

3.9 Surface Replacement of the Hip: Contra

S. Goebel, M. Blanke and Ch. Hendrich

Introduction

The surface replacement of the hip as an alternative method to the implantation of a conventional hip prosthesis seems to be advantageous in consideration to bone conservation particularly for young patients.

Because of the today's commonly used materials and designs there is almost no aseptic loosening of the acetabular side to be seen. Therefore the conservation of the bone stock of the femur might be the major profit of a surface replacement.

Earlier variations of the surface replacement prosthesis such as the Wagner cap used polyethylene components for the acetabular cup. In fact of the large head diameter only thin polyethylene components could be used. This is said to be the major cause for the failure of the Wagner cap. In consideration of this fact the use of hard material for the articulation is necessary. Today there is a large amount of just metal to metal surface replacement designs on the market, however there are no alternative materials available yet.

Aseptic loosening

Clinical datas of the surface replacement of the hip published in the literature are leaving open many questions. For the Wagner prosthesis a 12.4 % loosening rate in 466 with a follow-up period of 7 years has been described.[16] Dustmann et al. showed a loosening rate of 9 % after 3 years.[14] Solely Wagner himself described only 6 loosening of components during a follow-up of 4 months to 4 years.[57]

Beside the aseptic loosening of the surface replacement of the hip because of the thin polyethylene component there was a second reason identified. A necrosis of the femoral head underneath the cap is considered to be another major cause of implant loosening.[24]

The BHR-prosthesis by McMinn for the different designs showed losing rates of 7 % within a follow-up period of 2.8 years for the cemented version and up to 8.6 % within a follow-up period of 4.2 years for the press-fit group.[39]

For the THARIES prosthesis, a metal-polyethylene surface replacement design, Amstutz et al. reported a 10 years survivorship ratio of merely 48 %. In 97 % of the cases an aseptic loosening of either one or even both components was found. Because of this metal-on-metal components were used. For this design 4 year survivorship rates of 94.4 % are reported. 10 of 12 revisions were due to either aseptic loosening of the femoral component or to fracture of the femoral neck.[2]

In contrast in today's models problems with the acetabular shell are almost none existing. The high rates of aseptic loosening are almost exclusively based on failures of the femoral component.

In sight of the cited literature there are still studies missing with sufficient number of patients and follow-up time.

In comparison the new generation of the ceramic-on-ceramic components show good results. In a recent a 97.5 % survivorship rate for a young and active group (average age was 41 years) during a follow-up period of 5 years was traced. The 10 year follow-up showed a rate of 89.4 % for 131 total hip endoprostheses.[50] In another study there were 85 % of uncemented ceramic-on-ceramic total hip prostheses implanted during the years 1979 and 1980 without any aseptic loosening after 18.5 years of follow up.[22] Lazzaro et al. showed a survivor-ship rate of 81.2 % after 13 years. They reviewed 38 patients with an average age of 55 years.[33] In a recent publication, no aseptic loosening occurred after 5 to 8 years of follow-up.[26]

Nizard described that in the first years of usage of the ceramic-on-ceramic components there were a few cases of broken ceramic components seen. However, with improved materials no further cases of this specific complication were reported.[42]

Wear behavior

The wear of the polyethylene is the main reason for osteolysis around the prosthesis resulting in the aseptic loosening.[19,25,41] The wear rate increases with larger head sizes.[12,30,31,36,46] For surface replacement hip prosthesis large head sizes are used. First attempts with a metal-polyethylene combination by the THARIES-prosthesis had to be stopped.[5] Metal-on-metal-components can supposed to generate less wear compared to metal-polyethylene- or ceramic-polyethylene-components.[5] However, a metal-on-metal wear couple results in a higher concentration of cobalt and chrome in the serum and urine.[28,29,47] Relative to a possible carcinogenesis of cobalt-chrome-molybdenum particles a study by Memoli et al. suggests a slight increase in the rate of sarcomas.[40] Visuri et al. found a 1.23 times higher incidence for carcinomas by patients supplied with metal-on-metal-prostheses.[56] Furthermore there was a significant increase for kidney- and prostate-carcinomas and also for lymphomas and leukemias.[18,44] Other studies could not underline these findings.[17,23,35,45,54] Other unwanted side-effects, for example the decrease in white blood cells[48], sensibilisation of lymphocytes and the increase of inflammatory cytokines were described.[20] To summarize, long term studies have to be performed to verify the unwished effects of the metal wear and the increase of the concentration the ion-concentration in the blood and urine. Clinical data for the metal-on-metal prosthesis with large head diameter are missing, yet.

In contrast the ceramic-on-ceramic wear couple regarded as bioinert. Toxic effects have not been described yet during 40 years of use.[9,13,60]

Revision of surface replacement prosthesis

The advantage of a surface replacement prosthesis may be a better conservation of bone stock, especially in regard to the head and the neck of the femur.[4,5,58]

This conserved bone stock should result in an easier revision procedure. In today's literature there are just three papers dealing with the outcome of revision of surface replacement prosthesis of the hip. Steele et al. performed 13 revision surgeries in 12 patients after a surface replacement. The average follow-up was 3 years after the revision. The results showed a comparable outcome between the revisions after surface replacement and the revision after a conventional hip arthroplasty.[53] Thomas and Amstutz analyzed 17 revisions, of which 8 patients were supplied with a conventional and 9 patients with a surface replacement hip prostheses. They found no significant improvement of the clinical outcome when comparing both groups. On the one hand they described an easier revision on the femoral side. Conversely the difficulties with acetabular component revision seemed to be higher as for a revision of the conventional prosthesis.[55] In particular the rough coated press-fit acetabular shell of the metal-on-metal surface replacement made revisions more difficult. Capello et al. found in 24 patients after revision of a surface replacement prosthesis a lower rate of complications in comparison to revisions after conventional hip arthroplasty.[7] Ultimately only one study showing an advantage for the revision of the surface replacement.

Modern concepts with metal-on-metal wear couples are using large head sizes. Nevertheless there is always a bedding-in period of the head and cup. The effect of a second bedding-in period after a revision using a larger revision head has not been investigated either in simulator studies nor in vivo.

Dislocation and leg length

The advantage of large heads in the hip arthroplasty is evident in a higher range-of-motion, the avoidance of impingement and lower rates of dislocation.[8,11,15,32]

For the surface replacement the cited literature has fulfilled the expectations relative to the dislocation rate. Amstutz describes a dislocation rate of 0.75 % in 400 patients. The range of motion could also be improved significantly.[1]

Similar results, however, can also be performed with a modern ceramic-on-ceramic hip prosthesis. In an own study with 40 patients only one dislocation occurred. However the postoperative range-of-motion was inferior compared to the study of Amstutz.

However, today there are ceramic-on-ceramic prostheses available with a head size of 36 mm in combination with a 12/14 mm cone which allows an increase of the range-of-motion of more than 10 %. The head-neck-ratio is considered to play the major role for the quantity of the range-of-motion.[10,37]

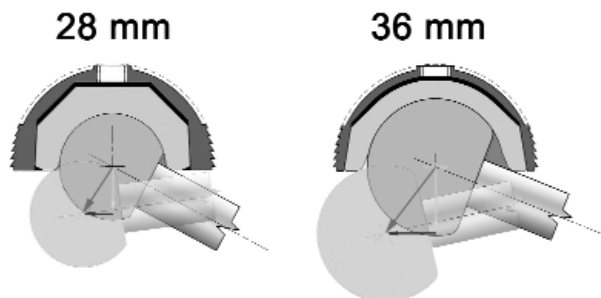


Figure 1:
36 mm large ceramic-on-ceramic wear couples to obtain more stable THA with a higher range-of-motion with permission from Toni, A., G. Willman; Bioceramics in Joint Arthroplasty; Georg Thieme Verlag; New York Stuttgart 2001.

Amstutz et al. describe the leg length difference after implantation of surface replacement hip prosthesis. There was a difference of 1-2 cm in 4 % of the patients, 2 % had a difference of 2-3 cm and even one patient showed a difference of more than 3 cm. The rather poor results might depend on the more difficult intraoperative testing by using the posterior approach.[3] In our own study all patients except one showed a leg length difference within 1 cm by using the transgluteal approach.

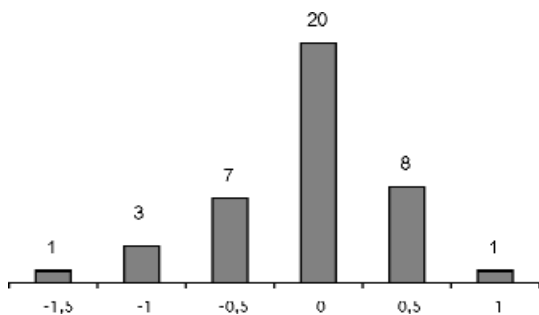


Figure 2:

Leg-length difference postoperatively in cm of 40 patients with a ceramic-on-ceramic arthroplasty. The only patient with a leg-length inequality of 1.5 cm had a shortening of -3.5 cm pre-operatively.

Surgical approach

For the implantation of a surface replacement large surgical approaches are needed to create a good overview of the acetabular region. Wagner described an anterior approach[59] whereas Amstutz and McMinn prefer the posterior approach.[5,38] For this approach the proximal femur is mobilized ventrally. Paresis of the femoralis nerve occur in 1 % of the cases, Amstutz. (personal communication)

In today's hip arthroplasty minimal-invasive approaches become more and more interesting because of their preservation of the soft tissue, faster rehabilitation and better cosmetics.[52,61] In conventional hip arthroplasty a surgical approach of 7 – 12 cm or a two-incision technique may be performed. Because of the above mentioned reasons for surface replacement a large posterior approach is necessary.



Figure 3:

Large posterior approach.

This stands in a certain opposition to the minimal-invasive rationale of this technique.

Restrictive to a final estimation is the fact that there are not many studies about the minimal-invasive approaches available so far. However because of the lack of sufficient studies employing minimal-invasive techniques a decisive statement about its usefulness cannot be made, yet.

Conclusion

With a 5-year survivorship-rate of up to 95 % even among the modern surface replacement prosthesis the loosening rate is worse than for the conventional total hip arthroplasty even in a young patient group. In contrast, for the ceramic-on-ceramic prostheses 5-years survivor ship-rates of 97.5 % to 100 % and 10-year rates of 82 % to 89 % have been published.[6,21,27,34,43,49,51]

Modern surface replacement prostheses are available as metal-on-metal combinations only. For longer bearings no clinical results for the wear rate are available, yet. Additionally, one has to consider the increasing concentration of metal-ions in the serum and urine. The long term side-effect are not know, yet. In contrast the ceramic materials have not shown any biological side-effects during 40 years of usage.

The surface replacement of the hip promises a better bone stock for a future revision. An advantage on outcome has only been shown in one of three studies. For the range of motion the modern surface replacement has proved a better result. On the other hand 36 mm ceramic heads in combination with a 12/14 mm cone are available allowing a similar range-of-motion. Especially with regard to the leg-length difference the ceramic-on-ceramic prosthesis shows a superior result compared to a surface replacement.

For the implantation of a surface replacement large posterior approach is necessary. This is in direct contrast to its minimal-invasive goal. In contrast ceramic-on-ceramic prostheses can favorably implanted using minimal-invasive techniques.

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