Comparison of anatomic and straight stems in total hip arthroplasty using the Robodoc-System for stem implantation

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ABSTRACT

Between June 1997 and December 1999 we operated on 107 patients using the Robodoc-System for stem implantation. We used 78 anatomical stems (ABG-System) and 39 straight stems (Osteoloc-System). The indication was primary osteoarthritis in 43 cases and secondary osteoarthritis following congenital and posttraumatic deformities in 64 cases.

The outcome of the operations were clinical and radiological investigated. Specific complications have been seen only after Osteoloc-stem implantation.

Using a straight stem the Robodoc cutter is destroying a big part of the greater trochanter region with the abductor muscle-tendon attachment. In these 39 cases postoperatively we've seen 4 trochanter fractures and 6 patients with insufficiency of the abductor muscles. With hand implantation of the Osteoloc stems none of these complications has been seen.

In our opinion the implantation of straight stems using surgical robotics and instrumentation can't be recommended, if an anatomical stem is available. The different cutting way in using an anatomic stem with the Robodoc system preserves the abductor muscle-tendon attachments and leads to a better hip function postoperatively.

The short term follow up using an anatomical stem with surgical robotics correspond to the hand implanted THA's. The long term results will show if surgery using the Robodoc-System is superior to standard implantation.

Keywords: total hip arthroplasty, Robodoc, robot assisted surgery, femoral component

1. INTRODUCTION

The goal of total hip replacement is a long term stability of components. An assumption is the exact implantation of the stem. To improve the insertion technique and achieve superior bone-implant contact robot assisted techniques have been developed. In 1992 the first experiments have been performed with computer assisted cutters for preparation of the proximal femur. The goal was an optimal position of the stem and excellent bone-implant contact.

In 1993 the first surgery using the Robodoc-System was performed. After a computerised templating the Robodoc-robot is cutting the proximal femur for cementless stem implantation. Since this time more and more adult reconstruction centers, especially in Europe has been
used successfully the system for stem implantation, so long term results can be expected in the next future. At the moment we don’t know if the long term results are superior to hand implanted total hip arthroplasty.

Using the Robodoc-system the surgeon has the choice between different straight and anatomical stems depending on his preferences. There is no special indication for using the system in total hip arthroplasty. In generally it can be used for every kind of primary or secondary osteoarthritis.

The advantage in complicated cases after dysplasia, trauma or osteotomies of the proximal femur are the excellent possibilities of three-dimensional templating with the Orthodoc – the planning unit of the system.

![Figure 1. Robodoc](image)

2. MATERIAL AND METHODS/PATIENTS

Between June 1997 and December 1999 we operated on 107 patients using the Robodoc-System for stem implantation. We used 39 straight stems (Osteoloc-System) until December 1998 and 78 anatomical stems (ABG-System) since January 1998.

The indication was primary osteoarthritis in 43 cases and secondary osteoarthritis following congenital and posttraumatic deformities in 64 cases.

The procedure was performed on 61 male patients and 46 female patients, 38 times on the right side and 49 times on the left side.

The two-pin method was used in all cases. After insertion of two pins in the greater trochanter and medial condylus of the femur a spiral CT-scan is performed. These data are used with the Orthodoc to template the femoral component. It is a three-dimensional graphic computer to size and position the stem.

On day two the modified Orthodoc-data are transferred to the Robodoc. The femur is digital reconstructed in the computer and the cutting process can start. The accuracy is 0.1 mm in length and 0.1° in rotation.
Figure 3. Posttraumatic Osteoarthritis
Straight Osteoloc stem

A transgluteal approach to the hip was performed in all cases. For robot-assisted femoral preparation the leg was externally rotated and fixed in a leg holder. For the fixation of the Rehodoc to the patient more soft tissue has to be removed compared to hand implantation. Using a straight stem the cutter removes a big aspect of the greater trochanter region and the abductor muscle tendon attachments. On the other side the cutter saves this structures in using an anatomical stem. The cutting way of both stems is shown in figure 5,6.

The surgery time is extended to hand implantation (mean surgery time: 110 min.). The mean cutting time depends on the size of the stem and ranges from 17.5 min. to 21 min.

Figure 5. Orthodoc-imagine
Straight Osteoloc stem

Figure 6. Orthodoc-imagine
Anatomic ABG stem

After surgery all patients were mobilised with full weight bearing. The mean hospital stay was 12.1 days.

Patients were clinically and radiologically evaluated after 3 and 6 month.
The Osteoloc-stem is a proximal fixed straight stem. The ABG stem is an anatomical component, proximal fixed as well. Both stems are made of titanium alloy and proximally HA-coated.

3. RESULTS

The clinical short time results postoperatively correspond to the hand implanted total hip arthroplasties. The mean Harris-hip-score after ABG-implantation was 91.3 6 month postoperatively. There is no significant difference compared to hand implantation. The radiological results are superior to hand implantation. There was no malposition of the femoral component. The accuracy of stem insertion is superior.

Figure 7. AP-radiograph after ABG-implantation with Robodoc

In our cases we had the following complications:
- 2 thromboses (1 pulmonary embolism)
- 2 superficial infections
- 1 postoperative luxation (malposition of the acetabular component)
- 1 intraoperative fractures of the greater trochanter (Osteoloc-implantation)
- 3 postoperative fractures of the greater trochanter (Osteoloc-implantation)

The last specific complications have been seen only after Osteoloc-stem implantation. Using a straight stem the Robodoc cutter is destroying a big part of the greater trochanter region with the abductor muscle-tendon attachment. In these 39 cases postoperatively we’ve seen 4 trochanter fractures and 6 patients with insufficiency of the abductor muscles. With hand implantation of the Osteoloc stems none of these complications has been seen.
4. DISCUSSION

In generally surgical robotics offer certain advantages including excellent three dimensional planning and templating, accurate position of the femoral component, superior bone-implant contact (figure 8,9), remaining structures of cancellous bone and reproducible quality.

On the other site there are major disadvantages: 2 surgeries, extended surgery time, extended approach and soft tissue damage and high costs. These disadvantages limit the procedure. It should be performed in difficult complicated cases when an excellent planning of the surgery is essential.

With the newer pin-less method we’ve been using for 4 month one surgery can be saved and the procedure is less traumatic.

Comparing the femoral components in our opinion the implantation of straight stems using surgical robotics and instrumentation can’t be recommended, if an anatomical stem is available. The high number of patients with insufficiency of the abductor muscles and fractures of the greater trochanter is not acceptable.

The different cutting way in using an anatomic stem with the Robodoc system preserves the abductor muscle-tendon attachments and leads to a better hip function postoperatively.

The short term follow up using an anatomical stem with surgical robotics correspond to the hand implanted THA’s. The long term results will show if surgery using the Robodoc-System is superior to standard implantation.

![Figure 8: bone-implant contact Robodoc implanted](image1)

![Figure 9: bone-implant contact Hand implanted](image2)

5. BIBLIOGRAPHY

silent three dimensional, superior bone-implant lucible quality. Surgery time, extended limit the procedure. It planning of the surgery can be saved and of straight stems using anatomical stem is abductor muscles and the system preserves the postoperatively. Features correspond to the Robodoc-System.