Complications of liner locking system in Micro-Structured Omnifit acetabular components

A radiographic evaluation of 887 hips followed for 5–10 years

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ABSTRACT – We evaluated 887 hips in 672 patients with uncemented MicroStructured Omnifit acetabular components for liner locking complications. We found 2 types of radiographic signs of liner locking system complications in 7 hips, developing between 2 and 4 years postoperatively. The incidence of liner locking system complications was 0.8% using this modular acetabular component. We recommend that a patient who has received a total hip arthroplasty including a MicroStructured Omnifit acetabular component should be monitored frequently for radiographic signs of liner locking system complications, especially with a polyethylene thickness of less than 8 mm.

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We began to use the uncemented MicroStructured Omnifit total hip arthroplasty in November 1988. As early as 2 years after surgery, complications of the liner locking system and excessive wear occurred in some patients. This finding prompted us to review our experience with the use of such acetabular components (Shih et al. 1997).

Patients and methods

From November 1988 to December 1993, we implanted in 956 consecutive patients 1,401 uncemented primary total hip arthroplasties, using MicroStructured Omnifit (Osteonics, Allendale, New Jersey) components. Of these, 887 hips in 672 patients, who had a minimum follow-up of 5 years (maximum 10 years), were included in the present study.

The MicroStructured Omnifit components have a titanium metal shell which is of dual-geometry design and not HA-coated (Figure 1). A modular polyethylene liner, fixed at the periphery by metal tabs and a circumferential wire, was snap-locked into the shell with hand pressure and the light tap of a mallet. The reliability of the liner locking system was carefully confirmed by the surgeon. The femoral head and stem were of cobalt-chromium alloy. All of the femoral components had a circumferential plasma-sprayed porous coating over their proximal third and a modular femoral head of 32 mm or 26 mm in diameter. Postoperatively, all patients had the same rehabilitation and follow-up program. The radiographic follow-ups were carried out postoperatively at 3 months, 6 months, 12 months, and yearly. The presence of osteolytic lesions and polyethylene linear wear on

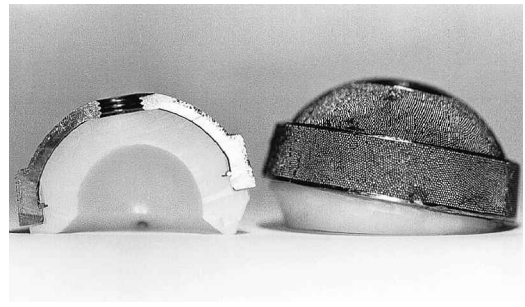

Figure 1. The Omnifit dual-geometric acetabular component, including its cross-sectional view.

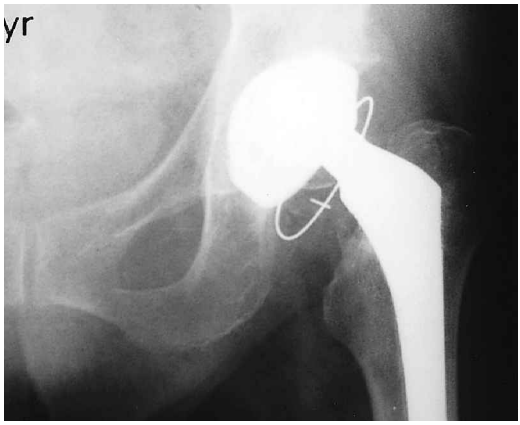

Figure 2. Case 1, liner dissociation.

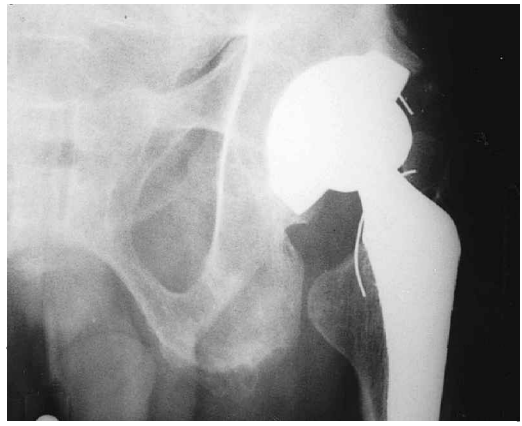

Figure 3. Case 4, breakage of the circumferential wire from the liner locking system and significant polyethylene linear wear on the left hip.

serial radiographs was assessed using a computer-aided digitizer.

In the radiographic evaluation, we defined complications of the liner locking system as gross destruction of the locking components between the metal shell and the polyethylene liner. Failures that occurred as a result of liner "wearthrough" to the metal shell, liner fracture, or a combination of both were not included.

Results

The incidence of complications of the liner locking system using a MicroStructured Omnifit acetabular component was 0.8%. 2 types of complication of the liner locking system were identified: dissociation of the liner from the metal shell in 3 hips and breakage of the circumferential wire from the liner in 4 hips (Figures 2 and 3, Table). The complications occurred between 2 and 4 years postoperatively. The implants were not seriously maligned in any of these patients. The mean polyethylene thickness was 6.5 (3.9–9.5) mm. Only 1 hip had an initial polyethylene thickness of more than 8 mm.

The hip liner dissociation which occurred in 3 patients was manifested by a sudden episode of pain. At revision, the femoral heads were found to be articulating directly with the metal shells in the superior-lateral region, and there was a little gross metallosis, with staining of the synovium. Polyethylene wear was found on both surfaces of the liners. Some of the peripheral metal tabs had worn

Details of 7 patients in whom complication of the liner locking system occurred

Case	Age at operation	Sex	Diagnosis [a]	Mode of complication [b]	Time to complication (yr)	Metal shell size (mm)	Femoral head size (mm)	Thickness of polyethylene liner (mm)	Acetabular component opening angle (°)
1	78	F	Osteoarthritis	LD	1.8	48	32	4.1	52
2	24	F	Hip dysplasia	LD	2.4	40	26	3.9	49
3	61	M	AVNFH	LD	4.3	52	32	6.5	43
4	42	M	AS	WB	3	52	32	6.5	55
5	55	M	AVNFH	WB	2	52	26	9.5	46
6	46	M	AVNFH	WB	3	54	32	7.5	50
7	49	F	Osteoarthritis	WB	4	48	26	7.9	49

[a] AVNFH Avascular necrosis of the femoral head; AS Ankylosing spondylitis.
[b] LD Liner dissociation; WB Wire breakage.

through and the corresponding liner slots had become deformed, resulting in dissociation of the polyethylene liner from the metal shell.

The 4 patients with breakage of the circumferential wire from the liner were all asymptomatic. 1 of the 4 patients had accepted revision hip arthroplasty due to severe osteolysis and polyethylene wear. At the end of this survey, the average polyethylene linear wear in these patients was 0.24 mm per year.

Discussion

Modular designs of hip prostheses have become popular, but they introduce the potential problem of locking system complications. Dissociation of a modular acetabular component as a result of failure of the locking system has been reported previously (Brien et al. 1990, Kitziger et al. 1990) A survey was conducted by the American Association of Hip and Knee Society to determine their experiences of device-related failures: among 57,569 modular acetabular components, 87 (0.2%) had been revised for acetabular dissociation (Heck et al. 1995). In our series, the dissociation rate was higher.

In our study, we have addressed another complication of the liner locking system which is device-specific and not reported: breakage of the circumferential wire from the locking system. Although the latter 4 patients were all asymptomatic, the average polyethylene linear wear (0.24 mm per year) was higher than the average for the whole series (0.17 mm per year).

It is clear that specific types of prosthetic complications are associated with specific manufacturers. The MicroStructured Omnifit cup is a two-piece component designed to be assembled at the time of operation. The polyethylene liner is snap-locked into the metal shell but may be removed without disrupting the shell fixation should it ever become necessary. Once locked into the metal shell, however, the polyethylene liner cannot be removed without destroying it. The use of a circumferential wire as an element of the liner locking system is rarely seen in metal-backed acetabular components and is used on all variants of the Osteonics metal-backed cup. Theoretically, it can enhance the interfacial stability of the locking system, but our clinical experience has shown that breakage of the circumferential wire and dissociation of the whole polyethylene liner can occur even in the early follow-up period. In addition to the possibility of iatrogenic damage to the liner locking system when the liner is snap-locked into the metal shell, we believe that the polyethylene liner does not fully contact the metal shell and is at risk of excessive edge stress on the locking system. Inadequate polyethylene thickness may also have contributed. The hips in which complications of the liner locking system occurred had thinner polyethylene thickness (mean 6.5 mm), compared to the hips of the whole series (mean 9.3 mm). It is well known that, in a metal-backed prosthesis, polyethylene stress increases rapidly as the polyethylene thickness falls below 8 mm (Bartel et al. 1986).

Because of liner locking system complications, we recommend close follow-up of all patients who have the same circumferential wire locking mechanism used for all variants of the metal-backed Omnifit sockets, particularly those which have less than 8 mm of polyethylene liner.

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