Revision of total hip arthroplasty using an anterior cortical window, extensive strut allografts, and an impaction graft: follow-up study

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ABSTRACT

Purpose. To report the outcome of revised total hip arthroplasty procedures involving an anterior cortical window, extensive strut allografts, and an Exeter impaction graft.

Method. Eight patients (9 hips) with a mean age of 58 years underwent revision of total hip arthroplasty using the Exeter hip impaction graft system and strut allografts between 1995 and 1998. An extensile anterior approach was used, and an anterior cortical window was created in the femur, to remove the old implant. External strut allografts were attached by wires to provide cortical support. The mean follow-up duration was 74 months. Indications for surgery were aseptic loosening of previous implants in 8 hips and infection of one hip that had previously undergone total arthroplasty.

Results. 19 Dall Miles cables, 4 ordinary cerclage wires, and 8 cerclage wires tightened with the clincher knot technique were used to secure the allograft to the host bone. The strut grafts were found to be incorporated in all cases. No wires became loose. One patient developed 20° of angulation at the allograft-host bone junction. Using the method of Fowler and Gie, we found that one femoral implant had subsided 2 mm within the cement mantle. Two other implants had 1 mm of subsidence at the cement bone interface, and one patient had a major subsidence of 15 mm that required revision.

Conclusion. Using an anterior cortical window in the femur to remove the old implant does not predispose to failure of the allograft to incorporate into the host bone.

Key words: arthroplasty, replacement, hip; bone transplantation; hip prosthesis; treatment outcome
INTRODUCTION

Revision of total hip arthroplasty (THA) is always a challenge for the orthopaedic surgeon. Removal of the failed implant often accentuates any pre-existing bone loss. Allografts, in the form of morselised impaction grafts or strut grafts, have been used to treat different types of bone deficiency in the proximal femur. Bone cavities can be filled with morselised impaction grafting, whereas segmental defects can be covered with strut cortical grafts, which can also support the host bone in areas of cortical fracture.1-6 In 1908, Lexer7 reported probably the first series of patients to be treated with allograft transplants. However, the use of allografts has become more common only during the last 2 decades. It is an attractive approach, because of its inherent capacity to incorporate into the host tissue and to become an integral part of the femur, and because of the theoretically high potential for attachment to surrounding soft tissue. The surgical procedure, however, is technically demanding and expensive. Furthermore, there is a risk of disease transmission and non-union at the graft-host junction.8,9 Few papers have reported the results of using a combination of impaction and strut allografts. In this article, we report the outcome of revised total hip arthroplasty procedures involving an anterior cortical window, using these 2 types of grafts.

PATIENTS AND METHODS

We studied 8 consecutive patients—2 women and 6 men—who underwent a total of 9 revised THA procedures between 1995 and 1998 at the University Malaya Medical Centre. We used a ‘vastus slide’ approach to access and dislocate the hip joint. In this approach, implant removal was facilitated by creating a large anterior cortical window. After successful removal of the implant, the cortical window was replaced and reinforced with extensive cortical allograft that was wired into position with which an impaction allograft was placed, along with a strut allograft for implant stability. This procedure was potentially problematic, because there was a possibility of devascularisation of the proximal femur and subsequent failure of graft incorporation. In our view, the recovery of the endosteal blood supply, together with the posterior cortical blood supply, would compensate for the loss of anterior periosteal vascularity.

All surgeries were performed by the same surgeon. We routinely used a first-generation cephalosporin as the prophylactic antibiotic in all cases. We also used the Exeter revision hip system in all cases. Six cases required a size-1 (37.5 mm offset) prosthesis and 3 cases required CDH (35.5 mm offset) prosthesis. All surgeries used an extensive vastus slide, created an anterior cortical window, and used a combination of onlay cortical and impaction allografts. All allografts were fresh frozen, irradiated, and stored at -85°C.

The patients were placed in the lateral decubitus position, and a direct lateral skin incision was used. After sharp dissection, the anterior third of the gluteus medius muscle was elevated from the cortical bone, along with the entire proximal portion of the vastus lateralis and vastus intermedius.10 The hip capsule was then excised extensively before the old implant was dislocated. Using pre-drilled holes and osteotomes, or an oscillating saw, we then created an anterior cortical window to remove the prosthesis and cement (Fig. 1). The distal extent of the window was placed at least 1 cm proximal to the tip of the templated Exeter stem to be used.
We fashioned fresh-frozen proximal tibia or distal femur into strips to fit the proximal femur as cortical struts, which were very extensive and covered the medial, anterior, and lateral surfaces of the proximal femur (Fig. 2). The struts were shaped and fitted to the end at least 1 cm distal to the replacement implant (Fig. 3). To attach the grafts, we used Dall Miles cables and ordinary cerclage wiring, as well as cerclage wiring that we tightened with the clincher knot technique.

We used the standard impaction grafting technique described by Gie et al.\(^1\) to implant the Exeter stems. Most of the bone that we obtained for impaction grafting came from the cancellous portion of the proximal tibial allografts. In some cases, a thin segment of cortical bone was also included, and in other cases, grafts were supplemented with femoral heads. Chips of bone of various sizes, which were prepared using bone rongeurs and a bone mill set to 'large', were compacted with the phantoms. For patients requiring CDH stems, phantoms were not available; we used the trial prostheses in these cases to embed the graft.

Partial weight-bearing exercise was started on the third postoperative day. The time to full weight-bearing was usually at 6 weeks. Patients were discharged home about one week after surgery and were asked to return to the clinic for follow-up at 6 weeks, 12 weeks, 6 months, and then yearly. At each follow-up visit, patients were examined clinically. Walking distances and range of motion were measured. Standard anteroposterior radiographs of the pelvis (including both hip joints) and lateral views of the affected hip were taken. Radiographs were examined for any evidence of loosening, such as progressive radiolucent lines, wire breakage, subsidence of implant and assembly, fracture, or resorption of bone. Evidence of allograft incorporation into the host bone was also assessed.

All the patients were reviewed by independent reviewers who were not involved in the initial surgery. The preoperative radiographs were studied and classified according to the Endoklinik classification system.\(^11\) We used the Oxford hip scoring system to assess the hip function at the final follow-up visit.\(^12\)
This scoring system uses a patient-based satisfaction score based on answers to 12 questions, each with 5 items that are graded from one (fewest symptoms or problems) to 5 (most symptoms). Thus, the highest score was 12 and the lowest was 60.

RESULTS

The mean age of the 8 patients was 58 years (range, 32–80 years) at the time of the revision surgery. Their mean weight was 61 kg. Indications for surgery were aseptic loosening of previous implants in 8 hips and Girdlestone procedure for infection of one hip following arthroplasty that had been performed several years earlier. The left hip was revised in 3 cases and the right in 3. One patient underwent bilateral revisions. Three stems were classified as Endoklinik grade 2; 5 were grade 3; and one was grade 4. One patient, who died of liver failure 5 years after surgery, was doing well with the prosthesis before death.

On average, 1.45 procedures had been performed before revision surgery. Five hips were revised after the index arthroplasty and 4 had undergone an intervening procedure. We used 19 Dall Miles cables, 8 cerclage wires using clincher knots, and 4 ordinary cerclage wires. The mean duration of follow-up was 74 months (range, 60–103 months). The mean Oxford hip score at the final follow-up visit was 24 (Table 1). The mean walking time in 6 patients (7 hips) was more than 30 minutes; in another patient, it was 16 to 30 minutes. One patient—a 90-year-old—was homebound because of cardiopulmonary problems.

The mean angle of flexion was 0° to 90° (range, 40°–110°), and the mean abduction angle was 0° to 40° (range, 30°–45°). One femoral component subsided by 2 mm within the cement mantle. Two other stems subsided by 1 mm at the cement bone interface. In addition, one patient showed a major subsidence of 15 mm within the allograft, which required revision. None of the cables or wires broke. There were radiolucent lines on the anteroposterior radiographs in 7 hips; all lines were non-progressive and were present on the first postoperative radiograph. All the strut grafts had incorporated into the host bone (Fig. 4). The impaction allograft had been incorporated in 8 hips. The exception was the case that required revision.

One patient developed a 20° angulation at the allograft-host junction (Fig. 5). This angulation developed gradually during the first postoperative year, after which the deformity stabilised and did not progress further. Aseptic loosening of the revised hip developed in another patient, and moderately severe bone resorption occurred in another, in Gruen
zones 1, 6, and 7 on the anteroposterior radiograph of the femur. However, this patient was asymptomatic. There were no infections or intra-operative fractures of the femur in our series of patients.

**DISCUSSION**

Bone loss in the proximal femur around a failed total hip prosthesis is a complex problem and always makes the conventional revision technique more difficult. Restoration of bone stock is vital to the success of the procedure. One worry with the use of large exposures (i.e. extensive detachment of muscles and concurrent use of an anterior bone window) such as in our cases, is the risk of devascularisation of the proximal femur and subsequent failure of the graft to incorporate into the host bone. When we compare the results of our technique with those of other series, we find that the results are similar (Table 2). Our series is relatively small because of the selection of patients who underwent arthroplasty using a combination of an anterior cortical window, strut allografts, and an impaction graft. All the patients had large defects, as indicated by the Endoklinik grading. The potential problems with this form of surgery include infection, implant subsidence, dislocation, non-union, and periprosthetic fracture. All the strut allografts united to the host bone, and none of the cables or wires that were used to secure the graft to the host bone broke or became loose. We are encouraged by the high level of patient satisfaction, as assessed by the Oxford hip scoring system. The only patient with a poor Oxford hip score was incapacitated because of medical problems rather than hip pain. Two hips showed lucent lines in one or more Gruen zones; lines in one hip did not progress, and the other hip required further revision.

In our series, there was one case (11%) of subsidence that required revision. One patient developed gradual angulation of $20^\circ$ (Fig. 5), which was due to failure to ensure that the cortical struts ended well distally to the tip of the implant. However, the allograft was later fully incorporated into the host bone, and a callus was seen at the host-allograft junction. In retrospect, we may have avoided the latter complication with the use of longer stems. However, preoperative templating indicated that the smaller femora of our patients would not accept these larger stems.

Popular approaches for the complex revision of THA using allografts include transtrochanteric, trochanteric slide, and vastus slide techniques. We chose the vastus slide technique to maintain the continuity of the mobilised anterior gluteus, vastus lateralis, and medialis, while still covering the allograft struts with live muscle. In all cases, the strut grafts became incorporated. The use of strut grafts saves some cost for the patients, as we would otherwise have had to use plates or wire mesh to address the bone loss. In addition, later revision becomes easier because the strut grafts gradually restore cortical bone stock; this was certainly true in the one case we had to revise again.

A number of treatment options are available to deal with the problem of bone loss in the proximal femur—for example, excision arthroplasty, arthrodesis, megaprosthesis, long-stem prosthesis, use of allograft-implant composites, use of onlay strut allograft, and impaction grafting. Each technique has its advantages and pitfalls. Long-stem implants were not suitable in our series, because these were too large for the patients. The long-stem implants in the Exeter system were based on the larger size-3 stems, whereas patients in this series received size-1 and CDH stems, thereby indicating a smaller proximal configuration.

In our view, the use of impaction grafting and onlay strut grafting enables us to restore bone stock and to use a standard prosthesis. These approaches thus enable us to provide effective care, particularly in cases of moderately severe bone loss, represented by Endoklinik grades 2 and 3.

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