2.1 Seven years of experience in MoM resurfacing: Results and open questions

M. Menge

Introduction

Since causal treatment of coxarthrosis as a cartilage disease still is not yet possible, replacing the joint by a total hip replacement constitutes the only solution if conservative therapy fails and affliction is high. While resurfacing has long been practiced in respect of knee joints, early approaches to replace only the diseased or damaged surfaces in the hip joint with artficial surfaces failed mainly for reasons of the materials and fixation techniques used. It was Derek McMinn who in 1991 came up with a metal-on-metal (MoM) hip resurfacing system and later on presented the results obtained from resurfacing [3], which showed that the procedure was useful and safe especially for younger patients. Despite the positive reports that were received from other users [2,11,19] also, there still is a controversial discussion going on after more than 15 years of clinical use. On the occasion of the AAOS in Chicago in March 2006, Lachiewiecz [8] presented the results collected by various authors, and in his conclusion: "Resurfacing Arthroplasty: Time to consider it again?" answered this question by a clear "No". In his opinion, it is especially the rate of early complications, which speak against resurfacing, and he stated that the results obtained from the use of uncemented standard THRs were good enough and would not justify the use of high-risk resurfacing procedures. He stated in particular, that only a "limited number of experienced surgeons" should use resurfacing whereas the majority should wait until the results of 10 years of clinical use were available "before taking on the learning curve". Howie evaluated the results reported by the Australian Orthopaedic Association National Joint Replacement Registry [5] and came to the conclusion that there is a number of well-tried and highly safe procedures available to patients under the age of 65 also. "In younger patients, the theoretical advantages of resurfacing hip arthroplasty are more important, but these need to be balanced against the problem of a young patient unnecessarily entering the downward spiral of multiple revision surgery because of early resurfacing failure" [7].

Failure of resurfacing arthroplasty in the past, as well as the non-approval of implants by authorities in some countries, and the relatively high implant cost or the technical difficulties involved in the surgical procedure, and the possibility of supplementary complications definitely constitute an obstacle to the clinical use of resurfacing hip arthroplasty. Apart from that, good long-term results are reported for some conventional procedures [6]. One thing that seems to be sure is that hip resurfacing is not suited for patients who due to their life expectancy are not likely to have to undergo revision surgery, or for patients whose bone structures are damaged to an extent that will not allow resurfacing for anatomic reasons. On the other hand, there have been complications reported for hip resurfacing, which in the eyes of many surgeons make this procedure inappropriate for younger patients also.

Material and method

We have reported about our own experience several times before [10,11], and came to the conclusion that hip resurfacing should be used in young patients. In this paper, the medium-term experience gained for a number of 1,200 cases over a period of seven years shall be presented, and any unsettled questions are discussed. In the period from 1999 until the end of 2004, we performed a number of 1,201 primary hip resurfacings. The share of female patients was 56.8%, and of male patients was 43.2%. The median age of the male patients was 54.4 [16-73], and of the female patients was 53.6 [21-69] years. The cases treated were either primary or secondary coxarthrosis, and in individual cases was necrosis of the femoral head with the bone structure of the femoral head preserved to a sufficient extent; we excluded cases with extensive bone defects located in load-carrying areas of the femoral head. We did not perform presurgical bone density tests since there was no reason to assume that involution atrophy of the femur would result in an increased fracture rate of the femoral neck in any of our patients.

In most of the cases, the hip joint was accessed from dorsal approach since the patients operated on from lateral access had exhibited a tendency towards postsurgical luxation, and since lateral access of the joint caused higher traumatization of the patient. Apart from that, minimized invasive approach for the purpose of inserting the prosthetis is possible from dorsal access only.
In the following, the problems on which the opponents of hip resurfacing put the spotlight shall be discussed.

Problem No. 1: Early fracture of the femoral neck

A distinction has to be made between early fracture of the femoral neck which may occur as the result of an acute incident without any external cause and without any reliable prodromal signs within a period of up to eight weeks after surgery, and late fracture of the femoral neck which may occur in the form of intracapital fracture with the cap tipping into a varus position, and pain which persists some time before within the first three years after the operation. In our patient group, we had a relatively high rate of 2,8% of postsurgical femoral neck fractures during the first two years. In 1999, there had not been any information provided by McMinn relating to the risks of hip resurfacing. In the seventies, during which Wagner or Freeman caps were used as a resurfacing device, the spotlight had been on problems in connection with acetabular cups although femoral neck fractures also had been observed then [13]. The reason for fracture in our opinion lies in predisposing microfractures, which are generated as a result of the mechanical strain caused when preparing the femoral head and when hammering on the cap, and by excessive exposure of post surgical strain to the hip joint. Also, prolongation of the femoral neck without having the milled head segment covered with the cap naturally will cause increased fragility (Fig. 1). Moreover, notching of the lateral cortex of the femoral neck represents a predisposing factor (Fig. 2).

In the meantime, we are trying to keep the surgical trauma as small as possible, and shorten the femoral head to a level which allows for the cap to cover the milled segment completely, and depending on the type of cap use the smallest

Figure 1a:
50.4 year old female patient with insufficient resection of the femoral head: the milled distal sector is covered by the cap only insufficiently.

Figure 1b:
The leg was somewhat lengthened. Apart from that, the cap was in a slight varus position. Four weeks later, spontaneous fracture occurred in the spongious area.

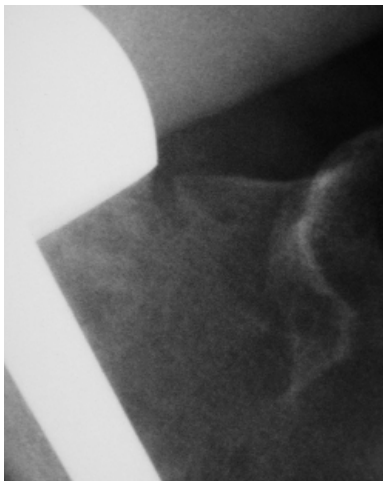


Figure 2a:
In this 55 year old female patient, the lateral corticalis of the femoral neck was affected during milling operations on the femoral head.

Figure 2b:
Three weeks later, the patient was hospitalized again for reasons of fracture of the femoral neck. Fig. 2b shows a radiograph of the fractured femoral neck with the fracture located in the notch area.

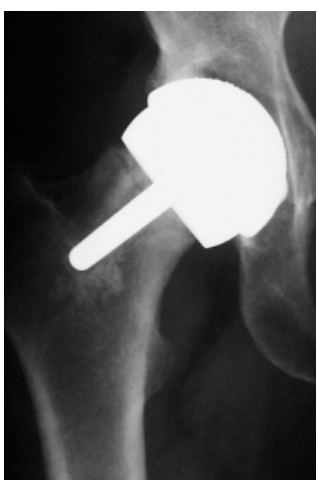
amount possible of low-viscosity cement (Fig. 3). Anchoring holes are reserved for those conditions, where cortical structures cannot be reamed completely. During the first six weeks after the surgical operation, patients are not allowed to do heavy exercise.

Figure 3:
Cementing was performed using a very thin layer of low-viscosity bone cement on the cap wall. Generally, there aren't any anchorage bores used since leakage of blood to the surface of the femoral head, and increase of intraspongious pressure which may occur when hammering on the cap are eliminated as a result of suction from a cannula located in the greater trochanter.

While in the Australian Orthopaedic Association National Joint Replacement Registry [5] the share of early fractures in the entire number of total revisions is reported to be more than 59%, which corresponds to an approximate rate of 1.3%, the frequency of fractures observed within our study meanwhile is 0.42% in females and 0.5% in males. Hence, we cannot confirm the data indicated by the Australian Registry according to which the risk is twice as high for females. Apart from that, the median age of the patients of our patient group, who experienced fracture of the femoral neck is 53 years, and hence is more or less the same as the one of the entire patient group. For this reason, we cannot confirm that older patients will face a higher risk. As a consequence, we have no longer performed any bone density tests for years but exclusively rely on the radiological presentation of the structure of the femoral head.

Problem No. 2: Avascular necrosis of the femoral head

In our patient group, we revised a number of 12 late fractures of the femoral neck, which occurred after a median period of 19 months (Fig. 4). As causes of such fractures underperfusion of the femoral head accompanied by unphysiological factors including minor circulation are discussed [14]. Since in the case of



a)

b)

Figure 4a, b:
In the first years of clinical use, adhesion bores were provided on the femoral head to enable the use of larger amounts of cement on both the femoral head and the femoral neck. In the sequel, femoral head necroses with intracapital fractures were observed sporadically. The radiograph shows the tipping cap and a seam around the stem (a),with the explant exhibiting necrotic areas of the femoral head underneath the cap (b).

dorsal access the femoral head has to be put into this position only two times for a few minutes each, we believe that this is not a sufficient explanation. We have, however, modified our cementing technique and use only little cement, and avoid anchorage holes. Since then, there has no longer been avascular necrosis of the femoral neck followed by intracapital fracture.

Problem No. 3: Clicking and squeaking

Just like other hard-on-hard bearings, metal-on-metal joints for reasons of the relatively slow movement of the frictional components and the relatively low lubricating capacity of aqueous body fluids tend to be subject to so-called "boundary lubrication" which means that the articulating components are not completely isolated from each other by the fluid film, and that there is a direct contact between the materials mostly under high strain and in slow movements such as in stair climbing. Some patients who had received a BHR-type artificial joint reported squeaking sounds during the first months after the implantation, which lasted for a while and disappeared again after a few days. The rate of such patients is approx. 4% [1]. We have made it a habit to inform the patients about this possible phenomenon prior to the implantation.

Two patients who had received resurfacing arthroplasty the articular cavity of which was smaller than in BHR-type or comparable "classical" implants had to undergo revision surgery because of persisting sounds of the joint, and hence we now use only hip resurfacing devices which respects the classical clearance of about 250µ.

The "clicking sound" which is occasionally observed seems to be due to micro-separation of the articulating components in special movements. At first sight, the larger head diameter seems to allow for improved movability compared to the conventional femoral head which features a diameter of 28 or 32mm, but the obvious benefit offered by the larger head is thwarted by the preserved natural femoral neck: the range of motion offered by hip resurfacing is slightly more than 90° until contact of the femoral neck and the acetabular rim is established. When using resurfacing arthroplasty, the position of the cup is even more important than in conventional standard prostheses. A steeper cup position and a sufficient degree of anteversion of the cup are required to enable sufficient flexion and the preservation of adduction and internal rotation. Otherwise, subluxation involving the relevant clinical afflictions (pain in the groin) will be caused in flexion as a result of impingement of the femoral neck on the acetabular rim.

We had to do revision surgery in four patients for this reason, and had to reposition the cup accordingly.

Problem No. 4: Metal-on-metal

There still is the question of metal abrasion. The concept of using metal on metal is frequently referred to as a knockout criterion as far as the resurfacing procedure is concerned. In the panel discussion which took place on the occasion of the AAOS 2006 in respect of the selection of head and cup materials for the prosthetic treatment of young patients, seven of the nine prominent panelists voted in favor of metal-on-metal bearings (28mm), while only the

remaining two panelists preferred ceramic-on-ceramic bearings. Since both, the large-head version and the 28mm system cause the cobalt and chromium levels in the blood to increase, it is hardly understandable that the resurfacing prostheses are refused for the sole reason of material problems. There wasn't any carcinogenic effect detected [15,18]. Metal incompatibilities are rare [4]. We had to perform revision surgery in three patients because of persisting afflictions, and found lymphocytic infiltrations in one patient only. Also, allergic reactions do not have to be expected even in the case of established cutaneous allergies [12]. Nevertheless, the release of metal ions to the body remains a problem in females of childbearing age: McMinn detected cobalt and chromium ions in the umbilical cord blood in ten females who had received metal-on-metal bearings. It is still unclear whether and in as much such increased levels have an effect on both, the embryonic and the later development of the child [9]. At any rate, this item should be mentioned when discussing prosthetic treatment with female patients who plan to have children. In view of the long-term results obtained from various studies [15,18], the discussion relating to the promotion of tumors has ceased.

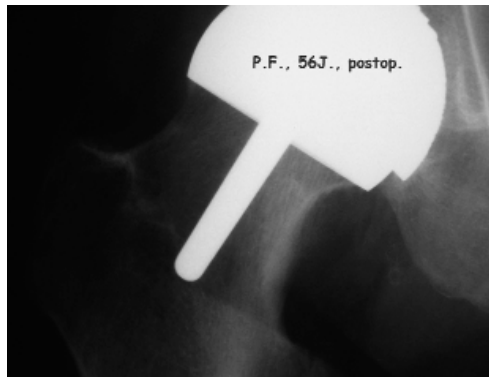
Discussion

It is the low loss of bone substance on the femoral part, and hence the ease of revision, which constitutes the essential benefit, offered by hip resurfacing, and which make this method particularly predestined for patients whose life expectancy is still high. If resurfacing arthroplasty should fail, it will after all be possible to use any other type of prosthesis that will suit the patient. Moreover, the high stability of the joint owing to a larger head diameter, and the preserved proprioception of the proximal femur make resurfacing particularly suited for physically active patients. However, there are special risks connected to hip resurfacing, which seem to be a problem, such as early fracture of the femoral neck that after all causes almost 60% of the revisions reported by the Australian Orthopaedic Association National Joint Replacement Registry. Since resurfacing involves a number of special technical processes, the method should exclusively be used by clinical centers with relatively high operating volumes. The method is not recommended to "low-volume-surgeons" since the learning curve is long.

Conservation of the natural femoral neck prevents the expected benefit of increased range of motion owing to the use of larger heads. The alternative use of a larger head than necessary and hence of a larger cup will be connected to a corresponding loss of bone in the acetabulum and cannot be justified in respect of the general prognosis of an uncemented pressfit cup. Also, the steeper cup position, which is necessary because of possible impingement problems, could harbor the risk of earlier loosening upon exposure of the acetabular implant to eccentric strain. So far, there hasn't been any tendency towards implant loosening been observed.

Release of metal ions to the body owing to abrasion, and the problem of clicking or squeaking joints, as well as rare incompatibilities and possible risks to the unborn child in female patients of childbearing age seem to be further arguments against the use of MoM resurfacing. Apart from that, there have been first signs of possible unfavorable effects of remodeling ("thinning" of the femoral neck, (Fig. 5)), which also could constitute a long-term risk. Finally, it will be the

a)



b)

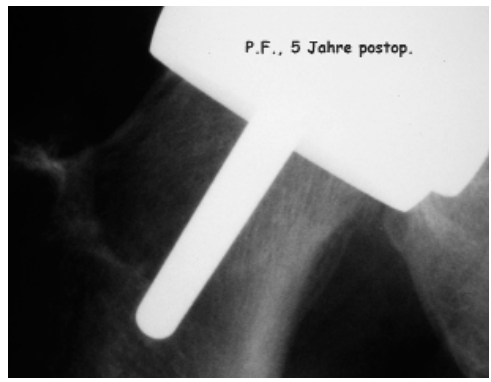


Figure 5a, b:
Remodelling of osseous structures occurs more rarely in resurfacing arthroplasty than in shaft-type THRs. The radiographs show the postsurgical condition (a) of a 56 year old patient, and atrophy of the peripheral structures around the cap opening also referred to as "thinning" after a period of five years (b).

actually measured results that will be decisive. It was shown by the results obtained by us so far, that the supplementary risks of hip resurfacing i.e. early fractures, frictional problems, longer operating times and higher surgical difficulty were compensated by quicker rehabilitation and high satisfaction of the patient [10]. The question "Resurfacing Arthroplasty: Time to consider it again?" asked in the beginning must definitely be answered by "yes". The statement saying that resurfacing will cause "patients unnecessarily enter the downward spiral of multiple revision surgery because of early resurfacing failure" can neither be derived from the data indicated by the Australian National Joint Replacement Registry, nor can it be concluded from the data gathered by us. Selfevidently enough, there still are aspects which should be improved in the further development of hip resurfacing: on the one hand, enlarging the range of motion for instance by providing a notch on the cup rim would be feasible while on the other hand there are first approaches towards the improvement of tribology for instance by using ceramic-on-metal or ceramic-on-ceramic bearings. Until then, the implants according to McMinn, which have been used so far, will provide us with an excellent therapeutical instrument for the treatment of younger patients. However, the use of these devices and the more difficult technique should be restrained to centers with highly trained surgeons where adequate numbers of cases were performed and that are trained to avoid and to deal with the possible complications of hip resurfacing technologies.

References

1. Back DL, R Dalziel, D Young, et al. (2005) Early results of primary Birmingham hip resurfacings. An independent prospective study on the first 230 hips. JBJS 87-B, 324-9.
2. Dalton PA, R Nelson, S Krickler (2005) Up to 10-year results of hip resurfacing. Presented at the British Orthopaedic Association Annual Congress. Sept. 20-23, 2005. Birmingham.
3. Daniel J, PB Pynsent, DJW McMinn (2004) Metal-on-metal resurfacing of the hip in patients under the age of 55 years with osteoarthritis. JBJS 86-B, 177-84.
4. Davies, AP, HG Willert, PA Campbell, ID Learmonth, CP Case (2005) An Unusual Lymphocytic Perivascular Infiltration in Tissues Around Contemporary Metal-on-Metal Joint Replacements. JBJS 87-A, 18-27.
5. Graves S, D Davidson, L Ingerson, et al. (2005) Australian Orthopaedic Association National Joint Replacement Registry. Annual Report. Adelaide: AOA (www.dmae.adelaide.edu.au/aoanjrr/).
6. Herberts P, H Malchau, G Garrelick (2004) Annual Report. www.jru.orthop.gu.se.
7. Howie DW, H Bhinda, M McGee (2006) Why Resurfacing Hip Arthroplasty: An Australian Perspective. AAOS 2006 Annual Meeting Proceedings, 67.
8. Lachiewicz PF: Resurfacing Arthroplasty: Time to consider it again? No (2006) AAOS Annual Meeting Proceedings, 77.
9. McMinn D, J Daniel, C Pradhan, et al. (2006) Transplacental Transfer of Cobalt and Chrome in Patients with Metal-on-Metal Bearings. AAOS Annual Meeting Proceedings, 484.
10. Menge M (2004) Metal-on-Metal in Resurfacing Arthroplasty: Risks or Benefits? In: JY Lazennec, M Dietrich (ed.): Bioceramics in Joint Arthroplasty. 9th Biolox Symposium, Proceedings. Steinkopff, 111-117.
11. Menge M (2005) Oberflächenersatz am Hüftgelenk – 6-Jahres-Erfahrungen mit der dritten Generation. Z. Orthop. 143, 377 –81, 2005, (www.prof-menge.com).
12. Schramm M, RP Pitto (2000) Clinical Relevance of Allergological Tests in Total Joint Replacement. In: G Willmann, K Zweymüller, (Hrsg.): Bioceramics in Hip Joint Replacement. Thieme, 101-6.
13. Steffen RT, SR Smith, HS Gill et al (2005) Blood flow in the femoral head during metal-on-metal hip resurfacing. Presented at the British Orthopaedic Association Annual Congress. Sept. 20-23, 2005, Birmingham.
14. Schreiber A, HAC Jacob (1984) Loosening of the femoral component of the ICLH double cup hip prosthesis. Acta Orthop. Scand. 207, 55.
15. Tharani R, FJ Dorey, TP Schmalzried (2001) The Risk of Cancer Following Total Hip or Knee Arthroplasty. JBJS 83-A, 2001, 774-80.
16. Thomas, P (2000) Allergological Aspects of Implant Biology. In: G Willmann, K Zweymüller (Hrsg.): Bioceramics in Hip Joint Replacement. Thieme, 117-21.
17. Treacy R: Hip Resurfacing – The UK-Experience. AAOS Annual Meeting Proceedings, 66, 2006.
18. Visuri T, et al. (1996) Cancer Risk After Metal on Metal and Polyethylene on Metal Total Hip Arthroplasty. Clin Orthop 329, 280-9.
19. Witzleb W-C, A Knecht, T Beichler, T Köhler, KP Günther (2004) Hüftgelenk-Oberflächenersatzendoprothesen. Orthopäde, 1236-42.