1.3 Clinical advantages with large diameter heads

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Introduction

Hip replacement surgery is an elective procedure that is nearly always successful in improving the strength and decreasing pain in a disabled hip. Recently, much interest is focused on the use of large diameters couplings to improve the quality of the results of this operation. In our experience we recognized three major clinical purposes to utilize large heads: decrease dislocation rate, improve feeling of hip stability in young patients and begin accelerated rehabilitation protocol.

Decrease Dislocation Rate

The most common complication the orthopaedic surgeon encounter after total hip replacement is dislocation [1]. This event can be the consequence of a number of factors including previous femoral neck fracture, obesity, osteonecrosis, incorrect "head-to-neck ratio", surgical approach, neuromuscular disorders, cognitive impairment [2,5]. The orientation of the prosthetic components in terms of acetabular abduction and anteversion and femoral anteversion, it is one of the major implant-related factors limiting the range of motion after total hip arthroplasty. Poor positioning of the prosthetic components can determine impingement between the neck and the margins of the acetabular cup, thus facilitating dislocation.

For these reasons, at the very beginning of the hip replacement era, the implants were applied with large diameters balls. These devices were soon abandoned because of the poor quality of the materials available at that time [6]. The improved tribology of modern couplings, with much lower wear, have brought back the large diameters. The advantages of large diameters implants have been specially advocated by those surgeons supporting hip resurfacing. Large diameters enhance stability increase range of motion ROM [7] and reduce the risk of impingement between neck and border of the cup. Other surgeons, not persuaded from hip resurfacing, are now implanting large diameters in conventional total hip replacement. They claim that the advantages of the big heads are the same whether these are applied in surface replacement or on a conventional stem. Obviously this type of coupling can't be used for all patients because of the high costs. However they are gaining more and more popularity for specific groups of patients with high requirements such as young active patients or old patients with neurological diseases [8]. A larger femoral head must travel a greater distance before subluxating or dislocating. This enables a greater range of hip motion before the femoral neck impinges on the acetabular component and levers the head from the shell [9]. All this explains the proportional decrease of dislocation with the increase of femoral head diameter [9,10].

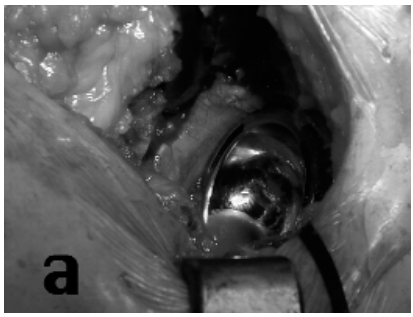
Our current trend for the use of large diameters, either ceramic on ceramic or metal on metal, is largely influenced buy the limited number of implant of this type that the we can perform because of the high costs. The first and main indication is for young and active patients that are likely to be willing to continue an active sportive life. These are the same kind of patients which have recently been considered elective candidates for hip resurfacing. It is our opinion that the same results in terms of hip stability and range of motion, and thus ability to perform sports, can be achieved also with a large diameters head implanted on a conventional, or better, bone preserving uncemented implant. A number of early complications have been described after hip resurfacing [11,12]. We have personally had 2 femoral neck fractures after 4 and 7 weeks respectively, in a limited series of 15 patients. Both fractures occurred raising from a chair without any significant trauma. Other surgeons reported similar high incidence of this serious complication [13]. It is quite difficult, at least in our country, to have our patient accepting these kind of totally new complications, peculiar of the hip resurfacing technique. For this reason, while waiting for more extensive investigations on hip resurfacing, we presently prefer to apply, in young and active patients, an ultra-short bone preserving stem with a large diameter coupling. (Fig. 1a, b).

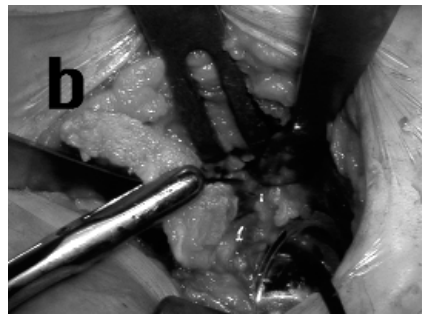
Figure 1a, b:
Ultra short bone preserving femoral implant with large ceramic on ceramic coupling (a) and large metal on metal coupling (b).

Other indication for primary large diameter THR is for us the treatment of a displaced femoral neck patient in a relatively young and active patient. In these patients there is a reported much higher risk of early and late dislocation [14] and, furthermore, there is a high risk of leg lengthening to obtain proper joint tension. In our experience, the use of large diameters significantly lower such complications.

Last, we suggest the use of large diameters in neurological and multiple revision patients. In such cases, the choice of high cost ceramic on ceramic or metal on metal joints or rather a conventional coupling is decided according to life expectancy and level of activity.

Event thought large diameter joints are quite forgetful, this does not mean that the surgeon is allowed to pose less attention during the operation. Maximum care is required in checking the orientation or the components and the absence of impingement with osteophytes (Fig. 2a, b, c).





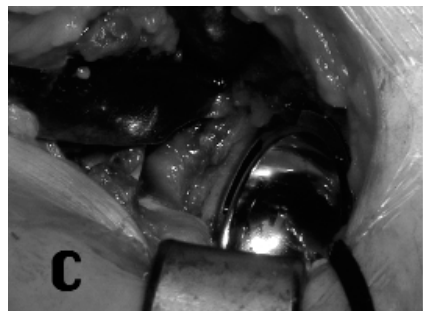


Figure 2a, b, c:
a) A large osteophyte is present on the anterior border of the acetabulum after cup implantation.
b) The exceeding bome is removed with an osteotome.
c) After removal. Impingement of the neck during flexion and internal rotation is no longer possible.

Improve Feeling of Hip Stability

In the healthy hip joint, the femoral head is continually in close and stabile contact with the socket during all movements. The stability of the healthy hip joint is provided by numerous supporting structures around the hip joint, including a thick joint capsule, a system of joint ligaments built in the joint capsule, and a ligament inside the hip joint itself. These joint structures create a passive resistant force on the hip joint that keeps the femoral head in close contact with the hip joint socket during all movements.

Moreover, the 19 muscles surrounding the hip joint provide further dynamic stability. Every surgeon who tried to extract the femoral head from the hip joint in a patient with a broken femoral neck knows how difficult task it is.

On the other hand, during total hip replacement a portion of these supporting structures muscles, ligaments, capsule are divided. Even if the surgeon tries to restore muscle and soft tissue balance by suturing together, there is usually some imbalance of soft tissues left. As a consequence, the artificial head separate transiently from the center of the cup component during gait. This evidence has been demonstrated by X-ray studies of patients with total hip joints. When the operated on leg swings and the hip is not loaded, the femoral ball moves to the upper outer side of the cup component. When the patient's leg comes in contact with the floor and the leg takes the body's weight, the ball returns to the close contact with the whole cup. Thus, the ball moves from the center of the cup to the outside of the cup and then backs like a piston. The "pistoning" movements are small, between 2 to 5 millimeters. Studies showed that these "pistoning" movements occur in all conventional total hips. It is then possible, almost certain, that more movements occur also during other activities without any acknowledgements by the patient.

It is common experience of all those surgeons who have used hip resurfacing, that patients report an increased feeling of having a "normal" hip. It is obviously very difficult to provide a scientific explanation for this finding. Some may believe the better result due to an increased respect of hip proprioception. This is evidently not true. Any operation of hip replacement produces an extensive damage to the peri articular soft tissues and this it is only more true for hip resurfacing were the soft tissue stripping it even more extensive to achieve good exposure of the acetabulum. In that case, the nerve endings around the hip are extensively removed and cannot explain the better feeling of hip stability reported by the patients. What it is more likely, it is that the improved results are due to two other factors. First, in surface replacement, there is, at least in rather normal hips, a better respect of femoral head offset. Second, the large diameter provide less micromovements and a better range of motion. It possible, thought it has not been investigated yet, that the "natural" pistoning, previously described, that occurs in all conventional THR during gait, does not occur here. In our experience, with large diameters metal or ceramic heads applied on conventional femoral implants, we have had exactly the same feed back by our patients. Patients describe their hip as being more "normal" with large diameters coupling, and this is in particular appreciated by those who want to maintain a very active lifestyle.

There is not much science in these assertions because it is not clear why this happen and it is quite impossible to draw a direct relationship between improved results and large diameters. To our knowledge, there is no clear explanations of this clinical findings and we could not find any convincing report explaining the exact mechanism by which large diameters improve the feeling that the patient has of his own hip.

Accelerated Rehabilitation Protocol

One of the request that we have from our patients it is a normal or almost normal range of motion of the artificial joint. Young patients willing to participate in sporting activities require a good range of motion of the hip especially if they are involved in activities like yoga and martial arts. Furthermore, in Asia and the Middle East, many activities are performed while squatting, kneeling, or sitting cross-legged. These positions demand a greater range of motion than that typically required in Western populations. For example, authors report that to squat one requires 130° full hip flexion and 111°-165° (or full) knee flexion. To sit cross-legged one requires 90°-100° hip flexion and 111°-165° (or full) knee flexion [15].

Conventional total hip implants are constructed so that they will allow the patient to flex the thigh from 0 to 90 degrees against the trunk. Flexing the thigh beyond 90 degrees bring the neck of the femoral prosthesis against the rim of the cup. There is no strong joint capsule to keep the ball in place if impingement occur. This is why the patients, in the first weeks after THR, are urged not to bend the thigh beyond 90 degrees against the trunk.

However these restrictions, at least in theory, should not been imposed on those patients receiving THR with large diameters. As previously mentioned, such devices do allow an increased range of motion and thus patients receiving such implants should undergo different postoperative rehabilitation protocols.

In fact, if we want to keep all the benefits of the improved range of motion, we have to allow an early mobilization of the artificial joint. As we know the capsule around the hip is naturally quite thick and also the scar tissue which replaces the capsule after the operation it is very often strong. The result is that, once the soft tissues are healed, not always it is easy to be able to stretch them back. Conventional rehabilitation protocols require no flexion of the hip past 90° for the first 6 weeks and similarly no adduction of the leg past the midline of the body, no combined extension of the hip joint with external rotation and no flexion with internal rotation. These protocols were designed to avoid even the slightest risk of impingement and thus of dislocation. Indeed, such protocols, in most cases do not provide a very good range of motion. By the time the soft tissues are healed, approximately 6 weeks, most of the patients with total hip replacement have acquired only a partial range of motion which is, regrettably, likely to remain all of what they will, get by their new joint. It is obvious that, if the surgeon want to maintain the increased expectations of large diameter THR, should significantly modify his postoperative protocols.

In our practise we have instructed our physiotherapists to have a different approach when they treat a large diameter THR. In particular early flexion above 90° is started from the 2nd week and continued for the first 6 weeks always with the operated leg in external rotation and minimum 10° of abduction. Complete abduction, adduction and internal rotation it is similarly allowed from the 2nd week, but only with the leg in full extension. Internal rotation associated with hip flexion it is never forced at more than 70° of flexion and, anyway, never before the 6th week.

This "aggressive" course of physiotherapy have resulted in a significantly better range of motion for our patients with large diameter THR. Obviously, we would never trust the application of such early mobilization protocol after hip resurfacing where there is already an increased risk of femoral neck fracture [13].

Conclusion

A larger femoral head with a last generation ceramic on ceramic or metal on metal coupling is an useful recent introduction in THR. Most of the clinical advantages reported with the use of hip resurfacing (increased stability, improved ROM and lower dislocation rate) can be reproduced with large diameter joints and a conventional femoral implant. Some concerns still remains on the potential ions release by metal on metal in the long term.

At the present time, not all patients in our practise receive large diameter THR. Restriction of the use of these devices is mostly influenced by the high cost of these components. It is possible that, in the future, large diameter, either metal on metal or ceramic on ceramic, will completely replace the conventional 28mm THR.

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