Cementless modular hip revision arthroplasty with the MRP titanium stem

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As the number of primary THRs of younger patients with high physical demands increases, the amount of revision operations also grows. Bone loss with severe osteolysis, joint instability, function of pelvitrochanteric muscles, leg length discrepancy, a proper antetorsion angle, cement mantles, periprosthetic fractures, or infections are problems to be considered in revision arthroplasties of the hip. A femoral prosthesis stem should guarantee the proximal transmission of force. The aim of this prospective study was to scrutinise the outcome of hip joint revisions using the modular revision prosthesis (MRP) titanium stem. The mean follow-up time for all 72 patients including 34 men and 38 women was 3.6 years (range, 2-7 years). The mean age of the patients at the time of the operation was 67.3 years (range, 45.5- 88.6 years). The indication for the hip revision arthroplasty was in 56 cases an aseptic loosening of cup and stem, in 14 cases an aseptic loosening of the stem, and a Girdlestone hip in 2 cases. The Harris hip score improved from 54.9 to 92.2. In all cases the spontaneous refill of bony defects was detected with remodeling of bone without any bone transplantation. The most common intraoperative complication was a femoral fissure or fracture during the stem removal (4 cases), the most common early postoperative complication a deep venous thrombosis (2 cases), and the most common late postoperative complications a recurrent dislocation (2 cases), a subsidence of the stem (2 cases), or a persisting infection necessitating the removal of the prosthesis (2 cases). The revision rate was 4.17 %. With the MRP titanium prosthesis a stable primary fixation with a reduced risk of dislocation could be achieved. Modularity of the prosthesis allows an optimal lever arm to improve the function of pelvitrochanteric muscles, to equalise leg legth discrepancy, and to choose a proper antetorsion angle. A total hip replacement (THR) is one of the most successful principles in orthopaedic surgery. As the number of primary THRs of younger patients with high physical demands increases, the amount of revision operations also grows. Bone loss with severe osteolysis, joint instability, function of pelvitrochanteric muscles, leg length discrepancy, a proper antetorsion angle, cement mantles, periprosthetic fractures, or infections are problems to be considered in revision arthroplasties of the hip. The osseous anchoring is essential for the function of THR (1). Bone defects need long revision stems. According to recently published good results in hip revision surgery (1-9), there is a tendency for cementless revision arthroplasty. A femoral prosthesis stem should guarantee the proximal transmission of force to avoid the atrophy of the proximal femur caused by stress shielding. Still sometimes only a distal fixation can be achieved because of the considerable bone resorption (1). A modular revision prosthesis can resolve these problems (2, 3, 5-7, 10). In order to improve the durability of a revision prosthesis, wear has to be reduced by diminishing e.g. the friction between the femoral head and the acetabular cup, and the morse taper junctions. Although some negative effects of the modularity regarding morse taper junctions have been published (6), most authors have found no disadvantages (8, 11-15).

The aim of this prospective study was to scrutinise the outcome of hip joint revisions with the modular revision prosthesis (MRP) titanium stem (Peter Brehm Chirurgiemechanik, Weisendorf, Germany) used since 1994. The MRP stem system made of a special titanium alloy (Ti6Al7Nb) includes a stem, an extension sleeve, a neck, a neck with a trochanter, and an expansion screw. The shot peening process has improved the strength of the morse taper junction. All components can be combined to achieve length variations in 3 mm steps, and can

be fixed in every rotational position with a torque of 25 Nm. The length of the stem varies from 140 mm (straight) to 320 mm (curved) up to 190 mm or 420 mm.

Patients and methods

In this prospective study, 72 patients including 34 men and 38 women having a hip revision arthroplasty were examined. The Harris hip score (16) was calculated. The patients' satisfaction of the outcome of the operation, functional capability, and presence of thigh pain were identified. The radiographs taken during the follow-up were analysed for radiolucent lines, changes in bone density, cortical hypertrophy, and heterotopic ossification. The bone defects were classified according to Paprosky (17), radiolucencies described by Gruen (18), femoral implant stability according to Engh (7), and heterotopic bone formation according to Brooker (19). The mean follow-up time was 3.6 years (range, 2-7 years). The mean age of the patients at the time of the operation was 67 years (range, 45.5- 88.6 years). The average weight of the patients was 74.8 kg (range, 41-115 kg).

Table 1. Intraoperative and postoperative complications in the present study

Complication	Number
Intraoperative Complications	5
Femoral fissures / fractures	4
Lesion of the sciatic nerve	1
Early postoperative complications (< 4 weeks)	4
Deep venous thrombosis	2
Pulmonary embolism (not lethal)	1
Single dislocation	1
Late postoperative complications (≥ 4 Weeks)	9
Single dislocation	1
Recurrent dislocation	2
Heterotopic ossification (Brooker IV)	1
Periprosthetic fracture	1
Subsidence of the stem	2
Prosthesis removal because of a persisting infection	2
All	18

Table 2. The number of femoral defects in the present study according to Paprosky (17)

Femoral defect	Number
Type 1	29
Type 2 A	14
Type 2 B	16
Type 2 C	12
Type 3	1
All	72

The average height was 158 cm (range, 147-187 cm). The indication for the hip revision arthroplasty was in 56 cases an aseptic loosening of cup and stem, in 14 cases an aseptic loosening of the stem, and a Girdlestone hip in 2 cases. The intrafemoral approach (45 cases, in 17 cases with an additional distal vascularized fenestration) was used more often than the transfemoral approach (17 cases). The MRP stem was coated with the spongy flour of the last millings to achieve an osteogenic potency. In 34 operations an antibiotic prophylaxis was used: in 20 cases once, and in other cases more than three days. Antithrombosis stockings and subcutaneous low molecular weight heparin were used for the prevention of thromboembolic incidents. The mean hospital stay was 3.5 weeks. Partial weight bearing (20 kg) was requested for 12-16 weeks depending on the radiographic evaluation 12 weeks postoperatively.

Results

The Harris hip score improved from the mean preoperative value of 54.9 (range, 28-68) to the mean postoperative value of 92.2 (range, 56-100). The most common intraoperative complication was a femoral fissure or fracture in 4 cases, as an early postoperative complication a deep venous thrombosis in 2 cases, and as late postoperative complications a recurrent dislocation, a subsidence of the stem, or a persisting infection necessitating the removal of the prosthesis each in 2 cases (Table 1). Staphylococcus aureus was found in three intraoperatively taken bacterial samples from the hip joint. Only one patient (2.2%) had some femoral pain. The bone defects of the femur according to Paprosky classification (17) are shown in Table 2. In all cases the spontaneous refill of bony defects, and remodeling of bone without additional bone transplantation were detected. Most of the patients had no osteolysis on the last radiographs. In one case an osteolysis < 1 mm,and in another case > 1 mm were found in every zone according to Gruen (18), thus referring to a persisting infection. One patient had a 2 mm stem migration, and another patient fewer than that. The radiographs taken later revealed a secondary stabilisation of the stem. In both cases the diameter of the stem was primarily too small. The final result in all cases was a stable stem fixation with a good bony contact. A revision was necessary in three cases, and was performed twice due to a persisting infection after reimplantation of a MRP stem into a Girdlestone hip, and once due to a periprosthetic

fracture due to a fall at the ground level. The revision rate was 4.17 %.

Discussion

Approximately 4 000 THR operations with the MRP titanium stem have been performed in the world (information given from the manufacturer). The amount of a stem loosening has previously reported to be 4% (8). In the present study, the revision rate (4.17%) was lower than the 16.1-25% with the S-ROM revision stem described in the literature (2, 4), and was not needed due to an implant instability, or a stem migration. The rate of late dislocations of the MRP prosthesis was also lower (4%) than previously reported 11% (8). This concerns also the recurrence of the dislocations: 2.7% related to a transfemoral approach, and treated nonoperatively in our study versus 3.5% necessitating a revision in a previous study (8).

In the study concerned, the amount of the bone remodeling with the MRP prosthesis was better than previously reported (100% versus 86%) (8). Although the MRP stem was coated with the spongy bone gained during the last reaming procedures, no additional bone transplantation was needed compared with the bone transplantation rate of 22% in a multicenter study including 142 patients having a MRP stem (8). It has also been noticed before that a cementless revision stem together with structured bone grafts achieves a stable fixation in 85 % of the cases (20). Thus, bone transplantation could be necessary only for reconstruction of the greater trochanter, and special defects such as circular pseudarthrosis of the proximal femur, but not for small cortical defects.

In a previous study of 150 revision operations with the first generation Wagner revision stem, no proximal bone atrophy was noticed (1). In the present study, if the diameter of the stem exceeded 18 mm, a proximal femoral atrophy was detected. This could be explained the linearly increasing rigidity of the stem.

The amount of stress shielding related to another type of revision prosthesis has been 39% (21). Only one patient (2.2%) in the current study had some femoral pain. In concordance with other studies (3, 6, 21), there were no difficulties with the morse taper junction in the present study. The wear of the MRP titanium prosthesis could be reduced by the shot peening process of the male component, and an appropriate radius-to-wall - diameter ratio of the female component of the morse taper junction.

In conclusion, the MRP titanium prosthesis proved to be successful and reliable, and allowed a stable primary fixation. Modularity provides an optimum lever arm to improve the function of pelvitrochanteric muscles, equalise leg length discrepancy, and to choose the proper antetorsion angle in order to reduce the risk of dislocations. Above all, no implant failure could be recognized.

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