The trochanter slide osteotomy approach for resurfacing hip arthroplasty

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Abstract The aim of this prospective study was to assess the safety and efficacy of the greater trochanter slide osteotomy approach for resurfacing hip arthroplasty. Fifty consecutive hips (47 patients) with degenerative joint disease were enrolled in the study. Serial clinical and radiological assessments were performed after the index operation. At 1-year follow-up, the clinical outcome and patient satisfaction were rated excellent or good in all hips. The radiological assessment showed signs of satisfactory implant alignment. Periprosthetic fractures and non-unions of the greater trochanter were not observed. The greater trochanter slide osteotomy approach for resurfacing hip arthroplasty is a safe procedure and provides optimal exposure of the acetabulum and proximal femur, maintaining the soft-tissue integrity of the hip joint. Blood supply of the proximal femur is not violated using this approach.

Résumé Le but de cette étude est de mettre en évidence l'efficacité et la sécurité donnée par l'ostéotomie du grand trochanter lors de l'abord chirurgical de la hanche pour prothèse totale avec resurfaçage. 50 hanches consécutives chez 47 patients présentant des lésions dégénératives ont été incluses dans cette étude avec analyse clinique et radiologique. A un an post-opératoire, le devenir clinique des patients et la satisfaction sont excellentes/bonnes dans

toutes les hanches. L'analyse radiologique montre que les implants sont bien alignés. Nous n'avons pas observé de fracture ni de pseudarthrose du grand trochanter, l'abord par trochantérotomie, lors du resurfaçage de la hanche est une technique sûre qui permet une bonne exposition du cotyle et aussi une bonne conservation des tissus mous au niveau de la hanche. Cette technique n'entraîne pas de perte sanguine plus importante.

Introduction

The fracture of the femoral neck is the main cause of the early failure of current resurfacing hip arthroplasty (RHA) procedures, with a reported incidence of up to 2% [1, 15]. The aetiology of a fracture is likely to be multifactorial, but avascular necrosis (AVN) of the femoral head has been implicated [13]. AVN can also lead to the late failure of implant fixation. More than two decades ago, pioneers of RHA highlighted the vital role of maintaining the medial femoral circumflex artery [1, 9, 18]. Currently, the extended posterior approach is commonly used for RHA; nevertheless, this approach leads to significant interruption of the blood supply to the femoral head [17]. The antero-lateral approach appears to produce less disruption to the blood flow in the femoral head-neck junction than the posterior approach for patients undergoing RHA [18]; however, damage of the superior gluteal nerve and artery is likely [14]. Recent anatomical dissections and clinical experience with the trochanter slide osteotomy, also known as the digastric trochanteric osteotomy, demonstrated that it is possible to perform surgical dislocation and intracapsular hip joint procedures, including RHA, without causing osteonecrosis and neurovascular damage. This may be reflected, subsequently, in a lower incidence of fracture of

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the femoral neck and AVN. However, there is a paucity of clinical data to substantiate this assumption. The objective of this prospective study was to assess the safety and efficacy of the greater trochanter slide osteotomy approach in RHA.

Material and methods

Fifty consecutive hips (47 patients) with degenerative joint disease and without significant deformity of the proximal femur were enrolled in this study. The criteria for exclusion were age less than 18 years and more than 60 years, refusal to consent, pregnancy, metabolic bone disease and poor bone quality. The average age of the patients at the index operation was 40 years (range, 29–60 years). There were 40 men and 7 women. All patients were operated on by one surgeon. The greater trochanter slide osteotomy approach was performed in the lateral decubitus position. The gluteus maximus muscle was split in line with the fibres, in the direction of a line extending from the tip of the trochanter to the palpable posterior superior iliac spine. Attention was given to prevent muscle fibre dissection extending more than 7 cm proximal to the trochanter in order to avoid the risk of damage of the inferior gluteal nerve and artery. The greater trochanter was osteotomised using a posterolateral transtrochanteric approach, as described by the original designer [6, 7]. Anterior dislocation of the joint was performed after detachment of the gluteus minimus, preserving the piriformis and triceps coxae muscles. All hips received the same resurfacing hip replacement (ASR; DePuy International, Leeds, UK) and the same bone cement for the fixation of the femoral component (Cemex Genta Fast, Tecres, Verona, Italy). After relocation of the joint, the anterior capsule was closed and the tendon of the gluteus minimus was reattached to the femur. Stable

osteosynthesis of the greater trochanter osteotomy was achieved with two 3.5-mm cortical lag screws (Figs. 1, 2, 3). An image intensifier was used to confirm anatomical fixation of the greater trochanter fragment and adequate positioning of the 3.5-mm lag screws. Postoperatively, patients commenced partial weight-bearing (20/30 kg) for 6 weeks and full weight-bearing thereafter. During the first six postoperative weeks, the patients were instructed to ride a bike in the gymnasium and swim on a regular basis. They were allowed to drive a car 2 weeks after the surgical procedure. The clinical outcome was assessed using the Harris Hip Score (HHS) and the Oxford Hip Score (OHS). Serial antero-posterior and lateral-view radiographs were taken postoperatively, one week, 6 months and 12 months after the index operation. Preoperative radiological bone quality according to the classification of Dorr et al. [5] was rated A in all hips. The presence and extent of periarticular ossifications were assessed using the classification of Brooker et al. [3]. Implant stability was assessed using published criteria [10, 15].

Results

Forty-eight hips (45 patients) were clinically and radiologically assessed at 1-year follow-up. Two patients were excluded from the study (one patient moved overseas and one patient did not attend the 1-year follow-up). There were no complications requiring revision surgery. The mean preoperative HHS was rated 38 points (range, 29–70 points) and at 1-year follow-up, it was rated 96 points (range, 87–100 points). The mean preoperative OHS was rated 42 points (range, 35–58 points) and at 1-year follow-up, it was rated 14 points (range, 16–12 points). All patients were able to walk without limping at follow-up. No patient reported groin or thigh pain requiring analgesics, and no patient reported squeaking or any other noise from the hip

Fig. 1 Preoperative antero-posterior and lateral view radiographs of the right hip of a 39-year-old patient show advanced degenerative changes without anatomical deformity

Fig. 2 Postoperative antero-posterior radiograph of the right hip showing satisfactory alignment of the resurfacing hip arthroplasty and anatomical fixation of the greater trochanter with two 3.5mm screws

joint. The radiological assessment showed stable fixation of the cups and femoral components, and there were signs of osteointegration in all of the uncemented cups. There was no evidence of any radiolucent lines, osteolytic lesions or change of implant position at follow-up. Anatomical primary healing of the greater trochanter osteotomy was observed in all hips at 6-weeks postoperative follow-up. Small (less than 5-mm) bony spurs along the insertion of the gluteus medius and vastus lateralis were observed in two hips. No periarticular ossifications were observed in this cohort of hips.

Discussion

The aim of this prospective study was to determine the safety and efficacy of the greater trochanter slide osteotomy

approach in RHA. The main limitation of this study is the relatively small sample size of the patient population. The learning curve of the surgeon is included in this series; however, the surgeon used the trochanter slide osteotomy approach in more than 50 hips requiring intra-capsular joint-preserving surgery before embarking in RHA. The clinical outcome of RHAs using the trochanter slide osteotomy approach was not directly compared with the outcome of RHAs performed using a different surgical approach.

Lindgren and Svenson [12] first described a surgical approach on the hip joint maintaining the continuity between the gluteus medius, the greater trochanter and the vastus lateralis muscle, thereby, preventing the risk of proximal displacement of the trochanter. The procedure offered the advantages of effortless exposure and a high rate of bony union. The authors used this approach in 189 surgical procedures and they observed only four cases of non-union of the trochanter. They suggested using this approach in difficult cases requiring generous exposure. In 1991, Courpied et al. [4] described a new trans-trochanteric approach used for total hip arthroplasty. A two-slope trochanteric osteotomy was performed through a postero-lateral approach. The insertion of the piriformis was included in the trochanteric bone fragment attached to the gluteus and vastus lateralis. The trochanter with the three muscles was displaced anteriorly. The inclusion of the piriformis in the trochanter fragment requires surgical preparation of the soft tissues close to the deep branch of the medial femoral circumflex artery, with the potential risk of compromising the blood supply of the femoral head. To date, this potential risk of vascular damage has not been investigated in clinical settings.

The pathophysiology of fractures of the femoral neck after RHA is not well understood, and is probably multifactorial, including malalignment of the implant and neck notching [15]. A histopathological analysis of retrieved femoral heads/necks from metal-on-metal RHA in which a femoral neck fracture had occurred showed that there was a high incidence of established AVN [13]. Since

Fig. 3 One-year follow-up antero-posterior and cross-table radiographs of the right hip showing unchanged position of the implant and anatomical healing of the greater trochanter osteotomy

AVN was not the original preoperative diagnosis in these cases, it was concluded that disruption to the blood supply of the femoral head and neck had occurred during the extended posterior approach used for the surgical procedure. A substantial reduction of oxygenation in the femoral head was found during the RHA procedure using an extended posterior approach [16, 17]. This finding was considered to be related to damage to the medial femoral circumflex artery during the division of the short external rotators. The antero-lateral approach provides adequate exposure for hip resurfacing, while leaving the short external rotators intact [12]. However, surgeons should be aware of the risk of damage of the superior gluteal artery. In addition, some authors report that the antero-lateral approach adversely affects abductor function [8].

Postoperative complications of RHA may be reduced by adopting surgical approaches intended to preserve the blood supply and avoid muscle damage. This study shows that the trochanter slide osteotomy approach is a suitable alternative to the posterior and antero-lateral approaches for RHA. The clinical outcome and patient subjective outcome are satisfactory; surgical approach-related complications were not observed. The current literature substantiates these findings [2, 11].

In summary, the greater trochanter slide osteotomy approach is safe and useful in RHA. The blood supply of the proximal femur and periarticular nerve structures are not violated using this approach. The extent of soft-tissue exposure is minimal; the trochanter osteotomy also facilitates the correction of pre-existing deformities, such as femoral neck varus and pistol grip. The patient recovery is usually fast. However, the transtrochanteric approach requires partial weight-bearing until healing of the osteotomy. The author uses the greater trochanter slide osteotomy approach in all patients undergoing RHA. Nonetheless, the adoption of a different unfamiliar approach should be performed with caution, since RHA can be a challenging procedure.

References

1. Amstutz HC, Beaulé PE, Dorey FJ, Le Duff MJ, Campbell PA, Gruen TA (2004) Metal-on-metal hybrid surface arthroplasty: two to six-year follow-up study. *J Bone Joint Surg Am* 86:28–39
2. Beaulé PE, Harvey N, Zaragoza E, Le Duff MJ, Dorey FJ (2007) The femoral head/neck offset and hip resurfacing. *J Bone Joint Surg Br* 89:9–15
3. Brooker AF, Bowerman JW, Robinson RA, Riley LH Jr (1973) Ectopic ossification following total hip replacement. Incidence and a method of classification. *J Bone Joint Surg Am* 55:1629–1632
4. Courpied JP, Desportes G, Postel M (1991) A new trochanteric osteotomy method for a postero-lateral approach of the hip (330 operations with posterior transosseus and paramuscular curved approach. *Rev Chir Orthop Reparatrice Appar Mot* 77:506–512
5. Dorr LD, Faugere MC, Mackel AM, Gruen TA, Bognar B, Malluche HH (1993) Structural and cellular assessment of bone quality of proximal femur. *Bone* 14:231–242
6. Ganz R, Gill TJ, Gautier E, Ganz K, Krügel N, Berlemann U (2001) Surgical dislocation of the adult hip: a technique with full access to the femoral head and acetabulum without the risk of avascular necrosis. *J Bone Joint Surg Br* 83:1119–1124
7. Gautier E, Ganz K, Krügel N, Gill T, Ganz R (2000) Anatomy of the medial femoral circumflex artery and its surgical implications. *J Bone Joint Surg Br* 82:679–683
8. Gore DR, Murray MP, Sepic SB, Gardner GM (1982) Antero-lateral compared to posterior approach in total hip arthroplasty: differences in component positioning, hip strength, and hip motion. *Clin Orthop Relat Res* 165:180–187
9. Harty M (1982) Symposium on surface replacement arthroplasty of the hip. Anatomic considerations. *Orthop Clin North Am* 13:667–679
10. Johnston RC, Fitzgerald RH Jr, Harris WH, Poss R, Müller ME, Sledge CB (1990) Clinical and radiographic evaluation of total hip replacement. A standard system of terminology for reporting results. *J Bone Joint Surg Am* 72:161–168
11. Leunig M, Ganz R (2007) Vascularity of the femoral head after Birmingham hip resurfacing. A technetium Tc 99m bone scan/single photon emission computed tomography study. *J Arthroplasty* 22:784–785
12. Lindgren U, Svenson O (1988) A new transtrochanteric approach to the hip. *Int Orthop* 1:37–41
13. Little CP, Ruiz AL, Harding IJ, McLardy-Smith P, Gundle R, Murray DW, Athanasou NA (2005) Osteonecrosis in retrieved femoral heads after failed resurfacing arthroplasty of the hip. *J Bone Joint Surg Br* 87:320–323
14. Nork SE, Schär M, Pfander G, Beck M, Djonov V, Ganz R, Leunig M (2005) Anatomic considerations for the choice of surgical approach for hip resurfacing arthroplasty. *Orthop Clin North Am* 36:163–170
15. Shimmin AJ, Back D (2005) Femoral neck fractures following Birmingham hip resurfacing: a national review of 50 cases. *J Bone Joint Surg Br* 87:463–464
16. Steffen RT, Smith SR, Urban JP, McLardy-Smith P, Beard DJ, Gill HS, Murray DW (2005) The effect of hip resurfacing on oxygen concentration in the femoral head. *J Bone Joint Surg Br* 87:1468–1474
17. Steffen R, O'Rourke K, Gill HS, Murray DW (2007) The anterolateral approach leads to less disruption of the femoral head-neck blood supply than the posterior approach during hip resurfacing. *J Bone Joint Surg Br* 89:1293–1298
18. Stulberg SD (1982) Surgical approaches for the performance of surface replacement arthroplasties. *Orthop Clin North Am* 13:739–746