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The Wagner revision prosthesis consistently restores femoral bone structure

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Abstract The short-term results are reported for 43 hip revision operations with the long-stemmed Wagner prosthesis. The patients were followed-up for an average of 25 months. The Charnley scores were; pain 5.2, movement 4.0 and walking 4.0. All patients except one showed abundant new bone formation. The stem subsided more than 20 mm in 5 patients and in 22 the subsidence was less than 5 mm. The major complication was dislocation, which occurred in 9 patients; 8 of these were reoperated and from then on remained stable.

Résumé. Les résultats à court terme de 43 reprises d´arthroplastie avec la prothèse de Wagner avec une tige longue sont présentées. Les patients sont suivis pendant une moyene de 25 mois. Les scores de Charnley etaient: douleur 5.2, mobilité 4.0 et marche 4.0. Tous les patients sauf un montraient une formation d´os abondants. La tige était descendue plus de 20 mm chez 5 patients et moins de 5 mm chez 22. La complication majeure était la luxation ce qui est arrivée chez 9 patients. Huit d´entre eux sont réopérés est sont réstées stable.

Introduction

Major problems encountered in revision of the femoral component in total hip replacement (THR) are: (a) removal of the old stem and bone cement; (b) restoration of bone loss; (c) repair of a fractured femur. These problems can be solved in different ways. Removal of cement has become easier with the introduction of new tools such as ultrasound, motorized chisels, etc [11]. Broken femoral components can now be extracted in a safe way [16]. Restoration of bone stock can be achieved using structural [14] or morcelized allografts [6] or autogenous bone grafting [2]. Each of these methods has its advantages and disadvantages. With all three methods further surgical steps are added to an already complicated procedure. The use of allografts is not without risks and so far we do not have enough knowledge to predict the final result of bone restoration over time. Autogenous bone grafting has limitations in the amount of bone available. New devices for periprosthetic fracture repair may reduce the technical difficulties but there is an increased risk of loosening following such procedures [13].

In 1986 Wagner introduced a non-cemented revision stem with distal anchorage of the prosthesis [19]. A transfemoral or posterior approach was recommended. Since 1992 we have used the Wagner stem in patients with large femoral defects and in patients with periprosthetic fractures. The aim of this study is to analyze the short-term results with respect to bone restoration and early complications.

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Patients and methods

Forty-eight consecutive patients (49 hips) were followed-up for 22–39 (average 25) months (28 men and 20 women). Their mean age was 70 years (range 48–93) at the time of operation.

At the 2-year follow-up 4 had died from unrelated causes. Two were examined clinically, but several of the X-rays could not be recovered and their follow-up was thus incomplete. Forty-two patients with 43 hips, with complete 2-year records, remained. The following presentation will refer to these 43 hips.

Diagnosis

The diagnoses were aseptic loosening of the stem in 30 hips, and femoral fracture through the site of, or immediately below the prosthesis in 13 hips. The number of previous operations in the same hip was 1 in 28, 2 in 12 and 3 or more in 3 hips.

The degree of loosening according to the staging of the Endo clinic [4] was: 0: two hips, 1: 1 hip, 2: 13 hips, 3: 26 hips and 4: 1 hip.

Fig. 1 **A** Loosening of the femoral component (grade 3) in a 78-year old patient. **B** Acetabular component with a radiolucent line

Fig. 2 Postoperative radiogram showing Wagner femoral component and acetabular reconstruction with a reinforcement cage

Fig. 3 The same patient at 3 months postoperation

Fig. 4 The same patients at 3 years postoperation. Cancellous bone filling the medullary canal adjacent to the femoral stem

Operation

The operation was performed in the lateral decubitus position via a transfemoral approach (42 hips) [19] or a posterior approach without femoral osteotomy (1 hip). The mean operation time was 149 min (range 85–255) and the mean intraoperative blood loss was 1680 ml (range 550–4400); twelve cups were exchanged.

After surgery the patients were non-weight-bearing on the operated leg for 6 weeks and after that weight-bearing was gradually increased as tolerated.

Follow-up

The patients were examined preoperatively, at 6 weeks, 3 months, 6 months and then every year following the operation. The examination included clinical evaluation according to the Charnley modification of the Merle-D'Aubigné-Postel scoring system [3]. A radiological examination was performed and any dislocations were noted.

Radiological examination

The X-rays were examined in order to detect: (1) periprosthetic bone formation (or resorption); (2) ectopic bone formation and (3) stem subsidence.

New bone formation was evaluated according to an arbitrary scale where 0=no new bone; 1=some indication of new formation; 2=cancellous bone surrounding the stem; and 3=large areas of cortical bone adjacent to the stem surface. Ectopic bone formation was staged according to Brooker et al. [1], where 1=islands of bone in the periarticular tissue; 2=bony spurs not closer than 1 cm; 3=bony spurs closer than 1 cm; and 4=ankylosis.

Subsidence was measured from recognizable landmarks such as cerclage wires, the inferior edge of the cup or lesser trochanter, etc. The accuracy of these measurements on plain X-ray was estimated to be 3 mm [9]. The hips that were reoperated because of dislocation were not included when measuring the subsidence for the whole material. They are discussed separately.

Table 1 Clinical results preoperatively and at follow-up (Charnley score)

	Preoperative	Follow-up
Loosening (30 patients)		
Pain	2.8	5.2
Range of movement	3.3	4.0
Walking	2.3	4.0
Fracture (13 patients)		
Pain	–	5.5
Range of movement	–	4.1
Walking	–	3.8

Results

Clinical results

The clinical results are presented in Table 1. All three parameters measured improved for the patients operated on for loosening. Particularly the pain had decreased. The 2-year score for the patients who had been operated upon because of a fracture did not differ significantly from the other group. On the whole patients were satisfied, but results were not as good as those following a primary operation.

Radiological results

The overwhelming majority of the patients showed a strong tendency to form new bone around the prosthetic stem (Figs. 1,2,3, 4). Nineteen patients showed reformation of cancellous bone surrounding the prosthesis (score 2) and in 22 cortical bone had grown to the stem (score 3). One patient had only a small degree of new bone (score 1).

Only one patient did not show any tendency to new bone formation (score 0). She developed a resorption of the lateral femoral wall. However, the prosthesis did not migrate and the clinical result was good. As seen in Table 2 there was merely a slight increase of the degree of ectopic bone formation.

Table 2 Ectopic bone formation

Brooker class	0	1	2	3
No of hips				
Before Wagner arthroplasty	11	22	2	8
After Wagner arthroplasty	10	17	5	11

Table 3 Subsidence (cases with dislocations are excluded)

Subsidence (mm)	0–5	6–10	11–15	16–20	>20
No of patients	22	2	2	4	5

The majority of hips (24), which where not reoperated because of dislocation, subsided less than 10 mm. Five, however, subsided more than 5 mm (Table 3).

Dislocations

There were 9 dislocations and 8 of these have so far been reoperated. According the surgeon's analysis, at the time of reoperation, regarding the mechanism of dislocation the following categories were noted: (1) In five hips there was a suboptimal orientation of the cups. They were subsequently removed and reset at another angle. (2) In three hips there was a subsidence (3, 10 and 21 mm) with ensuing laxness of the joint; in these cases the stem was exchanged for a thicker one.

Discussion

Instead of trying to solve two difficult problems, prosthetic loosening and periprosthetic fractures, in a conventional way, the Wagner design represents a different way of thinking. The involved, often osteoporotic, thin or fractured area is bypassed and the stem is anchored in the femur distal to the old prosthesis and/or fracture site. The biological mechanisms respond by trying to restore the normal conditions in the proximal femur. As demonstrated in the present study abundant new bone is created and the anatomy appears to approach the normal situation. Only one patient showed a tendency to resorption in her lateral femoral cortex. An obvious advantage is that the process occurs without the aid of any external bone augmentation in the form of bone chips or strut-grafts [6,8]. It is a consistent phenomenon and our findings are confirmed by other studies using the prosthesis [7,12,15,17,20]. The bone formation appears in spite of an obvious proximal stress shielding. Head et al. [8] on the other hand, use a prosthetic design with a collar resting on a proximal strut graft in order to obtain proximal load. This load, in their view, is essential for the formation of new bone stock and to avoid distal stress fractures. The results obtained with the Wagner prosthesis do not support these views. It is attractive to think of the regenerated proximal bone stock as a firm bed for another prosthesis, if the Wagner, for some reason, fails. But, as the prosthesis alone gives good results, we have so far not had to exchange it.

We cannot explain the occurrence of the desired new bone formation. The fracture situation created by the transfemoral approach cannot be the sole explanation since the formation is also present in the patients operated without splitting the femur. One may speculate on the role of bone residues left after reaming and the properties of the titanium stem. It is also worth noticing that so far, there has been no re-loosening.

Initially we had some concerns about the abundant bone formation giving rise to excessive ectopic bone formation. This, however, was not the case.

By its design the prosthesis also simplifies the difficult treatment of peri- and subprosthetic fractures. It functions as a intramedullary nail with all the advantages of that design. It does not incorporate the ability to distal locking but the flute gives rotational stability and the conical shape resists shortening.

Our clinical findings, according to the Charnley score, show a substantial improvement, although they are not as good as in primary operations [5,10]. These results are in accordance with other authors who have reported their clinical results with the Wagner prosthesis [7,13,17,18].

Although hip revision is a major surgical procedure, there were no alarming incidents of thromboses and the only infection was successfully treated by repeated debridement. The reason for the low rate of infections might be the absence of foreign material in the form of bone grafts.

The major drawback using the prosthesis is the alarmingly high rate of dislocations; almost one fifth dislocated. Previous studies have reported very different rates of this complication. Wagner and Wagner [20] state that they have had 3 out of 150, Rinaldi et al., [15] 0 out of 19, Stoffelen and Broos [17] 1 out of 23, Hartwig et al., [7] 0 out of 33. Only Voigt et al., [18] 11 out of 50 and Kolstad et al., [13] 5 out of 31, report about the same rate of dislocations that we experienced. The reasons for this major complication are not clear. A certain learning curve is to be expected but the rate does not appear to be reduced with time. The dislocations were equally distributed over time. Extensive exposure and/or the very straight stem-neck angle might play a role among the causes. The offset angle, however, is the same as in the ordinary Charnley prosthesis.

Another argument against the prosthesis is the gradual decline of the cone (2°), which might make it prone to subsidence. This was also the case in our study as about half of the stems subsided more than 5 mm. Only in three cases, however, did it cause any major complication in the form of dislocations. Leg shortening as such was rarely a problem and was easily corrected by raising the shoe until the patient was comfortable. Apparently it does not, contrary to other prostheses, signal progressive loosening. As stated earlier the present series does not

show any new loosening. A certain concern for prosthetic fracture, due to excessive motion in a distally anchored stem, has not been confirmed.

We have found the Wagner prosthesis a very useful and reliable tool for dealing with two major problems in prosthetic surgery, loosening with progressive bone loss and periprosthetic fractures. In both these situations it has more than fulfilled our expectations. The stem has, however, two drawbacks: the major one being the high rate of dislocations and the minor a certain degree of subsidence.

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