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ORIGINAL PAPER

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Femoral revision using the Wagner stem: results at 2–9 years

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Abstract We followed 39 patients with 40 revision hip arthroplasties using the Wagner stem. Mean follow-up was 65 (29–108) months. There were 12 intraoperative proximal femoral fractures, which all united, five postoperative dislocations not related to subsidence, and two loose stems that were revised. Clinical improvement was best for pain. Once the stem was osteointegrated the clinical and radiological result remained stable for up to 9 years.

Résumé Nous avons suivi 39 patients aprés 40 révisions d'arthroplastie de la hanche en utilisant la tige de Wagner. Le suivi était en moyenne 65 (29–108) mois. Il y avait 12 fractures fémorales proximales peropératoires, qui ont toutes consolidées. Il y avait 5 luxations postopératoires non liées à un enfoncement de la tige. Deux tiges descellées ont été revisées. L'amélioration clinique était meilleure pour la douleur. Une fois que la tige etait osteo-intégrée, le résultat clinique et radiologique est resté stable juqu'au recul de neuf ans.

Introduction

Femoral reconstruction in revision total hip arthroplasty (THA) is a difficult problem when osteolysis has caused massive loss of bone stock in the proximal femur. Solid fixation at the site of the original prosthesis is impossible. Options include cemented long stems, uncemented stems with diaphyseal fixation distal to the defective zone [6, 10], allograft reconstruction (structural [3] or intraluminal cancellous allograft [2]), and Girdlestone resection arthroplasty. The Wagner femoral [10] component is a straight stem, with taper and flutes for immediate diaphyseal fixation. It provides a rough titanium surface for long-term biological fixation. The purpose of this study is to present our experience with emphasis on the peri- and postoperative problems and durability of fixation of the implant.

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Materials and methods

From 1988 to 1993, 39 patients had 40 revision THAs at our institution using the Wagner stem. Diagnoses prior to primary THA were osteoarthrosis in 26 patients, aseptic necrosis in one, rheumatoid arthritis in three, dysplasia in three, posttraumatic arthrosis in two, and unknown in five. Ten patients had 12 operations (range 1–2) before primary THA. The interval from the primary THA to the index revision averaged 12 years (range 3–25). Twenty patients had 26 prior femoral revisions (range 1–3). The mean age at index revision was 68 years (range 43–83). Thirty-four hips required both femoral and acetabular revision. The reason for index revision was severe proximal femoral bone loss with aseptic loosening in 29 hips (12 with periprosthetic fracture) and septic loosening in 11 (four Girdlestone hips and one periprosthetic fracture). Severe bone loss was defined as cortical thinning with or without defects, affecting the proximal femur to the extent that solid and durable fixation of a short-stemmed cemented component was not possible. The defects were classified according to the Paprosky system [6]. There were no type 1 defects, two type 2A, seven type 2B, five type 2C, and 22 type 3 defects. Four were unknown.

Stem lengths of 190–365 mm were used. The approach was transfemoral in 30 cases (semicircular osteotomy in 20, transverse osteotomy in ten), anterolateral/transfracture in three, transtrochanteric in three, and transgluteal in four (short stems). Heterotopic bone was excised in six patients. The osteotomies were fixed with circlage wires in 25 cases, with suture circlage in eight. No bone grafts were used. In 30 of the 40 operations the acetabulum was revised as well.

Two patients were lost to follow-up – at 5 weeks and 3 months. Their data are included up to the postoperative complications. Thirty-seven patients (38 hips) were available for review after a mean duration of 65 months (range 29–108). Radiological follow-up averaged 55 months (range 15–86). Twenty-three patients were examined in person, eight by their family doctor, and seven responded by telephone.

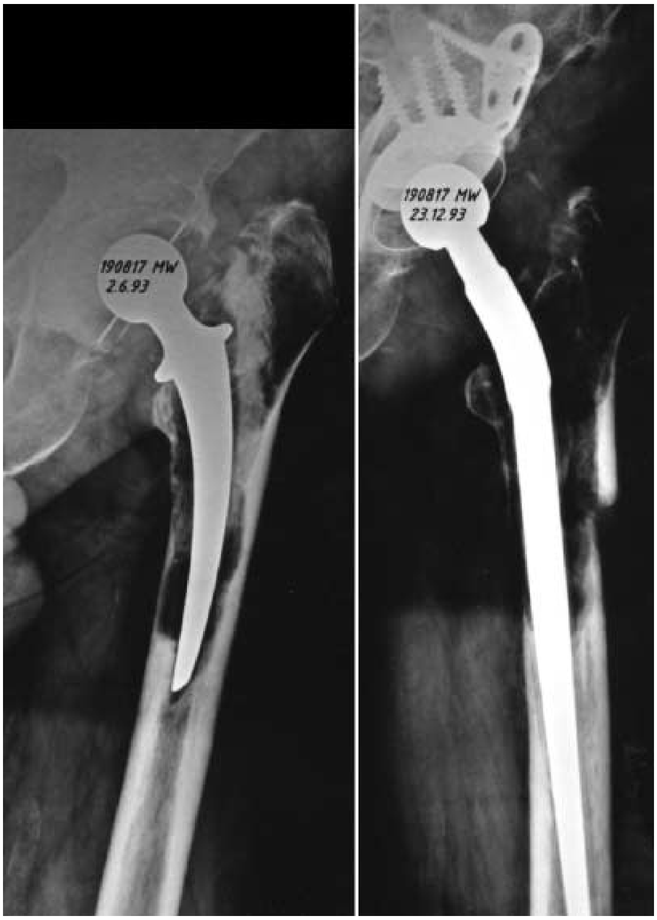

Fig. 1 Osteolytic destruction of the proximal femur, pre- and postoperatively

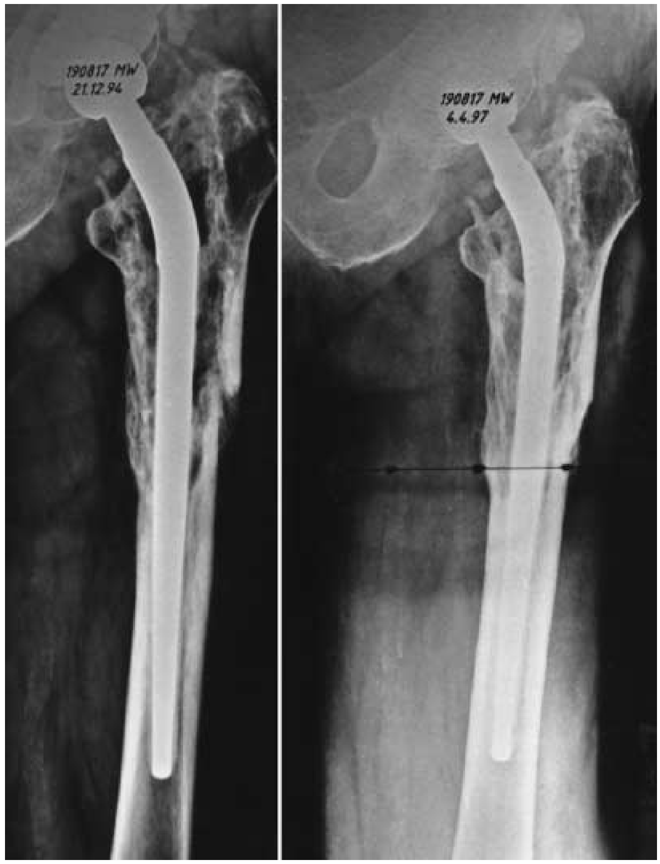

Fig. 2 Radiographs at follow-up of 1 and 3 years postoperatively show union of the osteotomy and progressive filling of the bony defects

Results

Clinical status

The preoperative Harris hip score [4] averaged 45 (21–78) points; at 1 year postoperatively it rose to 81 (58–100), and stayed at 76 (33–94) at the latest follow-up. Most of the improvement was noted for pain relief.

Radiographic evaluation

Subsidence was measured at 3 months in five hips (7, 8, 15, 21, 29 mm) and at 1 year in three additional hips (6, 11, 13 mm), without need for reoperation. Only one dislocation was related to subsidence. At the latest follow-up 37 of 38 stems were stable (no radiolucent lines in the anchorage zone, no subsidence compared to the 1-year radiogram). A complete radiolucent line was seen in one patient with a grossly unstable stem. Incomplete lines were occasionally seen at the calcar and trochanter in patients with long stems of small diameter, probably due to bending of the "elastic" stem within the proximal femur. Stress shielding was difficult to assess since many patients showed a diffuse loss of cortical bone density throughout the entire femur. Changes probably related to stress shielding (bone atrophy only proximally) were seen in seven cases. Bone growth (cancellous bone of progressive density on sequential radiographs) could clearly be observed in the cavitary defects in five cases (Figs. 1 and 2), to a lesser degree in ten, and not at all in 23. Small cortical defects tended to fill up with cancellous bone whereas large cortical defects did not. Of the 34 osteotomies (38 hips, including the periprosthetic fractures) 22 united within 3–6 months and ten appeared radiographically united at 1 year. Two trochanteric osteotomies failed to unite.

Complications

Intraoperative fractures are listed in Table 1. They occurred in the shell-like areas of osteolysis and were successfully managed using circlage wires. Postoperative complications are shown in Table 2. None were fatal. The nerve palsies did not recover fully.

Table 1 Intraoperative complications (*n*=40)

Fracture of the greater trochanter	5
Fracture of the diaphyseal shell	3
Longitudinal split	3
Fracture of the calcar	1

Table 2 Postoperative complications (*n*=40)

Infection (deep)	1
Infection (superficial)	1
Dislocation	5
Hematoma	1
Sciatic nerve palsy	1
Sciatic and femoral nerve palsy	1
Deep venous thrombosis	1
Pulmonary embolism	1
Myocardial infarction	1
Ileus	1
Allergic exanthema	1

Table 3 Indication for reoperation (*n*=38)

Deep infection and dislocation	1
Superficial infection	1
Hematoma	1
Unstable stem	2
Trochanteric nonunion	1

Reoperations

Of the 38 hips available for follow-up, six had to be reoperated (Table 3). Two unstable stems had to be revised. One of these patients received an undersized stem, experienced massive subsidence with dislocation on the first postoperative day, and was reoperated immediately. The correctly sized stem remained stable. The other patient had been revised for aseptic loosening of a long-stemmed femoral component with destruction of the upper two-thirds of the femur. Fixation of the Wagner component was attempted in the distal third of the femur in mostly cancellous bone with the largest available stem diameter. The patient developed symptomatic loosening 7 months later and received revision surgery with cement augmentation of the distal fixation without success. The patient refused further operations.

Discussion

The Wagner stem bypasses the mechanically insufficient proximal femur and anchors with fins and taper in the solid diaphysis. Distal to the isthmus this is increasingly more difficult. The approach retains the continuity of the abductors to the quadriceps. Early results [10] reported spontaneous formation of new bone at the site of the defects.

Preoperative planning is of great importance. The approach is chosen according to the required length of the prosthesis. The short stems (190 and 225 mm) can be implanted without a trochanteric osteotomy. Stems of 265 mm and longer require a femoral osteotomy. A semicircular osteotomy is performed if the femur is relatively straight. A transverse complete osteotomy is needed in femurs with marked anterior bow to prevent perforation of the anterior cortex.

The length of the construct is adjusted to achieve anatomical relationship proximally, i.e., the tip of the greater trochanter should be at the level of the hip rotation center. After firm seating distally and reconstruction with wire circlage proximally, the hip is brought through a full range of motion with special attention to impingement. Appropriate adjustments of the position of the fragments are made, and bony prominences are trimmed.

Since the proximal femur is bypassed by the majority of compressive forces, remodeling of the bone to accommodate the mostly tensile forces will occur. Stress shielding in the form of massive bone resorption was not observed. Mild to moderate osteopenia was frequently seen and only rarely recovered.

Few reports exist on the Wagner stem, although it is one of the most frequently used revision implants in Europe. Kolstad et al. [5] reported on 31 hip revisions. Complications included five dislocations and six cases of subsidence of 10–31 mm (five reoperations). Follow-up averaged 3 years (1.5–5). Twenty-one to 26 patients were pain free and 30–31 had radiologic signs of bone regeneration. Stoffelen and Broos [9] reported inhomogeneous findings of revisions and fractures with or without prosthesis. Of 23 patients 17 had a satisfactory outcome, with a follow-up of 12–38 months (average 19). Rinaldi et al. [8] reported on 20 patients at a mean follow-up of 2 years. Of these,19 hips were stable; only one prosthesis had subsided (20 mm). Abundant callus was seen at the osteotomy sites. In more than half of the cases metaphyseal bone remodeling occurred, and all of the cortical defects regenerated. Ponziani et al. [7] presented preliminary results of 20 patients at 1 year postoperatively. Two patients had dislocations and four had an unsatisfactory result due to subsidence of more than 20 mm.

Our main intraoperative complication was fractures occurring in the proximal osteolytic portion of the femur. They did not interfere with the ultimate stability of the implant. The major concern regarding intraoperative fractures is their potential to jeopardize the initial stability of the stem. In our series there were 12 minor fractures (30%) treated with circlage wires. Berry et al. [1] analyzed intraoperative femoral fractures, which occurred in 26% of their femoral revisions, and found a trend toward poorer survivorship free of aseptic femoral loosening.

The most frequent postoperative complications in the present study were dislocations. These occurred in five patients. The first reason for these dislocations is the lack of active soft tissue tension when the abductor muscles are atrophied. The second is the limited head-to-shaft offset of the prosthesis, which creates impingement of the trochanteric region onto the pelvis.

Subsidence of the tapered stem occurred in the first 3 months in five patients (13%). In three more patients it was noted at 1 year (total of 8/38=21%). The “late” subsidence probably occurred shortly after the 3-month follow-up visit, when full weight bearing is permitted and the prosthesis settles to its definitive position. No later subsidence was found, and all stems remained stable over time.

Growth of new bone was difficult to assess and quantitate. It occurred in five cases in areas of contained defects where progressive growth of bone could be observed, comparable to callus formation in fracture healing. No bone growth was seen in cortical defects. No clinical consequence (bone grafting, exchange to a shorter prosthesis) was drawn from either situation.

We have not been able to observe the extensive formation of new bone as reported by Kolstad et al. [5] and Rinaldi et al. [8] using the same prosthesis without bone grafting.

In summary the Wagner stem is reserved for revision situations where fixation of conventional short-stem prosthesis is either not possible or fraught with an undue risk of periprosthetic fracture. Careful preoperative planning and meticulous technique are prerequisites for a successful outcome. The complications do not differ from difficult hip revision surgery using other implant systems, except for the subsidence, which can be well controlled by careful seating of the prosthesis. All these factors contribute to the substantial learning curve with the use of this implant. This is also reflected by the fact that four of the six reoperations had to be performed in the first series of 16 patients. Errors usually result in instability. Removal of an osteointegrated component is difficult but not impossible.

The advantage of the Wagner stem is the simplicity of the design with no potential for mechanical breakdown other than at the head/neck junction. It also provides an excellent rotational stability. Once the stem is osteointegrated the results remain stable for up to 9 years. Further follow-up will show its long-term performance. Modifications of the proximal geometry may alleviate the problems of joint instability.

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