Two-stage total hip arthroplasty for complex pelvic abnormalities: Example of hip arthrodesis conversion with concomitant treatment of pelvic and acetabular non-union

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ABSTRACT

Hip prosthesis implantation requires a stable pelvic foundation, which may be lacking in patients with complex pelvic abnormalities (e.g., arthrodesis conversion, tumour excision, or revision with large bony defects). Many reconstructive options exist for these situations, but their outcomes vary with the initial amount of bone loss and with the technique used. We describe a two-stage arthroplasty technique (acetabular cupfirst, then femoral stem) and report its use in a case of arthrodesis conversion with concomitant treatment of pelvic and acetabular non-union. Clinical and radiological outcomes after 5 years are reported. This procedure can be adapted to the most complex cases of pelvic reconstruction.

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1. Introduction

The outcome of total hip arthroplasty (THA) may be jeopardised in technically demanding situations, particularly on the acetabular side [1]. Examples of such situations include arthrodesis conversion, tumour excision, revision surgery with bony defects, and loss of pelvic-ring continuity. Reconstruction of a stable bony foundation is indispensable to ensure survival of the prosthesis. The armamentarium available to achieve this goal is substantial [1,2]: it includes massive allografts, reinforcement rings, customised reconstruction implants, and trabecular metal. Nevertheless, the outcomes remain variable, particularly when the bone loss is extensive and/or combined with non-union, compromising the primary and longer term stability of the prosthesis [1,3–5]. Here, we describe a two-stage arthroplasty technique, which we illustrate by a case requiring hip arthrodesis conversion and concomitant treatment of pelvic and acetabular non-union. This technique constitutes a solution for the most complex cases of pelvic reconstruction.

2. Technique

At 9 years of age, our patient underwent surgery for a Ewing's sarcoma of the left iliac wing. The lower half of the iliac wing and upper half of the acetabulum were resected. Femoro-iliac arthrodesis was performed and reconstruction of the pelvis was achieved by using a bone strut from the ipsilateral tibia to connect the iliac wing and superior pubic ramus.

Groin pain and marked functional impairment prompted a decision 7 years later to take down the arthrodesis. The residual leg length deficiency on the left side, partially corrected by epiphyseal stapling of the right knee, was 2 cm. Computed tomography (CT) showed non-union of the femoro-iliac arthrodesis and non-union of the acetabulum. As a preliminary step, the fixation material was removed and samples were taken for microbiological and histological tests, which proved negative (Fig. 1).

The first surgical stage consisted in treating the pelvic non-union and implanting the acetabular cup. Through an extensive posterolateral approach, the femoral neck was cut flush with the lesser trochanter and used to graft the iliac non-union. The true acetabulum was identified and reamed to a diameter of 44 mm. The bone chips thus produced were used to graft the non-union. The diameter of the acetabulum was too small to allow the ready insertion of an acetabular ring, which would have required either the implantation of a very small cup, solution not suited to the needs of this young patient; or excessive acetabular reaming to accommodate a larger ring and larger cup. Finally, a 44-mm polyethylene cup (MüllerTM cup, Zimmer, Warsaw, IN, USA) was cemented into the true acetabulum. To limit the loads through the reconstruction until healing was achieved, the decision was made during the procedure to refrain from implanting the femoral component (Fig. 2).

The second stage was performed after 6 months without weight-bearing. During this interval, the patient followed a rehabilitation programme designed to maintain muscle mass and
Fig. 1. Non-union before (A) and after (B and C) removal of the material; a: iliofemoral non-union; b: acetabular non-union.

Fig. 2. First surgical stage: treatment of the pelvic non-union and implantation of the cup. A. Post-operative radiograph. B and C. Radiograph (B) and computed tomography (C) 6 months after the first stage and before the second stage, showing healing of the acetabulum but only partial healing of the iliac wing.

prevent contractures. CT showed bone healing of the reconstruction, except at the uppermost part of the iliac wing (Fig. 2). The same surgical approach was used to open the medullary canal of the femur then to implant a cemented femoral stem (PF MinimaTM, Zimmer). The residual iliac non-union was freshened, grafted with autologous bone obtained during preparation of the femur, and fixed using a locking screw plate (Fig. 3). Full weight-bearing was started immediately. The 2-cm preoperative leg length discrepancy was corrected. No complications associated with either of the two stages were recorded.

Fig. 3. Second surgical stage: further treatment of the pelvic non-union and implantation of the femoral stem. A and B. Radiograph taken postoperatively (A) and 5 years later (B).
3. Results

At last follow-up, 5 years after the THA procedure, the patient reported no pain. Motion ranges were 120°/15°/50°/30°/40°/40° and the Postel Merle d’Aubigné score was 17/18 (6-6-5). Her walking distance was unlimited, with no walking aid and with a slight limp. She had returned to her occupational and daily activities. She initially practiced fencing but had stopped because of secondary low back pain. She reported being very satisfied with the outcome. The radiographs showed bone healing with no peri-articular ossification of periprosthetic lucencies (Fig. 3).

4. Discussion

To our knowledge, two-stage THA with deferred implantation of the femoral component has not been reported previously. Challenges to primary or revision THA are often chiefly related to complex pelvic abnormalities (dysplasia, bone loss, loss of pelvic ring continuity) [1,2]. The usual strategy in these difficult cases consists in one-stage THA achieved using one of the many available options [1,2], such as massive allografts and internal fixation, reinforcement rings, customised reconstruction implants, and trabecular metal. Despite good function and prosthesis survival [1], the most complex cases may remain challenging to manage [1,3–5]. Thus, in a study of acetabular revision for pelvic ring disruption, Berry et al. [5] obtained only 59% of good outcomes. After complex acetabular reconstruction procedures studied by Abolghasemian and Sadeghi Naini [4], the 10-year loosening rate was 44% overall and even higher in patients with pelvic ring discontinuity. Goodman et al. [3] assessed 61 acetabular revisions performed using antiprotrusion cages with or without allografting. After 4 years, the prosthesis survival rates were only 76% overall and 50% in patients with pelvic ring discontinuity. The optimisation of implantation techniques for these complex cases remains an area in need of further research.

A major advantage of the two-stage technique described here is minimisation of the loads applied to the pelvis while waiting for the bone to heal, thus providing a strong foundation for the implant likely to promote strong primary cup fixation. This feature of our technique may be helpful when, as was the case in our patient, the use of bulky metallic reinforcement material is best avoided. It eliminates the morbidity associated with bed rest and traction, in situations where these methods may be deemed necessary. Compared to one-stage THA with elimination of weight bearing, it diminishes the stresses related to muscle tone and to any lapses in patient adherence.

Nevertheless, the two-stage technique induces some degree of morbidity and a prolonged period of disability, given the need for two operations separated by a period without weight-bearing. The patient must be able to tolerate these restrictions. Our young patient, however, experienced no complications or long-term functional impairments. Finally, the internal fixation method chosen initially is open to criticism, and a plate would have been more appropriate. This technical error (corrected during the second stage) does not call into question the principle of two-stage THA.

This technique would therefore seem deserving of a place within the surgical armamentarium for unusually challenging situations where the complexity of the pelvic abnormalities suggest potential benefits from delaying weight-bearing after the reconstruction procedure. A study in several patients would be of interest to validate this technique.

Disclosure of interest

Adrien Jacquot, Thomas Goetzmnn, Stéphane Jullion, and François Sirveaux declare that they have no competing interest. Daniel Mole declares that he has no competing interest but, independently from this work, receives royalties from Tornier-Wright Medical. Olivier Roche declares that he has no competing interest but, independently from this work, is an educational consultant for Zimmer and Tornier-Wright Medical.

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