2.2 Surgeon and resurfacing: considerations after a long experience

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Background

Resurfacing prostheses do not represent a novelty in orthopedics. In fact, in the 1950s several resurfacing devices had been already developed by Charnely (1950) and Muller (1968). Although this project was abandoned due to the use of inadequate materials like Teflon and polyethylene, it has been resumed in the last ten years. Since apparently the problems of wear have been resolved, the resurfacing philosophy has spread again following the latest trends in searching bone stock preservation, high implant stability, easer surgical revisions and the possibility of restoring normal hip biomechanics. The cases which have been most accurately studied are those reported by Mc Minn [1] and Amstutz [2] which show interesting data on follow-ups and survival curves.

In the last few years, however, the resurfacing procedure has been largely implemented by surgeons worldwide, even though their experience has not been much consolidated in this field, and their practice has also highlighted resurfacing risks and complications. In particular, some weaknesses have emerged as fractures of the femur neck and avascular necrosis of the femoral head, typical complications due to resurfacing [3,4]. Probably, the surgical technique needed for implanting a resurfacing prosthesis is not so easy, and the required learning curve implies unavoidable failures which are above all due to an incorrect indication for this type of prosthesis, to the vascularization's typology of the femoral head and to an inaccurate implant of prosthetic components.

Our experience, started enthusiastically in 2000, has gone through the stages described below, even though with some standstills and afterthoughts which have allowed us to identify the main causes of our failure and find out how to avoid them.

Methods

From March 2000 to March 2006, 127 resurfacing prostheses were implanted at the Orthopedic and Traumatological Division of St. Raffaele Hospital in Milan. These included 103 BHR and 24 MRS. At present, examinations are performed on the first implants, in particular the first 60 prostheses which had a longer follow-up period. Among the first 60 cases, 33 were male and 27 were female, with an average age of 47.9 years (min.= 25 - max.= 76), and the average follow-up period was 44 months (min.= 27; max.= 72). The candidates for the implant were patients aged less than 60 years with the exception of one case (72 years) who, though being older than the maximum required age, had a good quality of bone. The treatment with resurfacing prostheses was indicated for the cases of coxarthrosis, cephalic necrosis of the femur (Steimberg I-III), congenital hip dysplasia (Crowe I-II), which, however, did not have significant anatomical alterations.

In all the cases included in the follow up had BHR implant (MMT). The acetabular component was cementless, while the femoral one was cemented. Operations were carried out by two surgeons (FR and LT) using a posterolateral approach. A "transosseus" suction system was always used to improve the quality of femoral cementation as much as possible under vacuum conditions.

All patients started walking rehabilitation with the load on the operated limb from the second day after surgical intervention. The use of braces was interrupted within the first 60 days. A clinical evaluation was made according to HHS before the operation and, after discharge, at 5 weeks, 6 months and 1 year from operation. Radiographic examinations were performed immediately after operation at 5 weeks, 6 months, and 1 year. Then, the patients with follow-up were examined clinically and radiographically on a yearly basis.

Results

Clinical checks showed a significant improvement of HHS score at 6 months from the operation (Table 1) in the 57 patients having no complications causing an early failure. Their improvement remained essentially unchanged during the

N° subject				
Follow up	Basal	1 month	6 month	12 month
HHS	51.9	73.6	89.9	90.57
P Value		<0.02	<0.001	<0.001

Table 1:
Mean value of Harris Hip Score (HHS) obtained in subjects undergone to hip resurfacing during follow up; statistical comparisons between HHS obtained preoperatively and those obtained during the clinical evaluations.

subsequent checks (Table 1). Radiographic examinations revealed anomalous positions of the components such as an inadequate insertion, an excessive verticality, and an anomalous antiversion or retroversion of the acetabular component (Fig. 1). At femoral level, an evaluation was made of any anomalous positions in case of excessive varus or valgus deviation, of the exposure of the femoral head spongiosa due to milling, and of the superolateral notching (Fig. 2). Any migration of prosthetic components was also assessed. No migration of prosthetic components was highlighted by the periodical radiographic checks, while a periacetabular lysis occurred three years after implant caused the mobilization of an acetabular component. Five cases showed an inclination of the acetabular component of more than 50°. The anomalies in antiversion and retroversion positions assessed in the axial projection were considered significant if greater than 30° in case of antiversion or equal to neutrality in case of retroversion. Six cases, where an excessive antiversion was observed, did not show any signs of implant instability. In 3 cases we observed a superolateral notching and in 1 case there occurred an excessive circumferential abrasion of the neck of the femur. After 5 years, a periprosthetic thinning of the neck of the femur was noticed in 8 cases. The reported complications included, in particular, those specifically associated with the procedure and those generally caused by hip prosthesis surgery.

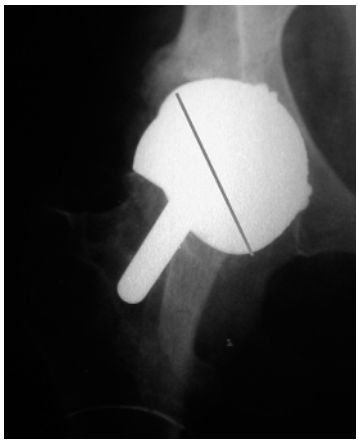

Figure 1:
Anomalous positions of the acetabular components: the AP x-ray reveled excessive verticality of the acetabular component.

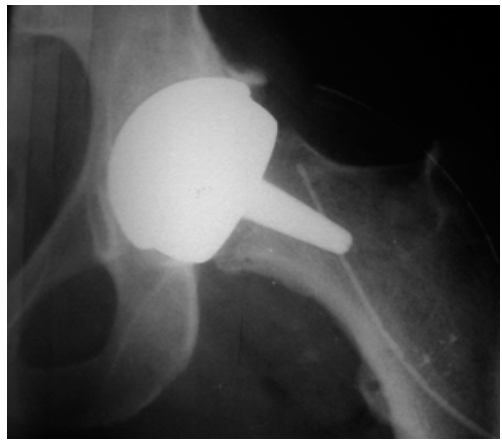

Figure 2:
Anomalous positions of the femoral components: the AP x-ray reveled an excessive varus deviation of the femoral component.

Specific complications comprised two fractures of the neck of the femur at 6 months and 8 months from operation despite the fact that the initial radiographic assessment had confirmed its normal conditions. These 2 cases required an early revision. Both patients were male aged over 50 years.

In 1 patient a revision was performed at 43 months from operation due to a severe metallosis caused by edge wear.

Among common complications associated with traditional prostheses, there occurred a deep infection, two periprosthetic calcifications, and a mobilization of an acetabular component.

The failure rate due to fracture of the neck of the femur was 3.3%, while the revision rate in the cases examined, including the mobilization of the cotyle and the deep infection, was equal to 8.3%.

All the above complications refer to the first 60 implants; in the subsequent 67 cases there were no fractures or revisions of the prostheses, so the percentage of fractures of the neck of the femur fell to 1,6% and the percentage of revisions dropped to 3.1%.

Discussion

Our first experience with resurfacing prostheses persuaded us to analyze the results critically and formulate some reflections.

The clinical results of the 56 resurfacing prostheses which did not cause any complications were definitely favorable for a 5-year follow-up period. The improvement of the HHS score remained constant with time and, in general, patients showed an excellent joint mobility, even if in 2 cases an occasional "squeaking" occurred during movement. Implants proved stable and there were no dislocations. Similarly, our examinations revealed a moderate dysmetria of not more than one centimeter after operation. High satisfaction was reported by the patients who resumed sports activities after operation.

However, when considering failures, we must take note that a percentage of 1.57% of the fractures of the neck of the femur and a percentage of 3.1% of the revisions do not seem acceptable when compared to all cases. Failures apparently occurred during the first phase of our experience and in particular in the first 60 cases. This may be due to the learning curve inherent to the procedure both in terms of technical aspects and indications.

In the 2 cases where the fracture of the neck of the femur occurred, no particular technical problems were found during the implant, and the radiographic check performed after operation did not reveal any misalignment of the implant. The ages of the patients (56 and 59 years) were the highest of the examined cases and one patient weighed 105 kg. The histological examination performed in the patient who had a fracture at 8 months after operation showed signs of cephalic necrosis.

We attributed the two failures to the patient weight and age as well as to technical problems associated with a failure of preservation of the femur neck vascularization.

The international literature reports the same complications we observed in our studies [5]. In particular, the actual risk of this procedure is the fracture of the neck of the femur. Therefore, we have tried to point out the elements of potential failure in an attempt to avoid them.

According to the data reported by literature and in light of our first experience, we can identify some elements which must serve as guidelines for using this type of implant.

Strict observance is required for the indications which must be well defined in terms of age, sex, bone quality, patient weight, and hip morphology [6].
It is common opinion [1-5] that osteoporosis is absolutely contraindicated for this operation and this is related directly to patient sex and age. Poor mineralization of bone, alone or associated with the damages caused by the treatment of the femoral head, produces stress microfractures in the area between the neck of the femur and the implant, which may lead to fracture. The best results are achieved in patients aged less than 50 years, and this is the age range to which we are currently limiting the indication of this implant.

Among the biological and morphological factors predisposing to fractures, it is necessary to consider both the pathology and the morphology of the head and neck of the femur which are connected one to the other [7]. Arthritis is the most suitable pathology for the specific indication even in case of dysplasia, provided that it is low-grade dysplasia. The cephalic necrosis can be treated if it has not damaged more than one third of the head (Steimberg I-III). The varus deviation of the femoral neck predisposes to an increase in bending stress of the prosthesis due to the protuberance of the proximal end of the femur. Moreover, in this case the valgus deviation of the femoral cup often causes the superolateral notching to counterbalance the anatomical shape; the superolateral notching represents another factor predisposing to fracture [8] (Fig. 3).

We believe that the head shape is particularly important: an non spherical head with a relatively large neck will predispose to a higher risk of an excessively milled neck and/or superomedial impingement (Fig. 4).

The aspects most strictly related to the implant technique have made us understand that a treatment with resurfacing prostheses is not easy to perform, if all parameters are to be complied with in order to ensure successful results with time. Our experience and the data reported by literature showed that the main

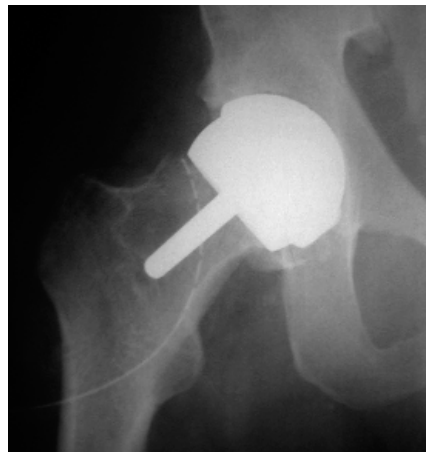

Figure 3:
Anomalous positions of the femoral components: the AP x-ray reveled the supero-lateral notching that represents a factor predisposing to fracture.

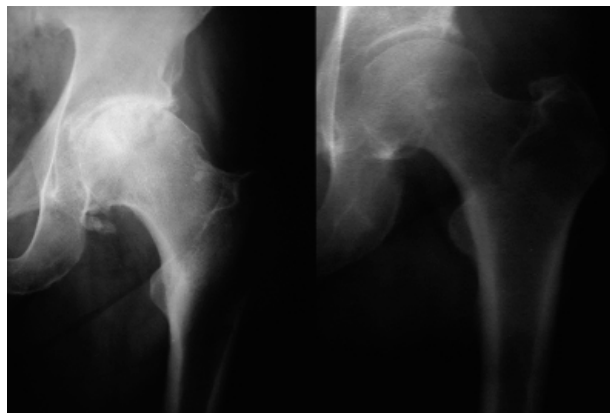

Figure 4:
At the right a normal femoral head, at the left site a "pistol grip" deformity femoral head: a non spherical head with a relatively large neck will predispose to a higher risk of failure because an excessively milled neck.

risk factors of failure due to the implant technique are the varus deviation of the prosthesis, the abrasion of the superolateral portion of the neck, the exposure of the neck spongiosa, the conflict between the prosthesis and the neck due to underdimensioned implants, the excessive verticality of the cotyle and/or implant subdislocations. Finally, we cannot ignore the vascularization of the femoral head during the surgical approach. The main femoral head vascular contribution in adults is given by the femoral medial circumflex artery (FMCA) which from the internal obturator penetrates into the superolateral portion of the femoral neck, at this site it is more likely cause a damaged by the insertion of the prosthetic cup or by the dissection of extra-rotator muscles during surgical approach. Moreover, it is well-known [9,1] that excellent results have been achieved in the treatment with resurfacing prostheses just using a posterolateral approach. The low incidence of cephalic necrosis is explained by the fact that vascularization allows to preserve the pericephalic soft tissues ensuring a correct anastomosis with the FMCA and, as a consequence, with the inferior gluteal artery. Another possibility is that of a prevailing endosseous circle which has become hypertrophic during the development of the atrophic pathology [4]. There exists also a hypothesis based on mechanics according to which, since in most of the cases, the polar portion of the head is removed, a large area likely to be subject to necrosis would

be eliminated, because the resurfacing involves the neck and not the head [4]. However, it is important to revalue the points of access to hip which do not cause any iatrogenic lesion to the FMCA [10]. An evidence of this is given by Wagner's prostheses, which, though being unsuccessful due to tribological problems, did not fail as a consequence of cephalic necrosis, since the author used an anterolateral approach.

Before choosing these prostheses, it must be taken into consideration that we use a metal-metal coupling, in particular chromium-cobalt. This material may trigger intolerances and allergies which should not be underestimated since, they cause prosthesis failure.

Much has been said on the tribological aspect in relation to a possible metallosis caused by the use of metal-metal prostheses [11], but, since the metallurgic element of modern prostheses is considered safe, there remains the personal experience of cases of very severe metallosis due to edge wear. This is the consequence of an incorrect compliance between the surfaces in contact or a misalignment of the acetabular cup which, in case its verticality or antiversion is excessive, puts the femoral cup in contact with its own edge, thus producing a consequent rapid wear of the surfaces and causing metallosis. Attention should then be paid in order not to underestimate the misalignment of the components, since a large diameter head, more stable than a small head, compensates any implant defects in terms of stability.

The thinning of the neck of the femur, which sometimes is revealed by radiographic examinations after some years from operation, is an observational datum which requires further studies for a correct interpretation.

Conclusions

Last generation resurfacing systems represent the best solution between the highest preservation of the femoral bone and the reliability with time in young patients, on condition that indications and exclusion criteria are observed and a high precision technique is used for performing the implant. The main problem is still the fracture of the neck of the femur which must be described in detail to the patient on which this procedure will be carried out. According to the data reported by literature, the incidence of the fracture of the neck of the femur ranges between 0.2% and 2%. When comparing these data with the incidence ranging between 0.33 and 4.51% of the dislocations caused by traditional prostheses, the obvious question is whether this complication, in case of well osteointegrated prostheses, is a problem less difficult to handle than the fracture of the neck of the femur.

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