

## CASE REPORT

# HISTOLOGY OF THE BONE-IMPLANT INTERFACE 45 YEARS AFTER BILATERAL IMPLANTATION OF A JUDET ACRYLIC HIP PROSTHESIS : A CASE REPORT

B. W. SCHREURS , J. KATS, P. BUMA , J. W. M. GARDENIERS

**The Judet acrylic femoral head hemiprosthesis was first implanted in 1946. We performed bilateral revision in one patient 45 years after implantation of a Judet prosthesis. Histological analysis of femoral neck remnants and joint capsule did not show aggressive osteoclastic bone resorption or signs of dynamic bone apposition as is frequently observed nowadays with failed total hip prostheses. Only limited tissue reaction was seen with some macrophages with a foamy cytoplasm. This case report confirms the extremely good tissue tolerance of PMMA, as reported by Judet in 1950, even after 45 years follow-up.**

**Keywords :** hip arthroplasty ; histology ; polymethylmethacrylate ; Judet prosthesis.

**Mots-clés :** arthroplastie de hanche ; histologie ; polyméthacrylate de méthyle ; prothèse de Judet.

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### INTRODUCTION

The Judet brothers developed an acrylic femoral head replacement prosthesis, which was first implanted in 1946. This hemiprosthesis has been one of the major steps to the present total hip designs. Fractures of these polymethylmethacrylate (PMMA) prostheses were frequently seen. Despite improvements in design with a stainless steel core, mechanical failures continued to occur.

We performed a bilateral revision in one patient in whom two Judet prostheses had been implanted 45 years previously and obtained histology of the bone-implant interface of the prosthesis, and we also studied the capsule histologically. To our

knowledge this is the longest follow-up of a hip arthroplasty with histological analysis ever published.

### CASE REPORT

A 61-year-old man with multiple epiphyseal dysplasia presented in our outpatient department with progressive pain in both hips. In March and November 1951 at the age of 17 years he had bilateral hip operations because of secondary osteoarthritis due to severely deformed hip joints. A Judet femoral acrylic head prosthesis with a stainless steel core was implanted bilaterally. Although after operation he still had limited hip function and persisting pain he was convinced by his former surgeon that nothing could be done. He was lost to orthopedic follow-up until 1995. At that time, both hips were nearly ankylosed and had a very limited range of motion with hip flexion of 80° and a flexion contracture of 60°. Abduction/adduction and rotation were not possible.

Radiographically a bilateral Judet prosthesis with a metal core was seen with some protrusion on both sides. Previous xrays were not available. Although the head was clearly fractured on the

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right side, it was remarkable that only limited osteolysis was seen after 45 years of implantation with limited protrusion (fig. 1a).

Both hips were revised in a two-stage procedure, and we used the posterolateral approach. After the opening of the posterior capsule the hips could be dislocated. We observed bilaterally damaged acrylic heads with loose acrylic fragments of 0.5 to 2 cm in the joint, but the overall macroscopic aspect of the tissues around both hips was quite normal. Both prostheses were macroscopically loose. Biopsies of the hip joint capsule were taken. After osteotomy of the neck around the implants both prostheses were removed without disturbing the osseous shell of the femoral neck around it. Extraction of the prostheses out of the trochanteric region was easy, and the trochanteric region was not further damaged. This construct was sent for histological analyses. All debris was removed, and bacterial cultures were taken. Both acetabula had a combined cavitory-segmental bone stock defect with a superolateral rim defect. These rim defects were reconstructed using X-Change metal meshes (Stryker-Howmedica) with screw fixation. To reconstruct the bone stock defect we used the bone impaction technique in combination with fresh frozen trabecular bone chips with a dimension between 0.7 and 1.0 centimeter. Next a cemented Exeter total hip prosthesis (Stryker-Howmedica) was inserted (fig. 1b).

### HISTOLOGICAL ANALYSIS

Histology was performed on both the femoral neck remnants with a special focus on the bone-implant interface and the joint capsule (fig. 2a-d). Nondecalfied sections were stained with hematoxylin-eosin and Goldner-Masson, and sections were stained to demonstrate Tartrate Resistant Acid Phosphatase (TRAP) positive osteoclasts.

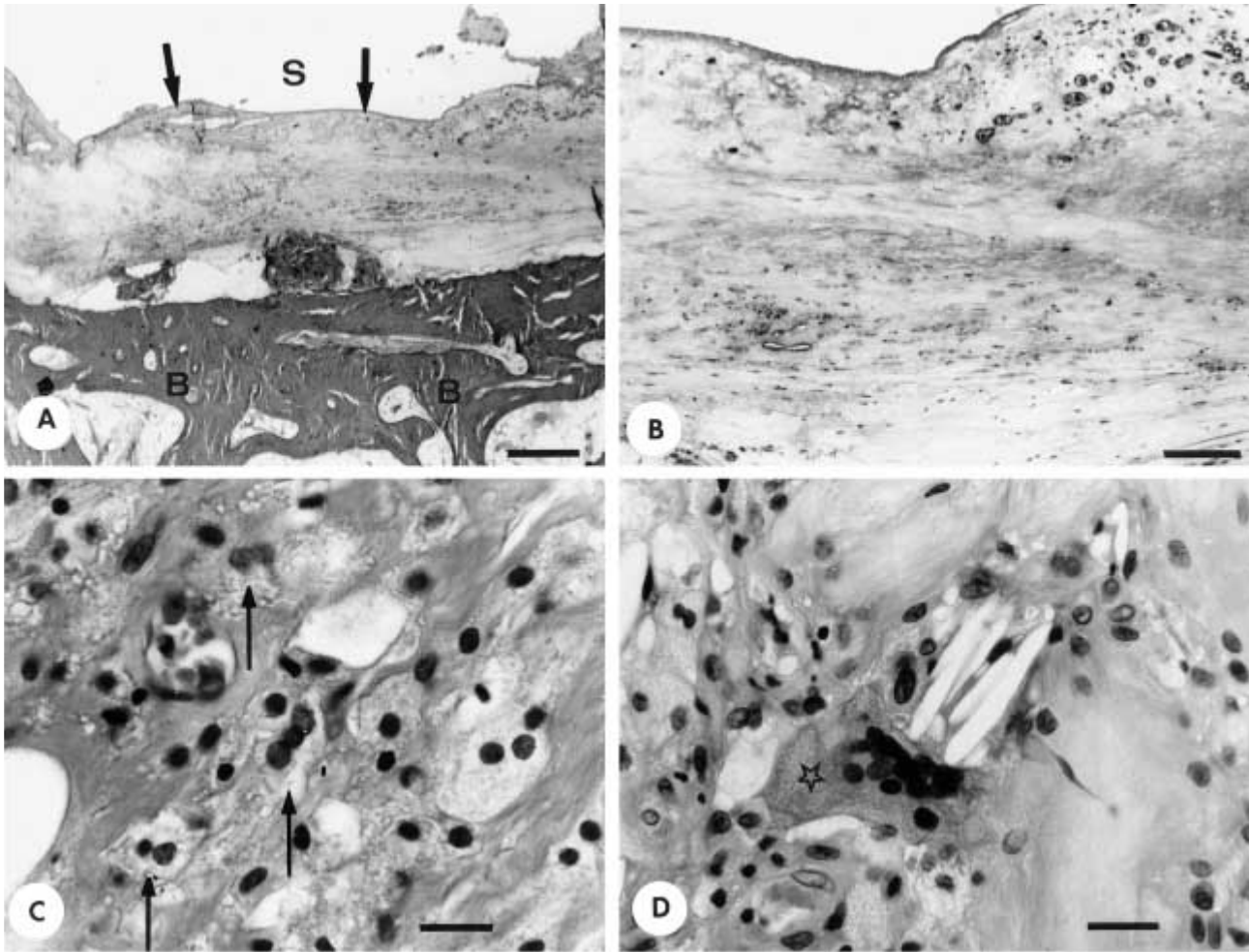
There was a soft tissue interface of variable thickness between the prosthesis and the bone of the femoral neck consisting of fibrous tissue with a variable cellularity (fig. 2a, b). Locally the bone made direct contact with the stem. Some sections showed local accumulations of mononuclear macrophages with foamy cytoplasm (fig. 2c). Also,



**Fig. 1.** — *a.* Preoperative xray with both prostheses *in situ*, 45 years after implantation. Bone stock loss with mild protrusion in the acetabulum is seen. The head of the right implant is deformed and must be fractured.

*b.* Situation 6 months after the bilateral revision with an acetabular reconstruction using the bone impaction technique. Acetabular rim defects were closed with a wire mesh. The center of rotation was restored. A cemented total hip implant was used.

giant cells containing large (up to 100 micron long) spindle-shaped smooth surfaced polymethylmethacrylate particles were seen (fig. 2d). However, no signs of aggressive osteoclastic bone resorption or signs of dynamic bone apposition were seen. Locally, cystic erosions of the periprosthetic bone were filled with fibrous tissue loaded with macrophages. No birefringent material was seen.



**Fig. 2.** — A. Low magnification micrograph of the thin soft tissue interface (see arrow) between the shell of cortical bone (B) and the stem (located at S) of the prosthesis. Original magnification  $\times 20$ , bar = 500  $\mu\text{m}$ .

B. Enlargement of small area of interface showing relatively acellular fibrous tissue. Original magnification  $\times 60$ , bar = 150  $\mu\text{m}$ .

C. and D. Parts of cell-rich interface showing macrophages with foamy cytoplasm (see arrows in fig. C) and giant cell (see asterisk in fig. D) with spindle-shaped polymethylmethacrylate particles. Original magnification  $\times 200$ , bar = 50  $\mu\text{m}$ .

**Fig. 2 A-D.** Hematoxylin and eosin staining in all.

## DISCUSSION

Cases have been reported with even longer follow-up with this type of prosthesis. Tennent and Eastwood (6) presented a case with a prosthesis still functioning 48 years after implantation. Hernigou (1) presented a case report of a Judet acrylic arthroplasty with a follow-up of 42 years. Heitfliesch and Wissenbach (2) reported a case with a Judet arthroplasty with a follow-up of 40 years. Ruston *et al.* (5) presented 3 cases with an average follow-up of 21 years.

In our study we focused on the histological aspects 45 years after implantation, which is to our knowledge the longest histological follow-up of a hip implant ever studied. We were impressed by the extremely good tissue tolerance of PMMA, even after 45 years and with some loose fragments of the prosthesis in the hip joint. The failure mechanism of a pure acrylic hemiprosthesis seems to differ completely from the progressive failures often seen at present with both cemented and noncemented hip designs in which progressive osteolysis is observed in most cases. The presence of additional

polyethylene particles and/or metal particles may have a more adverse effect on the *in vivo* reaction than particulate debris from one specific material (for a review see Lamerigts *et al.* (3)). Moreover the particles that were found were relatively large and spindle-shaped and had a smooth surface. These morphological factors may also contribute to the relatively mild adverse effect on the bone (3).

Judet (4) reported excellent tissue tolerance to PMMA. We can confirm this observation even 45 years after implantation.

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### SAMENVATTING

*B. W. SCHREURS, J. KATS, P. BUMA, J. W. M. GARDENIERS. De histologie van de interface tussen bot en prothese vijftienveertig jaar na een dubbelzijdige plaatsing van een Judet acryl kophalsprothese.*

De hemi-prothese voor de heup volgens Judet bestaande uit acryl werd voor het eerst geïmplantéerd in 1946. Een bilaterale heuprevisie werd uitgevoerd bij een patiënt die 45 jaar dubbelzijdig een Judet prothese in situ had. Histologisch onderzoek van de interface van de prothese in de femurnek en van het kapsel van de heup liet geen agressieve osteoclastische botresorptie zien of tekenen van verhoogde botaanmaak, zoals vaak wordt gezien na gefaalde totale heupprothesen die momenteel in gebruik zijn. Er was weinig weefselreactie met enige macrofagen die een blazig cytoplasma hadden. Deze studie bevestigt de zeer goed weefseltolerantie van PMMA, zoals reeds door Judet in 1950 werd beschreven, zelfs na een follow-up van 45 jaar.

### RÉSUMÉ

*B. W. SCHREURS, J. KATS, P. BUMA, J. W. M. GARDENIERS. Histologie de l'interface os-implant quarante-cinq ans après implantation bilatérale d'une prothèse acrylique de Judet.*

La prothèse acrylique de Judet a été implantée à partir de 1946, pour remplacer la tête fémorale. Les auteurs ont pratiqué une reprise chirurgicale bilatérale chez un patient qui avait subi 45 ans auparavant l'implantation de deux prothèses de Judet. L'étude histologique des restes du col fémoral et de la capsule articulaire n'a pas montré de résorption osseuse ostéoclastique agressive ni d'apposition périostée réactionnelle comme on en observe fréquemment aujourd'hui après échec de prothèses totales de hanche. Il n'existait qu'une réaction tissulaire limitée, avec quelques macrophages au cytoplasme spumeux. Cette observation confirme la tolérance tissulaire extrêmement bonne du PMMA, comme l'avait signalé Judet en 1950, même avec un recul de 45 ans.