Outcome of hip resurfacing arthroplasty in patients with coxarthrosis secondary to Crowe's types I and II developmental hip dysplasia

Ahmad M. Metwally[a], Samir M. El-Ghandour[a], K.H.A. Wahab[b]

[a]Department of Orthopaedic, Faculty of Medicine, Suez-Canal University, Port-Said, Egypt, [b]Department of Orthopaedic, Good Hope Hospital, Birmingham, UK

Correspondence to Samir M. El-Ghandour, MD, Orthopaedic Department, Faculty of Medicine, Suez-Canal University, 1375 Port-Said, Egypt
Tel: +20 100 591 8560; fax: +20 643 210 111; e-mail: elghandour@hotmail.com

Received 02 November 2014
Accepted 20 September 2014

Egyptian Orthopedic Journal 2014, 49:286–291

Background

Arthritis secondary to developmental hip dysplasia is a surgical challenge because of the anatomic abnormalities, which increase the complexity of any hip arthroplasty. Hip resurfacing has many theoretical advantages compared with conventional hip arthroplasty, especially for young and active patients. These advantages include minimal bone resection, normal femoral loading, avoidance of stress shielding, maximum proprioceptive feedback, reduced risk of dislocation, easy revision, and reconstruction of normal anatomy.

Patients and methods

Twenty-six consecutive patients (33 hips) with osteoarthritis secondary to developmental dysplasia of the hip of Crowe types I and II underwent metal-on-metal hip resurfacing through a modified lateral approach of Hardinge, taking care to protect the medial femoral circumflex artery and its retinacular branches over the femoral neck. The average age of the patients at the time of surgery was 62.8 years (range 30–73 years). Five (19%) patients were men and 21 (81%) were women. The mean follow-up was 4.8 years, range 1.8–10.3 years.

Results

Four patients developed heterotrophic ossification, which required excision because of persistent pain in one patient. Three patients had painful trochanteric bursitis; all responded well to local steroid injections. The Harris hip score improved from a mean of 52.2–97.4. There were no major complications, for example, dislocation, fractured neck of femur, loosening, infection, or symptomatic deep venous thrombosis.

Conclusion

Despite safety warnings, hip resurfacing remains an effective option in certain subgroups of hip dysplasia when it is performed with special precautions.

Keywords:

hip arthroplasty, hip dysplasia, secondary osteoarthritis

Egypt Orthop J 49:286–291

1110-1148

Introduction

Total hip arthroplasty was described as the operation of the 20th century and it is the procedure of choice for most patients with symptomatic end-stage coxarthrosis secondary to hip dysplasia [1]. The procedure has a higher failure rate for patients with dysplasia than for the general population in both the short and the long term [2–4]. This is probably because of the anatomic abnormalities of hip dysplasia. These patients are relatively young and wish to remain active, jeopardizing the survival of any arthroplasty device. Multiple previous childhood operations may also compromise the outcome [5,6]. Consequently, surgeons try to avoid total hip replacement in younger patients and hip resurfacing can delay this process by adding an additional step before total hip replacement [7].

The concept of hip resurfacing was first applied clinically from the mid-1970s into the early 1980s by Freeman, Furuya, Wagner, and Amstutz [7]. The results were mostly disappointing and closer examination of the failure patterns showed that this was a failure of materials rather than a failure of concept. It was clear that polyethylene could not be used as the bearing material in hip resurfacing as the inevitable use of a large femoral head diameter in the resurfacing arthroplasty would lead to high friction forces and excess polyethylene wear debris, osteolysis, loosening, and collapse of femoral heads [8,9].

In 1990, McMinn began to develop a hip resurfacing technique based on metal-on-metal articulating surfaces. Because of past experience in general, the McMinn concept was slow to gain acceptance. However, after the first publications in 1996, other prosthesis manufacturers began to copy the concept. This observation has resulted in renewed interest in hip resurfacing [10,11] and short-to mid-term results of hip resurfacing using modern metal-on metal designs are encouraging [7,12].

Hip resurfacing is considered one of the bone-conserving prostheses that has several advantages over conventional prostheses. The 'feeling' for the joint and the reflexes (proprioception) are retained. The large femoral head diameter reduces the risk of postoperative dislocation and increases the range of motion. The 'natural' biomechanical load transfer between the pelvis and the femoral head and femur prevents change in bone structure or bone loss and increases bone density; the prosthesis preserves the proximal femoral bone stock so that optimal conditions exist when revision surgery is required [7,12].

These advantages should make hip resurfacing quite suitable for arthritic dysplastic hips, although it is not without its complications.

Femoral neck fracture is one of the most common complications of hip resurfacing (up to 2%) and it is main cause of early failure in the first 6 months. It is considered to be related to reduced blood flow as a consequence of the surgical approach or surgical dissection [13,14].

Another aspect of the operative technique during hip resurfacing is the orientation of the femoral component when preparing the femoral head, where excessive valgus positioning or poor surgical technique can result in notching of the femoral neck [13]. Although notching of the femoral neck is a cause of mechanical weakening and subsequent fracture of the femoral neck, it might also damage the retinacular vessels and impair the blood supply to the head of the femur, leading to osteonecrosis of the femoral head, which may cause femoral neck fracture or prosthetic loosening [15–17].

There is a debate on the role of the surgical approach on the blood supply of the femoral head. The posterior approach is the most commonly used approach for resurfacing, claimed to provide better access and better orientation to the head, but it was proved that it placed the blood supply of the femoral head in jeopardy by breaching the retinacular blood vessels [18,19]. The modified lateral approach of Hardinge [20] could be a good alternative to overcome this problem.

Crowe's classification [21] is widely accepted for categorization of the degree of hip dysplasia. The authors divided dysplastic hips radiographically into four categories on the basis of the extent of proximal migration of the femoral head.

The surgical planning of hip reconstruction in dysplastic hips should be based on each individual's anatomic abnormalities. The procedure is only advisable when the shape of the femoral head and the stability of the bone offer sufficient support for the prosthesis; thus, it is not suitable for individuals with or at risk of osteoporosis. Hip resurfacing requires more than 70% contact between the bone and metal socket, and thus is not always an option for patients with severe hip dysplasia, that is, Crowe's types III and IV [22,23].

Recent reports on the short-term outcome of metal-on-metal resurfacing arthroplasty of the hip have shown that surgical technique and patient selection can minimize short-term failures [5,7].

This study is based on the hypothesis that hip resurfacing arthroplasty using the modified lateral surgical approach of Hardinge [20] with protection of the medial femoral circumflex artery and the retinacular vessels of the femoral neck may be a suitable modality for the treatment of secondary coxarthrosis because of less severe degrees (Crowe's types I and II) of hip dysplasia.

Patients and methods

Twenty-six consecutive patients (33 hips) underwent Conserve Plus hip resurfacing arthroplasty for osteoarthritis secondary to hip dysplasia of Crowe's types I and II between June 2001 and April 2010. Surgery was performed by the same team of surgeon in both Good Hope Hospital, Birmingham, UK, and Suez-Canal University Hospital.

There were 21 women and five men; seven resurfacings were bilateral. The mean age of the patients at the time of surgery was 62.8 years (range 30–73 years). A standard anteroposterior view of the pelvis and both hips and lateral radiograph on the affected side were used for the assessment of the degree of dysplasia as well as the presence of other deformities and impinging osteophytes.

In Crowe type I, the acetabulum is normal or ovoid in the vertical plane, and the femur is almost normal. The bone quality is good. In Crowe type II, the acetabulum is shallow and oval, and the femur is deformed with a straight and narrow medullary canal.

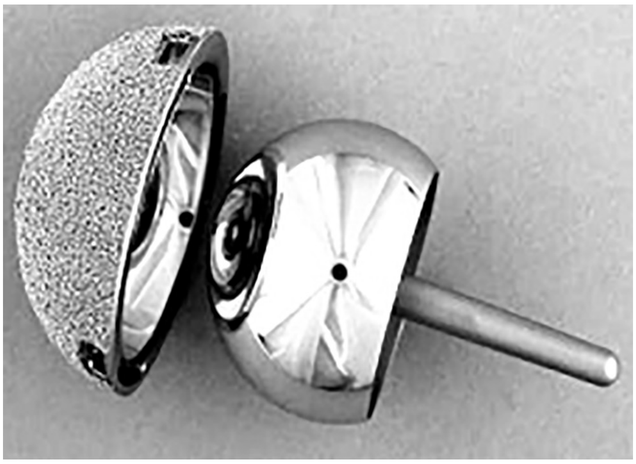
Twenty-eight patients were classified as Crowe type I and five patients as Crowe type II hip dysplasia.

Operative technique

The procedures were carried out under general or spinal anesthesia and with the patient in the lateral position using the modified lateral approach of Hardinge [20].

Standard instruments for the Conserve Plus hip resurfacing system (Wright Medical Division — Fig. 1) were used. The system is composed of a cementless

Figure 1



Wright Conserve Plus implants.

hydroxyapatite-coated acetabular component. The geometry of the socket includes a 170° coverage angle, and the edge of the socket is rounded slightly, which may prevent problems with impingement if the front edge of the socket is uncovered. The femoral component is designed for cemented fixation with a 1 mm cement mantle after head preparation. The components are precision-polished to fit each other with a small space for body fluid to lubricate.

During exposure, no dissection is carried out posterior to the piriformis muscle, to protect the medial femoral circumflex artery. After dislocation, the femoral head and acetabulum are prepared. Reaming of the femoral head carefully avoids excessive valgus positioning of the femoral component and meticulously respects the retinacular vessels and soft tissues on the femoral neck. Acetabular reaming is used to medialize the cavity to maximize coverage of the acetabular component, without breaching the quadrilateral plate. The cups are implanted in the standard press-fitted manner. No structural bone grafts were used to increase acetabular coverage. The valgus/varus deformity was corrected during preparation of the femoral head and neck. The neck-shaft angle was measured using a goniometer to achieve a target of 140 ± 5°.

Postoperative regimen

Perioperative antibiotic prophylaxis was prescribed for all patients. Daily low-molecular-weight heparin was administered for 4 weeks postoperatively to reduce the risk of thromboembolism. No radiation or indomethacin was used for the prevention of heterotopic ossification. Most patients were administered diclofenac for 48 h as part of their pain control regime.

Follow-up

Clinical follow-up

All patients were allowed to leave the bed on the second postoperative day and were allowed as much weight-bearing as tolerated, progressing to full weight-bearing as soon as the patient was comfortable enough. The range of motion was assessed clinically using a goniometer. Limb-length discrepancies were determined by measuring the length from the superior–anterior iliac spine to the medial malleolus with the patient in the supine position. The sum of range of motion (in all planes) by degrees was obtained. All reoperations for any reason were recorded and failure was defined as conversion to conventional total hip replacement for any reason.

Radiographic follow-up

Radiographs were taken postoperatively, and serially 1, 3, and 6 months after discharge, and then annually.

The femoral component and cup position were assessed using standard anteroposterior and 90° cross-table radiographs. Anteversion or retroversion of the femoral component was assessed by measuring the stem axis in relation to the femoral neck axis on the 90° cross-table radiographs.

All patients were followed for a minimum of 20 months (mean 4.8 years; range 1.8–10.3 years).

The Harris hip score (HHS) was used at the preoperative time and at the final assessment [24].

We considered these scores: 50–69, poor; 70–79, fair; 80–89, good; 90–100, excellent.

Results

On latest clinical follow-up, we found a significant improvement in the pain score (Table 1). We reported no patients with severe pain compared with 22 patients before surgery.

Range of hip movements improved significantly in all directions as shown in (Table 2). Flexion improved (P = 0.0004) from 95.7° (range 45–120°) preoperatively to 106.7° (range 90–130°) after surgery. The internal/external rotation arc improved (P = 1.45E–05) from 33.8° (range 0–80°) to 53.8° (range 25–75°). Abduction increased (P = 0.0002) from 32.0° (range 10–50°) to 39.2° (range 30–50°). Eight patients had limb-length discrepancies of 1 cm or less.

Activities of daily living improved significantly, where none of the patients reported restrictions. Also, the walking distance was improved (Table 3).

Four patients developed heterotrophic ossifications, and in one of them, surgical excision was required for persistent pain. Three patients had painful trochanteric bursitis; all responded well to local steroid injections.

There were no major complications, for example, dislocation, fractured femoral neck, loosening, infection, or symptomatic deep venous thrombosis. We had no failures and no patients needed conversion to conventional total hip replacement up to the latest follow-up.

All patients reported significant pain relief, an significant improvement in range of movements and functions on their operated hips. The overall HHS was good (80–89) in 10 patients and excellent (90–100) in 16 patients. The HHS improved from a mean of 52.2–97.4 (Table 4).

Discussion

It is now accepted that cemented total hip replacements can yield perfectly satisfactory results in elderly patients. Hip resurfacing arthroplasty has been an attractive alternative for younger and more active patients, with several theoretical advantages over other techniques [6]. Most important is the fact that the femoral neck is left intact. Notching of the femoral neck has been described as a cause of femoral neck fracture. Notching of the femoral neck during hip resurfacing is most likely to occur as the cylindrical reamer moves across the femoral head/neck junction, most commonly engaging the lateral aspect of the neck [15,16].

Table 1 Pain status of 26 patients both preoperatively and at the final follow-up visit

Follow-up	Pain			
	Severe	Moderate	Mild	No
Preoperative	22	4	0	0
Postoperative	0	1	3	22

Table 2 Results of range of motion of hip joints both preoperatively and at the final follow-up visit

Range of motion	Preoperative	Postoperative	*P*
Flexion	95.7° (45–120°)	106.7° (90–130°)	0.0004
Abduction	32.0° (10–50°)	39.2° (30–50°)	0.0002
External–internal rotation arc	33.8° (0–80°)	53.8° (25–75°)	1.45E−05

Table 3 Daily activity restriction and walking distance limitation both preoperatively and at the final follow-up visit

Follow-up	Daily activities restrictions			Walking distance limitations		
	No	Moderate	Severe	Mild or no	Moderate	Severe
Preoperative	0	23	3	0	16	10
Postoperative	26	0	0	21	5	0

Table 4 Significant improvement in Harris hip scoring

Harris hip scoring	Preoperative	Postoperative
Mean improvement	52.2	97.4

Damage to the retinacular vessels in this area may sufficiently impair the blood supply to the femoral head so as to increase the risk of an avascular event and lead to subsequent femoral failure by fracture or loosening [17].

The risk of fracture of the femoral neck after metal-on-metal hip resurfacing is recognized and is similar to that of dislocation after total hip replacement; its incidence of occurrence is about 2% [15,16].

In our study, we had no cases of fractured neck of the femur. We attribute this to the following:

(1) Careful reaming of the femoral head, avoiding notching of the lateral aspect of the femoral neck.
(2) Protection of soft tissues and retinacular vessels of the femoral neck.
(3) Protection of the medial femoral circumflex artery by avoiding surgical dissection posterior to the piriformis muscle.

Today, with the modern prosthesis design and the development of surgical techniques, cementless total hip replacement has been established as a treatment for mild developmental dysplasia of the hip (Crowe types I and II) [1,3]. Resurfacing hip arthroplasty has the advantage that it has an extra step before total hip replacement.

The literature reports that reaming up to the medial wall and superolateral structural bone grafting can increase the coverage and stability of the acetabular component [1]. In our study, there were five hips of Crowe type II; all five hips needed deepening by medial reaming to achieve good coverage of the acetabular cups, which was achieved without resort to structural bone grafting.

During hip resurfacing arthroplasty, excessive valgus positioning or improper surgical reaming of the femoral head can result in notching of the femoral neck. Although mechanical weakening and subsequent fracture of the femoral neck are well described, the potential damage to the retinacular vessels leading to an ischemic event is relatively unknown [13,15]. Beaulé *et al.* [16], in their vascular study, recommended that surgeons who perform resurfacing arthroplasty of the hip should pay careful attention to the retinacular vessels by avoiding excessive dissection around the femoral neck and/or notching.

In our study, we strongly emphasized three technical surgical steps: first, the proper preparation of the femoral head with avoidance of notching of the neck, second, surgical dissection should always be made anterior to the piriformis muscle, and finally, avoidance of any soft tissues pealing from around the femoral neck to reduce the risk of injury of the retinacular blood vessels.

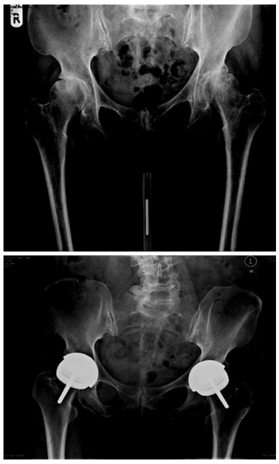
The patients in this study had Crowe's types I and II hip dysplasia with absence of severe deformities of the proximal femur on plain radiographs such as excessive anteversion, severe valgus or varus alignment, and severe head deformities. More severe types of hip dysplasia require reconstructive procedures for either acetabular or femoral components or both. In these severe cases, total hip arthroplasty is more appropriate [1,12,13].

In this series of patients with an average age of 62.8 years, HHS improved from a mean of 52.2–97.4. We had no major complications and no conversion to conventional total hip replacement at the mean follow-up of 4.8 years. Back *et al.* [25] reported improved HHS (from 63 to 98) and a 99% survivorship of Birmingham hip resurfacing at 3 years after surgery in patients with a mean age of 52 years. In a young group of patients (48 years), Daniel *et al.* [7] reported only one failure in 440 hips at a mean of 3.3 years after Birmingham hip resurfacing. Amstutz *et al.* [26] reported a revision rate of 3%, HHS of 94, in patients 48 years old after an average of 3.5 years after surgery. In the study of Naal *et al.* [26], the HHS improved to 97.3 and two of the 32 hip resurfacings had failed (6.3%). Amstutz *et al.* [27] showed 95.2% survivorship at 5 years (Fig. 2).

Conclusion

Hip resurfacing arthroplasty remains an effective option in mild subgroups of hip dysplasia (Crowe types I and II) when it is performed with special precautions through the modified Hardinge approach. The short-term results (up to a mean of 4.8 years) of the metal-on-metal hip resurfacing have been encouraging in the treatment of mild developmental dysplasia of the hip, with good range of motion recovery, improvement in HHS, and no major complications. Long term follow-up is required (Figs. 3 and 4).

Figure 2

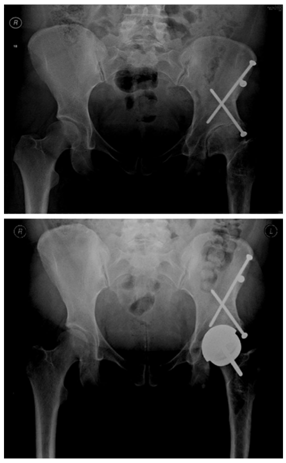


An example of bilateral hip resurfacing.

Figure 3

A 52-year-old male patient who had spastic paralytic dysplasia of the right hip joint. The patient underwent hip resurfacing, adductor tenotomy, and obturator neurotomy.

Figure 4



A female patient underwent open reduction and femoral osteotomy before the age of 1 year and underwent periacetabular osteotomy in her 20s before undergoing resurfacing in her 40s.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Sanchez-Sotelo J, Berry DJ, Trousdale RT, Cabanela ME. Surgical treatment of developmental dysplasia of the hip in adults: II. Arthroplasty options. J Am Acad Orthop Surg 2002; 10:334–344.

2 Kim WC, Grogan T, Amstutz HC, Dorey F. Survivorship comparison of THARIES and conventional hip arthroplasty in patients younger than 40 years old. Clin Orthop Relat Res 1987; 241:269–277.

3 Eskelinen A, Remes V, Helenius I, *et al.* Uncemented THR for primary osteoarthritis in young patients: a mid- to long term follow-up study from the Finnish Arthroplasty Register. Acta Orth 2006; 77:57–70.

4 Johnson SP, Sorenson HT, Lucht U, Soballe K, Ovegarerd S, Pederson AB. Patient-related predictors of implant failure after primary total hip replacement in the initial, short- and long-terms: a nationwide Danish follow-up study including 36 984 patients. J Bone Joint Surg 2006; 88-B:1303–1308.

5 Beaulé PE, Dorey FJ, LeDuff MJ, Gruen T, Amstutz HC. Risk factors affecting outcome of metal on metal surface arthroplasty of the hip. Clin Orthop Relat Res 2004; 418:87–93.

6 Sochart DH, Porter ML. The long-term results of Charnley low-friction arthroplasty in young patients who have congenital dislocation, degenerative osteoarthritis, or rheumatoid arthritis. J Bone Joint Surg 1997; 79-A:1599–1617.

7 Daniel J, Pynsent PB, McMinn DJW. Metal-on-metal resurfacing of the hip in patients under the age of 55 years with osteoarthritis. J Bone Joint Surg 2004; 86-B:177–184.

8 Head WC. Wagner surface replacement arthroplasty of the hip: analysis of fourteen failures in forty-one hips. J Bone Joint Surg 1981; 63-A:420–427.

9 Bell RS, Schatzker J, Fornasier VL, Goodman SB. A study of implant failure in the Wagner resurfacing arthroplasty. J Bone Joint Surg 1985; 67-A:1165–1175.

10 Amstutz HC, Grigoris P. Metal-on-metal bearings in hip arthroplasty. Clin Orthop Relat Res 1996; 329S:S11–S34.

11 McMinn DJW, Treacy RBC, Lin K, *et al.* Metal-on-metal surface replacement of the hip: experience with the McMinn prosthesis. Clin Orthop Relat Res 2000; 329S:S89–S98.

12 Pollard TC, Baker RP, Eastaugh-Waring SJ, Bannister GC. Treatment of the young active patient with osteoarthritis of the hip. A five to seven year comparison of hybrid total hip arthroplasty and metal-on-metal resurfacing. J Bone Joint Surg 2006; 88-B:592–600.

13 Markolf KL, Amstutz HC. Mechanical strength of the femur following resurfacing and conventional total hip replacement procedures. Clin Orthop Relat Res 1980; 147:170–180.

14 Jolley MN, Salvati EA, Brown GC. Early results and complications of surface replacement of the hip. J Bone Joint Surg 1982; 64-A:366–377.

15 Shimmin AJ, Black D. Femoral neck fractures following Birmingham hip resurfacing: a national review of 50 cases. J Bone Joint Surg 2005; 87-B: 463–464.

16 Amstutz HC, Le Duff MJ, Campbell PA. Fracture of the neck of the femur after surface arthroplasty of the hip. J Bone Joint Surg 2004; 86-A:1874–1877.

17 Beaulé PE, Campbell PA, Hoke R, Dorey F. Notching of the femoral neck during resurfacing arthroplasty of the hip: a vascular study. J Bone Joint Surg Br 2006; 88-B:35–39.

18 Steffen R, O'Rourke K, Gill HS, Murray DW. 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 2007; 89-B:1293–1298.

19 Steffen RT, Fern D, Norton M, Murray DW, Gill HS. Femoral oxygenation during hip resurfacing through the trochanteric flip approach. Clin Orthop Relat Res 2008; 467:934–939.

20 Frndak PA, Mallory TH, Lombard AV. Translateral surgical approach to the hip. The abductor muscle 'split'. Clin Orthop Relat Res 1993; 295:135–141.

21 Crowe JF, Mani VJ, Ranawat CS. Total hip replacement in congenital dislocation and dysplasia of the hip. J Bone Joint Surg 1979; 61-A:15–23.

22 Shimmin AJ, Bare J, Back DLThe Melbourne Orthopaedic Group. Complications associated with hip resurfacing arthroplasty. Orthop Clin North Am 2005; 36:187–193.

23 Li J, Xu W, Xu L, Liang Z. Hip resurfacing for the treatment of developmental dysplasia of the hip. Orthopaedics 2008; 31:1199–1205.

24 Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg 1969; 51-A:737–755.

25 Back DL, Dalziel R, Young D, Shimmin A. Early results of primary Birmingham hip resurfacings: an independent prospective study of the first 230 hips. J Bone Joint Surg 2005; 87-B:324–329.

26 Naal FD, Schmidt M, Monsignor, U, Leaning, M, Hersche, O. Outcome of hip resurfacing arthroplasty in patients with developmental hip dysplasia. Clin Orthop Relat Res 2009; 467:1516–1521.

27 Amstutz HC, Beaulé PE, Dorey FJ, Le Duff MJ, Campbell PA, Gruen TA. Metal-on-metal hybrid surface arthroplasty: two to six-year follow-up study. J Bone Joint Surg 2004; 86-A:28–39.