Case reports

Acetabular cup loosening—peeling off of the plasma-sprayed porous coating in 2 cases

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The cementless Romanus Combination Cup (RCC) (Biomet®, Biomet Ltd, Waterton Industrial Estate, Bridgend, UK) has been developed to combine the advantages of threaded and press-fit acetabular cups. Self-tapping threads are restricted to the periphery of the shell to give initial fixation while a plasma-sprayed porous-coated dome allows fixation by bone ingrowth. The dome is coated with titanium porous coating which is sprayed onto the smooth implant surface in powder form. During plasma-spraying, molten titanium particles arrive at the target surface and in spite of not heating the substrate, sintering of the particles onto the smooth titanium-alloy surface occurs. Such porous coating has been considered mechanically strong because of chemical bonding of the metallic layers. RCC also allows additional screw fixation through dome holes.

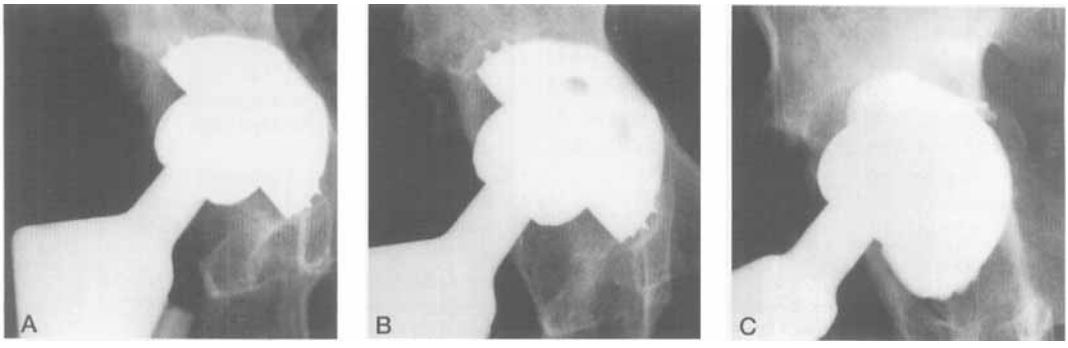
I report 2 patients with loosening of the RCC because the plasma-sprayed porous coating peeled off from the dome of the shell.

Case 1

A 38-year-old woman had secondary arthrosis due to developmental dysplasia (DDH) of her left hip and a cementless total hip replacement was performed in December 1991, with the use of a Biomet Bi-Metric stem and a 48 mm RCC. No fixation screws were used. Partial weight bearing was allowed during the first 3 months. She started to complain of hip pain on walking in the autumn of 1994. The pain was localized laterally in the hip region and in the groin. The radiographs were normal. When referred to our hospital she limped, the Trendelenburg sign was negative, but the strength of the abductor muscles was reduced. The range of motion was normal; rotational movements induced pain in the hip. Plain radiographs still appeared normal and there were no signs of infection. She was scheduled for revision of a suspected rupture of fixation of the gluteus medius muscle after a Hardinge approach.

Before the revision, 3.5 years after the primary THR, new radiographs revealed a definite change in the position of the RCC to a more vertical inclination and a radiopaque "halo" was seen above the dome of the cup. At the reoperation, the joint fluid and tissues were black because of titanium metallosis and the RCC was completely loose. Nearly all of the plasma-sprayed porous coating had peeled off from the dome of the shell, but remained tightly fixed to the wall of the bony acetabulum. The metallosis was caused by abrasion at the shell against the porous coating. Bone ingrowth into the porous coating was so good that it had to be removed piecemeal with a chisel.

Case 1.
A. At first complaints of pain.
B. A few weeks later the component showed a change in orientation and a separate radiopaque layer around the dome.
C. Removed RCC, from which nearly all of the porous coating had peeled off.



Case 2.
A. Shortly after THR.
B. 2 years after surgery, bone resorption around the threads.
C. 5 years after primary THR, a definite change in cup orientation and an asymmetric position of the head in the RCC are seen. Note separate radiopacity in the central dome area.
D. Loosened acetabular cup in which about half of the porous coating had peeled off.

Case 2

A 52-year-old-man had a cementless primary THR in 1990 with a Biomet Bi-Metric stem and RCC for developmental dysplasia in his right hip. The cup was 48 mm in diameter and no screws were used for fixation. 2 years after the THR the radiographs showed osteolysis around the threads, but the position of the cup was unchanged. 5 years after THR, the patient began to complain of pain on starting and exertion. The radiographs showed that the position of the cup had become more vertical and the position of the prosthetic head within the cup was asymmetric. Furthermore, a separate radioopacity adjacent to the dome was seen. At revision, gross metallosis in the periarticular tissues was found and the RCC was obviously loose. Most of the acetabular bony surface was covered by the separated coating of the RCC. About half of the porous coating had peeled off from the dome of the cup. Polyethylene wear was marked and the insert was also infiltrated by titanium particles. Again, the separated porous titanium layer was tightly fixed in the acetabular bone and could only be removed piecemeal with a chisel. The stem was well fixed, though there was a small periprosthetic granulomatous cyst in the trochanteric region.

Discussion

Most designs of smooth-surfaced threaded cups carry a high risk of loosening (Engh et al. 1990, Shaw et al. 1990, Capello et al. 1993, Tallroth et al. 1993, Fox et al. 1994, Savilahti et al. 1995). After resorption of bone around the threads, the load is transmitted through the dome of the implant; this is often reflected by increased bone density in the supraacetabular area (Tallroth et al. 1993). The signs of loosening between the threads appear sometimes within the first year, although the radiographic visualization of bone resorption may be obscured.

In both of my cases, the primary cup fixation was achieved using threads of the RCC without supplementary screws. The primary fixation was apparently sufficient for bone ingrowth into the plasma-sprayed porous coating. Obviously, in spite of the secondary fixation of the porous dome, bone resorption occurred between the threads and finally the cup stability was based only on the bony fixation of the remaining porous dome. Load transfer was thus concentrated to the dome, giving rise to shear forces at the interfaces between bone and coating as well as between coating and shell. Interestingly, the interface between the titanium shell and porous coating failed first.

According to a finite element analysis by Huiskes (1987), fixation at the superior and inferior corners of the cup is crucial. Another important issue is that the bonding of the plasma-sprayed titanium coating may be weaker than the biological bonding by bony ingrowth into the porous coating. No reports, to my knowledge, of peeling off of the porous coating from the totally coated press-fit cup have been published, although the plasma-spraying process in both titanium press-fit cups and RCCs by the same manufacturer is identical. Conceivably, the larger bonding area and possibly the supplemental screw fixation distribute the shear forces and prevent peeling off.

My report shows that bone resorption around the threaded part of the RCC makes the cup susceptible to

loosening and even the porous coating can peel off from the shell. The Romanus Combination Cup has few advantages over the corresponding totally coated press-fit cups. Manufacturers should pay special attention to the chemical bonding in the titanium plasma-spraying process.

References

Capello W, Colyer R, Kernek C, Carnahan J, Hess J. Failure of the Mecron screw-in ring. J Bone Joint Surg (Br) 1993; 75: 835-6.

Engh C, Griffin W, Marx C. Cementless acetabular components. J Bone Joint Surg (Br) 1990; 72: 53-9.

Fox G, McBeath A, Heiner J. Hip replacement with a threaded acetabular cup. J Bone Joint Surg (Am) 1994; 76: 195-201.

Huiskes R. Finite element analysis of acetabular reconstruction: noncemented threaded cups. Acta Orthop Scand 1987; 58: 620-5.

Savilahti S, Myllyneva I, Lindholm T S, Pajamäki K J, Nevalainen J, Laippala P. Clinical outcome and survival of Link RS total hip prosthesis. J Bone Joint Surg (Br) 1995; 77: 369-73.

Shaw J, Bailey J, Bruno A, Greer R. Threaded acetabular components for primary and revision total hip arthroplasty. J Arthroplasty 1990; 5: 201-15.

Tallroth K, Slätis P, Ylinen P, Paavolainen P, Paavilainen T. Loosening of the threaded acetabular components. Radiographic manifestations. J Arthroplasty 1993; 6: 581-4.

Posterior extradural disc fragment—a case report

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A 90-year-old woman with no previous medical history felt a sudden onset of severe low back pain. Over the following 10 days, the pain radiated to the anterior aspect of her thighs, and weakness and urinary incontinence developed in both legs. 20 days after onset of these symptoms, she was admitted to our hospital: she presented with severe bilateral leg pain and could not stand or walk. The segments below L2 showed hyposthesia bilaterally. Achilles and patella tendon reflexes were absent. Femoral nerve stretch tests were positive, while straight-leg raising tests were negative. Muscle strength evaluation revealed grade 0 or 1 power in the muscles of the lower extremities below the iliopsoas level.

Radiographs showed lumbar scoliosis and narrowing of the second lumbar disc space, marginal osteophytes at that level, but no bony destruction. Myelography showed a complete stenosis at the L1–2 level (Figure 1). MRI at the L1–2 level exhibited an oval, smooth rounded lesion with a signal intensity equal to

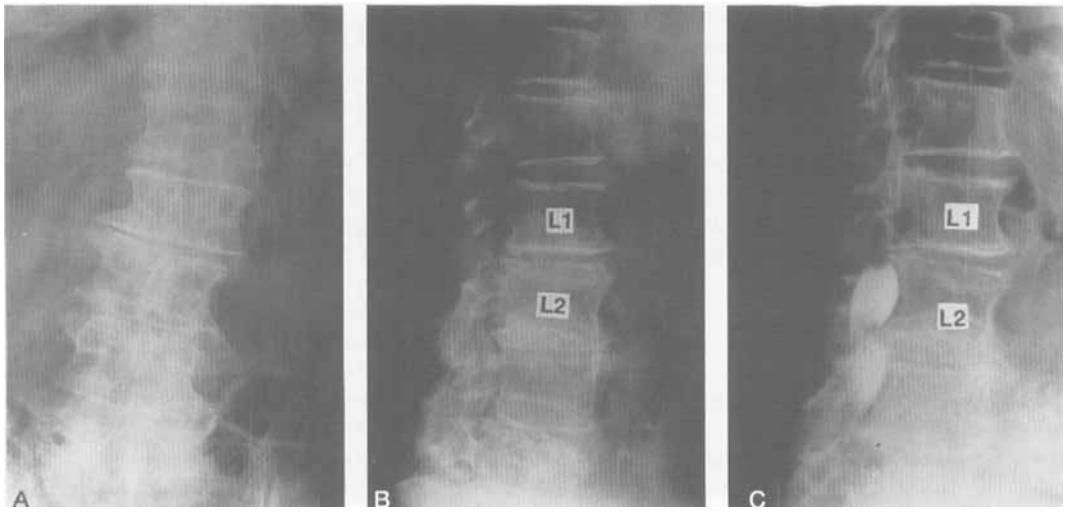

Figure 1. Lumbar spine films show scoliosis and marginal osteophytes at upper levels. Myelography shows a complete stop at the L1–2 disc..