of cross-linked polyethylene (XLP) cups articulating with 22.225 mm alumina ceramic heads,¹ and the radiological measurements of penetration in 19 of these hip replacements in 17 patients at a follow-up to 77 months. The simulator study showed a relatively high penetration of nearly 0.2 mm after 1.5 million cycles, the equivalent of the first 18 months of clinical use, but only about 0.1 mm during an additional 4.8 million cycles after the bedding-in period. In the clinical series, the radiological penetration was 0.2 to 0.4 mm (mean 0.29) during this initial period, but the subsequent mean rate after bedding-in was 0.022 mm/year.

We have now followed up the same group of patients for a mean of over ten years.

Patients and Methods

Of the original 17 patients,¹ 12 were men and five were women. Two men had had bilateral arthroplasties. Their mean age at operation was 53 years (27 to 80) and their mean weight was 76 kg (54 to 102). Four patients have died and one, who is confined to a wheelchair because of multiple sclerosis, has not been studied. The other 12 patients with 14 ceramic XLP arthroplasties remain under review with regular radiographs.

Penetration was measured from standard pelvic radiographs, centred on the symphysis pubis, as the apparent shortest distance between the head and a marker wire in the cup, which was carefully aligned in the coronal plane at insertion. This method has previously been described by Griffith and others² and verified by comparison with retrieved specimens.³

Results

A total of 14 ceramic XLP hips in 12 patients has now been followed for over ten years. None has needed revision, there have been no problems related to the design, and all the patients have continued physical activities appropriate to their age and gender. The mean total penetration at 10 years to 11 years 3 months is 0.37 mm (0.2 to 0.41), giving

Table I. Comparison of the rate of penetration in four patients with bilateral arthroplasties, one of alumina ceramic and cross-linked polyethylene and the other of stainless steel and UHMWPE

Case	Gender	Alumina ceramic XLP				Stainless steel on UHMWPE			
		Follow-up		Penetration		Follow-up		Penetration	
		Yr	Mth	Total (mm)	Rate (mm/yr)	Yr	Mth	Total (mm)	Rate (mm/yr)
1	Male	10	3	0.2	0.02	10	3	1.6	0.16
2	Male	10	2	0.4	0.04	11	2	3.2	0.29
3	Male	11	4	0.4	0.04	16	2	1.2	0.08
4	Female	4	0	0.39	0.1	2	1	0.4	0.2

a mean rate of 0.037 mm/year. This overall rate has remained unchanged since our previous paper.

Initially, we found a high penetration of up to 0.7 mm in the first year. The mean rate of 0.22 mm per year (0 to 0.41) in the first two years fell to a mean of 0.02 mm in the third and subsequent years, and this has continued to a mean follow-up of 10 years 6 months, as shown in Figure 1.

Four of the index patients also had conventional stainless-steel on ultra-high-molecular-weight polyethylene (UHMWPE) hip replacements on the contralateral side. The results for penetration in these paired hips is shown in Table I: the mean penetration in these patients was 0.04 mm per year for ceramic XLP replacements and four times greater at 0.16 mm per year for the conventional hips.

Discussion

After the first two years with a mean rate of penetration of 0.11 mm per year (0 to 0.22), the subsequent rate for the ceramic XLP replacements has remained the same for eight years, at 0.02 mm per year (0 to 0.05).

A recent large series of stainless-steel UHMWPE hips in patients under 51 years of age⁴ showed a mean penetration

rate of 0.11 mm per year, which is considerably greater, even allowing for the different age group. Compared with this series, the ceramic XLP combination offers a fivefold reduction in the rate of penetration. Whether or not polyethylene wear particles play a part in the loosening of components remains to be addressed. There is little doubt that reducing rates of wear by the use of a ceramic polyethylene combination is the next stage of evolution of the Charnley LFA. There have been no problems that could be attributed to the design used in this report.

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