

Conventional total hip replacement vs. resurfacing total hip replacement: what's best for my patient

K. DE SMET, A. CALISTRI

*Orthopedic Department, ANCA Medical Centre
Ghent, Belgium*

Hip resurfacing arthroplasty has increased in popularity as a viable treatment option for young, active patients with osteoarthritis that find in this procedure the real option to return to their old habits of life. Early literature show that resurfacing hip arthroplasty patients had kinematics and kinetics (abduction moments, extension moments, and walking velocities) that approached normal values for patients without hip osteoarthritis. Many of the technical problems that affected resurfacing implants have been identified and resolved with improved engineering and manufacturing techniques. At the present time, failure for THA for all diagnoses in patients younger than fifty years old, as reported by the Swedish Arthroplasty Registry, was associated with a ten-year survival rate of 85%. In contrast HRA failure for any reason is rare and the ten-year survival rate from the best cohort were 95.5%-96.1%. We do agree hip resurfacing arthroplasty only finds its place in high volume centres and experienced surgeons. We need further clarification by well planned prospective studies and evaluation of longer-term outcomes.

Key words: Arthroplasty, replacement, hip - Osteoarthritis - Recovery of function.

Metal on metal hip resurfacing arthroplasty (HRA) has gained popularity as a viable treatment option for young, active

patients with osteoarthritis of the hip, and high functional expectations. This procedure is more technically demanding than routine total hip replacement arthroplasty (THA), particularly for surgeons new to the procedure; only high volume hip surgeons who received training specifically in this technique should perform it. The learning curve is known to be longer than in other hip procedures, it is expected to be more than 50 surgeries.¹ The correct placement of both the acetabular and femoral components is critical for the optimal functioning of the metal-on-metal bearing. The controversy regarding the superiority of either resurfacing arthroplasty or conventional THA remains unsolved. There are several purported advantages of resurfacing over standard THA: Resurfacing is bone conserving on the femoral side, has lower dislocation rates, produces a more normal gait pattern, a quicker recovery and shorter hospital stay, increased activity levels and easier revision. It is interesting and important for the orthopaedic surgeon to know how and why to make the decision to choose the procedure for their patients between total hip arthroplasty and hip resurfacing arthroplasty.

Corresponding author: K. De Smet, Hipcentre, Jan Palfijn Hospital, Henri Dunantlaan 5, B-9000 Ghent, Belgium. E-mail: koen.desmet@skynet.be

Materials and methods

The authors systematically reviewed the literature found on the Medline and EMBASE bibliographic databases that were related to hip resurfacing and the comparison between THA and HRA. The search parameters used to identify relevant articles were "hip resurfacing and surface replacement" and "total hip replacement" and "total hip arthroplasty". Bibliographies of review articles were then analyzed for any additional relevant studies. We specifically analyzed articles that compared resurfacing to standard THA. We also looked for articles that described difference of these devices.

Results

There are limitations to the present analysis that include the level of evidence of the studies reviewed, as there were few randomized, prospective trials. We identified the items that had more controversies in the early literature and we try to discuss these by comparing data from the best articles and our from experience. We found controversies in bone removal with the two procedures, what to do in case of revision, range of motion, wear properties and consequent reactions, stress shielding and dislocation rate. The higher activity level in HRA remains today a "hot topic" but any difference between HRA and THA must consider if the THA has a 28 mm articulations or larger head size.

Bone removal between HRA and THA has been discussed in a lot of papers from, in vivo as well as in cadavers² and sawbones. Bone removal is always more conservative on the femoral side, and now with new instruments, a better understanding and low profile designs, also the resurfacing acetabular procedure can be even more conservative than in THA.

It is also well established in all papers about HRA and THA that the majority of patients are male in HRA (70%), female in total hip (70%).³ In general the cup size in females is about 6 to 8 mm smaller than the size in male patients, which supports our

point that there is not a difference between the two procedures. Vendittoli in a prospective, randomized study compared conservation of acetabular bone after THA and HRA of the hip.⁴ The results suggested that removal of bone on the acetabular side in HRA was comparable with that of THA, the mean or median diameters of the last reamer used or the mean size of the acetabular component (54.90 mm, range 44 to 64) for resurfacing arthroplasty and 54.74 mm (48 to 62) for THR, $P=0.770$. The same results were also seen in other studies.⁵ Moonot showed that hip resurfacing acetabular components were 2.03 mm less than that of the acetabular components in the uncemented total hip replacements ($P<0.0001$).⁶ We will not deny that an excessively large cup is never done in resurfacing, but this is seen as a mistake in the resurfacing technique as is also the high abduction angle in cup position. In revision of HRA it was reported that revision of HRA might be performed successfully with a minimal increase in bone loss.^{7,8} In our study based on revisions of 42 HRAs we show that the average increase in cup diameter after revision is only 1.4 mm in the hips that needed cup exchange.⁹

The discussion about better range of motion in THA than HRA, is not so simple and depends mainly on the head neck ratio we can find as well in THA where the head diameter is the most important, in HRA where the head neck ratio is important, as is also the surgical technique. If a resurfacing is well done with the correct head size, all osteophytes are removed, and a correct removal of the bump on the neck or conflicting bone, the same ROM as a normal hip should be achieved. In some clinical studies greater improvements in hip extension and abduction moment were found in HRA, indicating typical loading of the hip, compared to THA. Shrader in his pilot study showed that the HRA group achieved greater hip extension through the movement cycle compared to the THA group, which maintained reduced ($P=0.01$) hip extension angle.¹⁰ We cannot say that impingement problems and reduction of ROM never occur in HRA, but this problem does not have a high incidence/prevalence.

A variety of other complications related to HRA can be found in the literature, including metallosis, raised metal ion levels, aseptic lymphocytic vasculitis associated lesions (ALVAL), pseudotumors, clicking, squeaking, and nerve palsy.^{11, 12} Mabilieu in his overview of the literature on biological responses to metal-on-metal HRA found an increasing number of case reports on periprosthetic soft-tissue masses and osteolysis as a response to elevated metal ion levels.¹³ The increased concentration of metal particles in the joint space of HRA could lead to a T lymphocyte-mediated hypersensitivity reaction (Type IV). The authors express their concerns about the risks of long-term exposure to metal ions. An increased risk of developing lymphoma in patients with chronic inflammatory disease who undergo metal-on-metal arthroplasty has recently been considered.¹⁴ The same issues can be found with metal-on-metal total hips, especially in the current era of large diameter jumbo heads. Those are rare metal-on-metal problems, not simply HRA problems.

Varus placement of the femoral component leads to higher levels of stress on the femoral neck and increases the probability of failure.¹⁵⁻¹⁷ Cup anteversion greater than 25% or cup abduction less than 45% can result in impingement and increased wear.¹⁸ The safe zone for cup and head positioning is smaller in HRA than in THA, and deviations are less forgiving. This is a big diameter MoM problem — there is clear evidence that component design is an important determinant of component wear when the implant is malpositioned, so not all HRA's will suffer from this problem to the same extent. Langton *et al* have emphasized that the importance of the location of the articular contact patch in the standing position of the patient is crucial in the development of high wear states. The closer this patch lies to the rim of the acetabular component, the greater the chance of increased blood metal ion levels.¹⁹

Stress Shielding does occur to some extent in all hip replacements but the degree and clinical consequences are highly variable according to confounding factors including initial bone stock, vascularity, fixation and

biomechanical integrity of the construct. Analysis of long-term retrieved specimens (up to 23 years) shows that this is not inevitable or clinically consequential in many well performed HRAs. Indeed, these long term specimen often show remarkable remodelling and adaptation, even in female patients.²⁰

Lower Dislocation Rates; in comparison to standard THA, dislocation is a rare complication after hip resurfacing. With conventional arthroplasties, the dislocation rate ranges from 2% to 5%.²¹ In the international literature, the dislocation rate with resurfacing has been 0.21%.²² The senior author (De Smet) had a total of 5 dislocations in the first 900 cases, only 2 normal early dislocations for technical reasons. There were no subsequent dislocations in the following 2300 cases.

Conclusions

Metal-on-metal hip resurfacing has recently been advocated as an alternative to modern uncemented diaphyseal total hip components in young patients. At the present time, failure for THA for all diagnoses in patients younger than 50 years of age, as reported by the Swedish Arthroplasty Registry, was associated with a ten-year survival rate of 85%.²³ In contrast HRA failure for any reason is rare and the ten-year survival rate from the best cohort were 95.5-96.1%. More interestingly still, if we are going to evaluate the survival rate in males with osteoarthritis younger than 55 years old, the Kaplan-Meier survivorship curves show a survivorship rate of 99.4%.^{20, 24}

The reasons could lie with the bigger size of the prosthesis *i.e.* increasing femoral head diameters to improve fluid-film thickness and to reduce frictional forces on the articulating surfaces and thus reduce wear. Larger acetabular components also may resist deformation and thereby maintain clearance and prevent jamming and wear.^{24, 25}

We do agree hip resurfacing arthroplasty only finds its place in high volume centres and experienced surgeons. We need further clarification by well-planned prospective studies and evaluation of longer-term outcomes

, however, right now for a young patient, total hip arthroplasty is merely the beginning of treatment.²⁶

Riassunto

Protesi totale di anca convenzionale vs. protesi totale di anca di superficie: che cosa è meglio per il paziente

L'artroplastica di anca di superficie è sempre più popolare essendo una valida opzione di trattamento nei pazienti giovani, attivi affetti da osteoartrite, che grazie a questa procedura possono realmente tornare alle proprie abitudini di vita. I dati pubblicati finora in Letteratura dimostrano che i pazienti sottoposti ad artroplastica di anca di superficie presentano parametri di cinematica e di cinetica (momenti di abduzione, momenti di estensione, e velocità di cammino) che sono molto simili ai normali valori nei pazienti non affetti da osteoartrite. Numerosi problemi tecnici che riguardano gli impianti di superficie sono stati dapprima identificati, quindi risolti con migliorate tecniche di ingegneria e di fabbricazione. Al momento attuale, l'insuccesso della THA per tutte le diagnosi in pazienti di età inferiore a cinquanta anni, come riportato dallo Swedish Arthroplasty Registry, era associato con un tasso di sopravvivenza a dieci anni dello 85%. Al contrario, l'insuccesso della HRA per qualsiasi ragione è raro e il tasso di sopravvivenza a dieci anni nelle migliori serie era del 95,5%-96,1%. Secondo la nostra opinione, l'artroplastica di anca di superficie trova il suo spazio di applicazione soltanto in centri ad alto volume e con chirurghi esperti. Ulteriori studi prospettici e la valutazione dei risultati a più lungo termine sono necessari per chiarire ulteriormente il ruolo.

Parole chiave: Artroplastica d'anca - Osteoartrite - Recupero delle funzioni.

References

1. Australian Orthopaedic Association, National Joint Replacement Registry, Annual Report 2008 [Internet]. Available from www.aoa.org.au/jointregistry_pub.asp [cited 2010 Mar 1].
2. Su EP, Sheehan M, Su SL. Comparison of bone removed during total hip arthroplasty with a resurfacing or conventional femoral component: a cadaveric study. *J Arthroplasty* 2010;25:325-9.
3. Buergi M L, Walter W L. Hip resurfacing arthroplasty: the Australian experience. *J Arthroplasty (Suppl 3)* 2007;22:61-5.
4. Vendittoli PA, Lavigne M, Girard J, Roy AG. A randomised study comparing resection of acetabular bone at resurfacing and total hip replacement. *J Bone Joint Surg (Br)* 2006;88:997-1002.
5. Naal FD, Kain MS, Hersche O, Munzinger U, Leunig M. Does hip resurfacing require larger acetabular cups than conventional THA? *Clin Orthop* 2009;(467):923-8.
6. Moonot P, Singh P J, Cronin M D, Kalairajah Y E, Kavanagh T C, Field R E. Birmingham hip resurfacing: is acetabular bone conserved? *J Bone Joint Surg (Br)* 2008;90:319-23.
7. Ball S T, Le Duff M J, Amstutz H C. Early results of conversion of a failed femoral component in hip resurfacing arthroplasty. *J Bone Joint Surg (Am)* 2007;89:735.
8. McGrath MS, Marker DR, Seyler TM, Ulrich SD, Mont MA. Revision of surface replacement is comparable to primary total hip arthroplasty. *Clin Orthop* 2009;(467):94-100.
9. De Haan R, Campbell PA, Su EP, De Smet KA. Revision of metal-on-metal resurfacing arthroplasty of the hip: the influence of malpositioning of the components. *J Bone Joint Surg (Br)* 2008;90:1158-63.
10. Shuder MW, Bhowmik-Stoker M, Jacofsky MC, Jacofsky DJ. Gait and stair function in total and resurfacing hip arthroplasty: A pilot study. *Clin Orthop* 2009;1476-84.
11. Back DL, Young DA, Shimmitt AJ. How do serum cobalt and chromium levels change after metal-on-metal hip resurfacing? *Clin Orthop* 2005;177-81.
12. Lachiswicz PF. Metal-on-metal hip resurfacing: a skeptic's view. *Clin Orthop* 2007;86.
13. Mabileau C, Kwon YM, Pandit H, Murray DW, Sabokbar A. Metal-on-metal hip resurfacing arthroplasty: a review of periprosthetic biological reactions. *Acta Orthop* 2008;79:734-47.
14. Lidgren L. Chronic inflammation, joint replacement and malignant lymphoma. *J Bone Joint Surg (Br)* 2008;90:7-10.
15. Beaulé P E, Poitras P. Femoral component sizing and positioning in hip resurfacing arthroplasty. *Instr Course Lect* 2007;56:163-9.
16. Radcliffe IA, Taylor M. Investigation into the effect of varus-valgus orientation on load transfer in the resurfaced femoral head: a multi-femur finite element analysis. *Clin Biomech (Bristol, Avon)* 2007;22:780-6.
17. Lazarinis S, Milbrink J, Hailer NP. Avascular necrosis and subsequent femoral neck fracture 3.5 years after hip resurfacing: a highly unusual late complication in the absence of risk factors—a case report. *Acta Orthop* 2008; 79:763-8.
18. Langton DJ, Jameson SS, Joyce TJ, Webb J, Nargol AV. The effect of component size and orientation on the concentrations of metal ions after resurfacing arthroplasty of the hip. *J Bone Joint Surg Br* 2008;90:1143-51.
19. Langton DJ, Sprowson AP, Joyce TJ, Reed M, Carluke I, Partington P *et al*. Blood metal ion concentrations post hip resurfacing arthroplasty: a comparison of the Articular Surface Replacement and Birmingham Hip Resurfacing devices. *J Bone Joint Surg [Br]* 2009;91-B:1287-95.
20. McMin DJW, editor. Modern hip resurfacing. London: Springer; 2009.
21. Mont MA, Ragland PS, Etienne G, *et al*. Hip resurfacing arthroplasty. *J Am Acad Orthop Surg* 2006;14:454.
22. Lieske S, John M, Rimasch C, *et al*. Dislocation as a rare complication of resurfacing of the hip joint: case report and meta-analysis. *Unfallchirurg* 2008. details
23. Kärrholm J, Garellick G, Herberts P. Swedish Hip Arthroplasty Register annual report 2006. Gothenburg, Sweden: Sahlgrenska University Hospital; 2007.
24. McBryde CW, Theivendran K, Thomas AM, Treacy RB, Pynsent PB. The influence of head size and sex on the outcome of Birmingham hip resurfacing. *J Bone Joint Surg Am* 2010;92:105-12.
25. De Haan R, Pattyn C, Gill HS, Murray DW, Campbell PA, De Smet K. Correlation between inclination of the acetabular component and metal ion levels in metal-on-metal hip resurfacing replacement. *J Bone Joint Surg Br* 2008;90:1291-7.
26. Wroblewski BM, Siney PD, Fleming PA. Charnley low-frictional torque arthroplasty: follow-up for 30 to 40 years. *J Bone Joint Surg Br* 2009;91:447-50.