Early Results of Total Hip Replacement with the Metasul Metal-on-Metal Cementless Prosthesis

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Abstract

Background: The need for better durability and longevity in total hip arthroplasty in high demand patients is a constant challenge. For this purpose, a metal-on-metal prosthesis with improved tribology was developed. Our early results using this implant are presented.

Materials and Methods: A prospective analysis was performed for 56 Metasul hip arthroplasties between 1997 and 2001. There were 39 patients (43 hips) available for both clinical and radiographic evaluation at an average follow-up period of 42 months. Outcomes were measured using the Harris hip score.

Discussion: The average Harris hip score increased from 40.7 to 81.1. Subjectively, 87% of the primary cases were satisfied. The majority of patients had pain-free range of motion and had returned to improved daily functions. One technical intraoperative complication (false route) was resolved with immediate revision. Two patients required cerclage wiring, due to a femoral crack. There were two cases of persistent distal peroneal nerve palsy. Three cases of anterior dislocations were reduced and did not recur. A case of positive intraoperative culture was successfully treated with intravenous antibiotics. Two patients required revision to a cemented acetabular prosthesis, one due to cup loosening and the other due to a painful hip with a suspected infection. Radiolucent lines were seen in the acetabulum in one case, which underwent revision. No femoral or pelvic radiolucent lines were found.

Conclusions: We have had relatively satisfactory results in the early follow-up period. It remains premature to draw conclusions as to the superiority of this system over a conventional metal-on-polyethylene bearing prosthesis. Long-term follow-up studies are needed.

Total hip replacement (THR) with a metal-on-metal articulation was first introduced, in 1938, with the Wiles prosthesis. Similar designs included the McKee-Farrar prosthesis, which were in common use until 1972. The majority of metal-on-metal prosthesis were then abandoned in favor of hip replacement with a metal-on-polyethylene articulation. The reason for this change was primarily early cup loosening, which was more prevalent with these metal-on-metal designs than it was with metal-on-polyethylene designs. In 1988, the Metasul prosthesis was introduced by Sulzer Orthopedics in Switzerland, because the contribution of polyethylene wear particles to the failure of THRs had become more evident. This prosthesis involves a metal-on-metal design with improved clearance (space between the femoral head and the acetabular articulation surface, allowing fluid film lubrication and clearance of debris from within the joint), metal hardness and reproducible surfaces. This study was undertaken to review the clinical performance of this implant and to determine if early acetabular loosening or osteolysis, necessitating revision, were present.

Materials and Methods

Between 1997 and 2001, 56 Metasul (Sulzer Orthopedics Inc., Switzerland) hip arthroplasties were performed on 52 patients, by three different surgeons. Six were lost to follow-up and two died for reasons not related to the THR; it was known that they had well functioning hips at the time.
of demise. Five patients refused to come for an examination and their interviews were conducted by telephone; all were satisfied, including one using a walking cane. None of these patients had pain in the hip or had a revision. Satisfaction was assessed with a simple yes-no question. Thirty-nine patients (43 hips) were available for both clinical and radiographic evaluation at an average follow-up period of 42 months (26 to 66 months). The patient cohort contained 18 males and 21 females.

The average age of 57 years (27 to 77) at the time of operation was relatively young; average height was 163 cm and average weight was 79 kg (50 to 138). There were 20 left-sided THR and 23 right side THR. Of the total, four patients had bilateral THR. There were five cases of revision to a Metasul prosthesis, three due to loosening of a previously cemented cup, and two post-fracture repair procedures.

The etiology of hip pathology was primary osteoarthritis in 23, osteonecrosis in 10, developmental dysplasia of the hip in three, postsurgical procedures in two (one Girdlestone and one with posttraumatic degenerative changes following removal of a dynamic hip screw), and Paget’s disease in one. The group with osteonecrosis included four patients with a post-subcapital fracture and one from each of the following groups: post-pertrochanteric fracture, post-arthrodesis with nonunion, drug abuse, chemotherapy, steroid therapy, and idiopathic.

The THR prosthesis system consisted of a Wagner type uncemented cup, with a factory-assembled Metasul inlay. An uncemented, collarless, proximally hydroxyapatite-coated Spotorno titanium stem, with a modular 28-mm head, was used. Long stems were used in three cases, and a reinforcement cage was used in one case. Additional screws were employed in all cases for primary cup fixation. The Moore (15 hips) or Hardinge (28 hips) approach, with the patient lying either supine or in the lateral decubitus position, was performed. Bone preparation of the acetabulum was accomplished by reaming to the cortical bone of the cotyloid notch.

The acetabular component was inserted and secured by "press-fit"; additional screws (average of 3.4) were used for primary cup fixation. The femoral canal was reamed, and the cementless femoral component was inserted, with impaction by use of a mallet.

Patients were followed prospectively, with clinical evaluation performed preoperatively and postoperatively at the time of the present study. The clinical evaluation was performed with the Harris hip score preoperatively and postoperatively. Radiographic examination consisted of an anteroposterior pelvic radiograph that included the proximal part of the femur and the entire stem, as well as a lateral radiograph of the involved hip; these were performed at the time of each clinical evaluation. Radiolucent lines and osteolysis around the femoral stem were measured according to the zones described by Gruen and colleagues. Acetabular radiolucent lines were measured with the use of the zones, as described by DeLee and Charnley. To be counted, a radiolucent line adjacent to either the femoral or the acetabular component needed to occupy at least 50% of the zone. Measurements of wear were not possible, because of the inability to distinguish between the edge of the femoral head and the metal articulation surface of the acetabular component on the radiographs.

Average hospitalization time was 12 days. All patients

### Figure 1
Average Harris Hip Scores

<table>
<thead>
<tr>
<th>Harris Score</th>
<th>Preoperatively</th>
<th>Postoperatively</th>
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<tr>
<td>40.7</td>
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<td>81.1</td>
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**Figure 1** Average Harris hip score preoperatively was 40.7 (25 to 74) and postoperatively, 81.1 (42 to 99).

**Figure 2** Cerclage wiring employed due to an intraoperative femoral crack.
received perioperative antibiotic therapy, which continued until removal of the drain, usually on the second postoperative day. Anticoagulation was given for a period of 6 weeks postsurgery. Full weightbearing was allowed as tolerated.

Results
Average Harris hip score, preoperatively, was 40.7 (25 to 74) and postoperatively 81.1 (42 to 99) (Fig. 1). Subjectively, 87% of the primary cases with various etiologies were satisfied with the outcome. The majority of patients had pain-free range of motion and returned to improved daily function. Intraoperative complications included one case of a false femoral canal, which was resolved with immediate revision. Two patients required cerclage wiring due to a femoral crack (Fig. 2).

Early postoperative complications included two cases of persistent distal peroneal nerve palsy. No intraoperative event took place to explain this complication. Three cases of anterior dislocations were reduced and did not recur. Two of these cases had surgery performed by the Moore approach. A case of positive intraoperative culture was treated successfully with 6 weeks of intravenous antibiotic therapy. There were no cases of deep vein thrombosis or pulmonary embolus. Late complications included two cases, which required revision to a cemented acetabular prosthesis; one case of cup loosening (Figs. 3 and 4) and one (not related to mechanical failure) of a painful hip with suspected infection. Intraoperative culture was negative. There were no revisions of the femoral component.

Radiographic examination revealed one case with acetabular radiolucent lines in all three zones (Fig. 3); this patient underwent the above mentioned revision. No femoral radiolucent lines were documented. No hip had progressive radiolucent lines at the time of latest follow-up. No hip had radiographic evidence of focal pelvic or femoral osteolysis.

Discussion
The rationale for the use of a metal-on-metal articulation is the production of fewer wear particles, when compared to a metal-on-polyethylene articulation. Jantsch and coworkers reported that the average rate of wear of three retrieved implants with a metal-on-metal articulation was 0.001 mm per year, at an average of 14 years after the primary operation. Schmalzried and associates estimated that the combined linear wear of the acetabular and femoral components of McKee-Farrar implants retrieved at 20 years was 0.0042 mm per year. Schulte and colleagues measured wear of the Charnley metal-on-polyethylene prosthesis on radiographs at 20 years and reported an average rate of 0.10 mm per year, which is 25 times greater than the 0.0042 mm per year reported for the retrieved McKee-Farrar implants. The McKee-Farrar implants failed because of design deficiencies rather than accelerated wear. Measurements of wear of retrieved implants with a Metasul metal-on-metal articulation have continued to show combined acetabular and femoral
linear wear of 0.0030 to 0.0050 mm per year. This low production of wear particles seems to have prevented osteolysis as a cause of failure of the so-called first-generation metal-on-metal THR, which were characterized by a thin all-metal cup and a 38 to 42-mm femoral head that were machined together. Our study has not observed osteolysis as a complication.

We have found that the prevalence of early loosening was extremely low with the Metasul prosthesis and was similar to the rates of loosening of metal-on-polyethylene THR reported in the literature. We report a 2% rate of revision (one case) due to mechanical failure. A comparable rate of revision of 1.4% has been reported by Dorr and coworkers in 70 Metasul hips followed for an average of 5.2 years. Concerning metal-on-polyethylene, Beckenbaugh and Istrup reported that three (1.2%) of 255 hips had a cup revision and 16 (6.3%) had a loose cup at 4 to 7 years after replacement. Ritter and associates reported at 5 years post-implantation, two (2%) of 100 all-polyethylene cups were revised, and that 23 (23%) had radiographic evidence of loosening. Although there are limitations in our study, including an over 20% loss to follow-up and comparing disparate groups, the mechanical failure rate (the combined rates of revision and loosening) in our study group of hips, treated with Metasul metal-on-metal articulation, was comparable to those of previous studies of metal-on-polyethylene articulations.

**Conclusion**

The need for better longevity in total hip arthroplasty is a constant challenge, especially in younger patients. Wear and osteolysis have become the foremost concerns as complications of THR; the importance of a low wear rate as a factor in the durability of THR is well accepted. The Metasul metal-on-metal THR system with improved tribology was used with relatively satisfactory results in the early follow-up period, despite the surgical learning curve. Long-term follow-up studies are needed in order to compare with conventional metal-on-polyethylene bearing prostheses.

**Disclosure Statement**

None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

**References**