Revision

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Outcome of hip resurfacing revision through the Hueter-anterior approach

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Abstract

Background: The Hueter-Anterior Approach (HAA) with its limited soft tissue and internervous dissection has been shown to be an effective approach for primary total hip and hip resurfacing arthroplasty (HRA). The purpose of this study is to evaluate the clinical outcome of patients requiring revision of HRA to total hip replacement using the HAA, assessing function and complications.

Methods: We performed a retrospective review of a prospectively maintained research database. Between 2006 and 2015, 555 primary metal-on-metal (MoM) HRAs were performed via the HAA; we identified 33 hips in 30 patients that required revisions for aseptic causes to THA: aseptic loosening of acetabulum in 12 and femoral in 7, 10 for pseudotumour/ALTR, 4 for femoral neck fracture. All revision surgeries were performed through a HAA by a single surgeon who had also performed the index operation. PROMs were collected preoperatively and yearly at various timepoints postoperatively.

Results: The mean age at time of revision was 48.9 years (±5.3 SD) for 22 males (67%) and 11 females (33%). The mean time to revision surgery/failure of hip resurfacing was 3.3 years (±2.4 SD). There were 5 major reoperations with 3 infections, 1 acetabular loosening and 1 trunnionosis. There were significant improvements in multiple PROMs.

Conclusions: The HAA is a viable surgical approach for revision of HRA with smaller initial HRA acetabular components generally requiring a relatively larger acetabular compoent at time of revision. Patients reported improvement in symptoms and function and a lower risk of subsequent reoperation than what has previously been reported for failed MoM bearings.

Keywords
Components, HRA, Hueter-anterior, THA, revision

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Introduction

Hip resurfacing arthroplasty (HRA) has emerged as a surgical treatment option for those younger active individuals with end-stage hip osteoarthritis (OA) to provide pain relief and allow for return to high-impact activities.[1–3] However, HRA has been associated with unique complications such as femoral neck fracture, shown to be possibly related to an intra-operative vascular injury.[4,5] The Hueter-anterior approach (HAA) with its limited soft tissue and internervous dissection has been shown to be a reasonable alternative to more extensile approaches when performed for HRA.[6] In addition, anterior approaches have been advocated by some authors for advantages in revision total hip arthroplasty (THA) in addition to provide faster recovery and less postoperative pain.[6–9]

Registry data suggest an increasing number of primary and revision arthroplasties being performed in younger

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patients.[10] Although ease of revision is one of the proposed advantages of hip resurfacing, clinical studies of revised HRA have shown variable outcomes tied with the indication for revision.[11,12] More importantly, the Australian Joint Registry found that the re-revision rate for HRA was as high as 26% with no difference in surface bearing type used at the time of revision surgery. Thus, further research to determine patients' characteristics and surgical techniques that may affect the outcome of these revision surgeries would be beneficial.

The primary purposes of this study were to report the clinical outcome of patients requiring revision of HRA done through the HAA. We also sought to assess patient-reported outcome measures (PROMs) evolution pre- and post-surgically as secondary objectives.

Material and methods

Patients and demographics

Institutional Review Board approval was obtained for the present study. We performed a retrospective review of a prospectively maintained research database. Primary surgeries and revision surgeries of HRA done by a single surgeon (PB) between 2006 and 2015 were extracted. 555 primary metal-on-metal (MoM) HRAs were performed via the HAA during that period.[13] We identified 36 hips in 33 patients that required revisions to THA through an HAA approach which were then subsequently performed from 2010 to 2019 by the same surgeon. 3 of the hip resurfacings were revised for infection and were excluded from the study, leaving us with 30 patients and 33 hips. The mean time to revision surgery/failure of hip resurfacing was 3.3 ± 2.4 years (0.1–9.7 years). 19 patients required initial revision surgery for aseptic loosening with 12 (37%) acetabular and 7 (21%) femoral. Other indications for revision surgery included 10 patients (30%) for pseudotumour/adverse local tissue reaction (ALTR) and 4 (12%) for femoral neck fracture. All but 2 initial HRA were performed with the Microport Conserve Plus system (Conserve total resurfacing hip system, Microport, Arington, TN, USA). The other 2 were Cormet resurfacing system (Cormet 2000, Corin, Cirencester, UK). There were 22 males (67%) and 11 females (33%) involved. The mean age at time of revision was 48.9 years ($\pm$5.3 standard deviation [SD]). The average body mass index (BMI) was 27.2 ($\pm$4.9, 20–38) kg/m^2. 19 revisions were performed on the right side and 14 on the left side. 3 females had bilateral revisions (Table 1). Initial cup inclination on radiographic evaluation for this cohort was 39.9 ± 8 (25–55).[14]

29 (88%) patients had both components revised, receiving a ceramic-on-polyethylene (CoP) bearing at the time of revision surgery. The remaining 4 patients (12%) had a conversion to a large head MoM bearing surface. All patients received a cementless femoral component. Components used during initial THA conversion surgery are listed in Table 2. Five patients required revision post total arthroplasty conversion (Table 3).

Table 1. Bilateral initial revisions characteristics.

Case	Gender	Age	Time to revision (years)	Cause of revision
1	Female	46	2.2	Femoral loosening
		49	4.3	Acetabular loosening
2	Female	46	3.5	Acetabular loosening
		47	7.6	Acetabular loosening
3	Female	45	4.2	MoM debris reaction
		45	4.4	MoM debris reaction

MoM, metal-on-metal.

Patient-reported outcome measures

PROMs included disease-specific scores such as the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the Hip disability Osteoarthritis Outcome Score (HOOS).[15,16] We also reported the 12-Item Short Form Survey (SF-12)[17] and the University of California Los Angeles Activity Score (UCLA).[18] These scores were completed preoperatively and at 2 years follow-up. PROMs were completed by 19 patients (58%) preoperatively and by 21 patients (64%) at the 2-year follow-up visit.

Statistical analysis

Wilcoxon non-parametric tests were used to analyse continuous data between group and chi-square tests were used to analyse categorical variables between groups. The Statistical Package for the Social Sciences (SPSS v.27, IBM, New York, USA) was used for all analysis in this study.

Results

At mean follow-up of 3.34 years ($\pm$2.4 SD), 5 patients (17%) required a reoperation (4 men and 1 female) with a mean time to re-revision of 1.54 years ($\pm$2.13 SD). There was no significant difference in average length of stay of their initial primary hip resurfacing (2.51) when compared to average length of stay for revision surgery (2.09) ($p = 0.197$). There was significantly more blood loss at the time of conversion to THA surgery (671 ml) compared to the initial resurfacing surgery (390.3 ml) ($p = 0.003$).

For 4 of the revisions, 2 femoral neck fractures and 2 femoral loosenings, the cup was not changed (initial resurfacing MoM cup retained). For the other 33 revised to CoP THA, the median revision cup size was 59 ± 3 mm

Table 2. Initial revision surgery components.

Femoral stem	Number	Acetabular Cup	Number
Zimmer Biomet Taperloc Complete Micro	17	Zimmer Biomet TM	11
Microport Pro-femur TL	13	MicroPort Dynasty Biofoam	10
Medacta AMIStem	2	Zimmer Biomet Regenerex TM Ringloc	5
Stryker Secur-Fit	1	Zimmer Biomet G7	1
		Stryker Trident PSL	1
		MicroPort Lineage	1
		Wright Conserve Plus	4
Total	33	**Total**	33

Table 3. Reoperation post-revision to total hip arthroplasty.

Case	Gender	Age at 1st revision	Time from 1st to 2nd revision	Indication initial revision	Indication second revision
1	Male	62 years	0.1 year	Acetabular loosening	Sepsis
2	Male	43 years	0.1 year	Pseudotumour/ALTR	Sepsis
3	Female	49 years	2 years	Acetabular loosening	Trunnionosis
4	Male	43 years	4.5 years	Acetabular loosening	Acetabular loosening
5	Male	55 years	0.1 year	Femoral neck fracture	Sepsis

ALTR, adverse local tissue reaction.

(52–66 mm). The distribution of patients' sizes can be seen in Table 4. Acetabular screw fixation was used in 6 hips (16%). There was a variety of acetabular components used for the revision to THA with Zimmer TM cup (Trabecular Metal acetabular revision system, ZimmerBiomet, Warsaw, IN, USA) being the most common (Table 2). There was a variety of cementless femoral components with the Taperloc being the most common (Taperloc Complete Hip System, ZimmerBiomet, Warsaw, IN, USA) (Table 2).

The initial cup median size for the hip resurfacing was 55 ± 3 (48–60). The distribution of patients' size can be seen in Table 5. At time of revision to total hip arthroplasty, the mean increase of the acetabular component based on initial component size was 4 ± 2.3 mm (0–8, $p=0$) (Figure 1). They were distributed as follows: 6 mm increase for 48-mm cups; 5 mm increase for 50-mm cups; 4.9 mm increase for 52-mm cups; 4.3 mm increase for 54-mm cups; 3.6 mm increase for 56-mm cups; 4.5 mm increase for 58-mm cups; and 2 mm increase for 60-mm cups (Figure 2). There were significant improvements for all PROMs collected after 2 years postoperatively except for SF-12 physical (+12; $p=0.117$), SF-12 mental (+6; $p=0.463$) and UCLA Score (+2.1; $p=0.233$) as shown in Table 6.

In terms of complications, 5 patients needed re-operations; 3 infections with irrigation and debridement, 1 acetabular loosening which was revised and 1 trunnionosis. Case 1 had an irrigation and debridement with femoral stem exchange (Figure 3). Case 2 had a head and liner revision for infection. Case 3 had a taper sleeve implanted and a head exchange for trunnionosis. Case 4 had an isolated acetabular component revision to a Trabecular Metal acetabular component. Case 5, in which the hip resurfacing initial acetabular component was retained, only had a head and neck exchange for infection.

Table 4. Revision cup size characteristics.

Revised cup size	Number of patients	Percentage
52	1	3.0%
54	5	15.2%
56	5	15.2%
58	8	24.2%
60	7	21.2%
62	6	18.2%
64	0	0%
66	1	3.0%
Total	33	100.0%

Table 5. Initial cup size characteristics.

Initial cup size	Number of patients	Percentage
48	1	3%
50	2	6%
52	9	27%
54	7	21%
56	5	15%
58	6	18%
60	3	9%
Total	33	100%

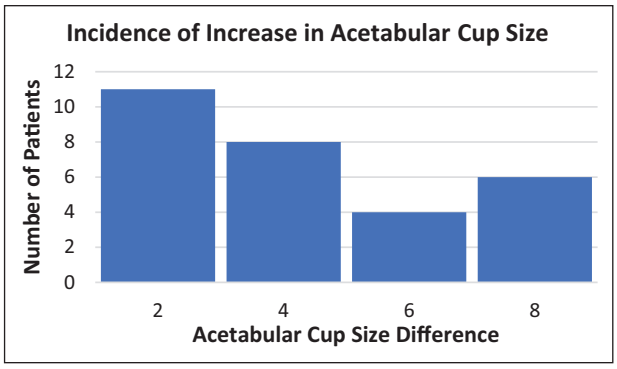

Figure 1. Incidence of increase in acetabular cup size.

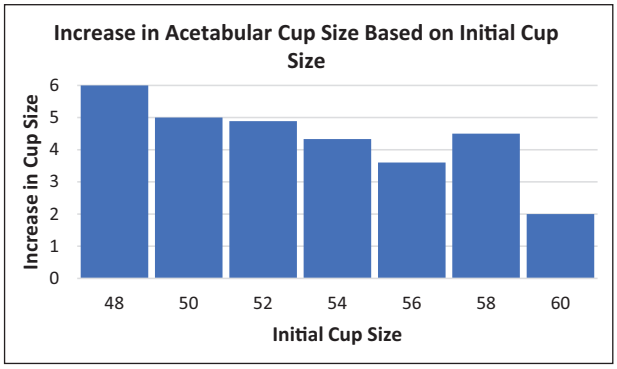

Figure 2. Increase in acetabular cup size based on initial cup size.

Discussion

The need for primary hip arthroplasties is expected to continue to grow with an average annual increase of approximately 5% in recent years.[19] With over $650 million estimated for hip arthroplasty in 2019–2020, this growth will also be leading to a significant expenditure annually on the healthcare system.[19] Concomitantly, the burden of revision surgery is also on the rise with over 10,300 hip and knee replacement revision totalising over $177 million in inpatient cost.[19] In 2019–2020, 8.1% of all hip replacements were actually revision surgeries.[19] With around 70% more than the primary joint surgery cost, revision surgery also required more than twice the number of acute care days (average 9 days).[19] Thus, it is important to understand the specifics of those revisions to decrease healthcare expenditures in addition to improve patients' outcomes.

The posterior approach is the most commonly used for total hips and hip resurfacing, however in the last decade, the anterior approach has provided as high a level of quality of care for patients requiring joint replacement surgery.[20,21] We have previously reported our overall experience with the HAA for hip resurfacing: excellent survivorship of 95.0% at 5 years and 92.5% at 10 years,[6] with females demonstrating high failure rates due to aseptic loosening and pseudotumour/ALTR.[22,23]

One of the key challenges in revision hip surgery is having adequate bone stock for implant fixation. On the femoral side, revision of hip resurfacing permits the use of a primary femoral stem.[24] However, on the acetabular side, the surgeon has 2 choices: either preserve the metal shell (i.e. convert to a large head MoM bearing) or change the acetabular socket, which can lead to further bone loss.[25] This can be more of a problem if a large acetabular shell was initially used at the time of primary resurfacing.[26–28] There are some case series reporting the increase in acetabular component size by an average of 4 mm while other level 1 studies report no difference.[29–31] In our series, the majority of patients underwent revision of the acetabular component as most of the failures were either due to acetabular loosening or a pseudotumour/ALTR. One of the key findings in our study was that smaller initial components required a larger increase in cup size at time of revision to THA. This is most likely related to wear-debris induced osteolysis: smaller diameter MoM hip resurfacings have been shown to have more wear, further illustrating the contra-indication of <50 mm resurfacing acetabular components.[32,33] Looking at the outcome of acetabular reconstruction after hip resurfacing. Jakobs et al.[34] reported that 29 out of 38 revisions needed either autologous and/or allogenous impaction bone graft and 10 of those also needed a reinforcement device. This is in keeping with our study that showed 16 out of 33 necessitating a Trabecular Metal cup during revision and 16% needing screw fixation. However, we had a lower rate of bone graft with only 9 allogenous and 1 autogenous graft during acetabular reconstruction.

Although the numbers are small, none of the patients who had the acetabular component maintained with MoM bearing had subsequent failure of their components. This likely plays a protective role to prevent re-operation, giving the patient a larger bearing surface. Larger prostheses usually survive significantly longer than smaller ones as previously investigated.[35] Consequently, if the acetabular component is well-fixed with no evidence of pseudotumour/ALTR, the senior author's practice is still to convert to large head MoM total hip.

In this study, we demonstrated that the outcome of revision surgery for hip resurfacing done through the Hueter approach is safe and effective. Our re-operation rate of 16.7% (5/30) is lower than the Australian Registry study (26%),[12] but slightly higher than the Dutch registry, which quoted 11.5% re-revision rate of all their MoM HRA and THA.[36] It is also higher than the 0% revision rate of the small 17 hips cohort from Bouveau et al.[7] Having said that, peri-prosthetic infection remains a common cause of re-operation in patients with a failed MoM total hip requiring new treatment strategies.[12]

Table 6. PROMs Preoperatively and at 2 years postoperatively.

PROMs	Pre-Revision	Post-Revision	Change	P-Value
HOOS S+S	35±19	80±18	45	0.005
HOOS Pain	41±20	82±21	41	0.005
HOOS ADL	45±18	84±20	39	0.011
HOOS S+R	21±14	66±30	45	0.044
HOOS QoL	11±11	66±30	55	0.009
WOMAC Pain	48±22	85±21	37	0.005
WOMAC Stiffness	36±18	76±21	40	0.003
WOMAC Function	49±20	84±20	35	0.013
WOMAC Total	46±19	84±18	37	0.008
SF12 P	32±9	44±10	12	0.117
SF12 M	48±13	54±6	6	0.463
UCLA	5.4±2.4	7.5±1.8	2.1	0.233

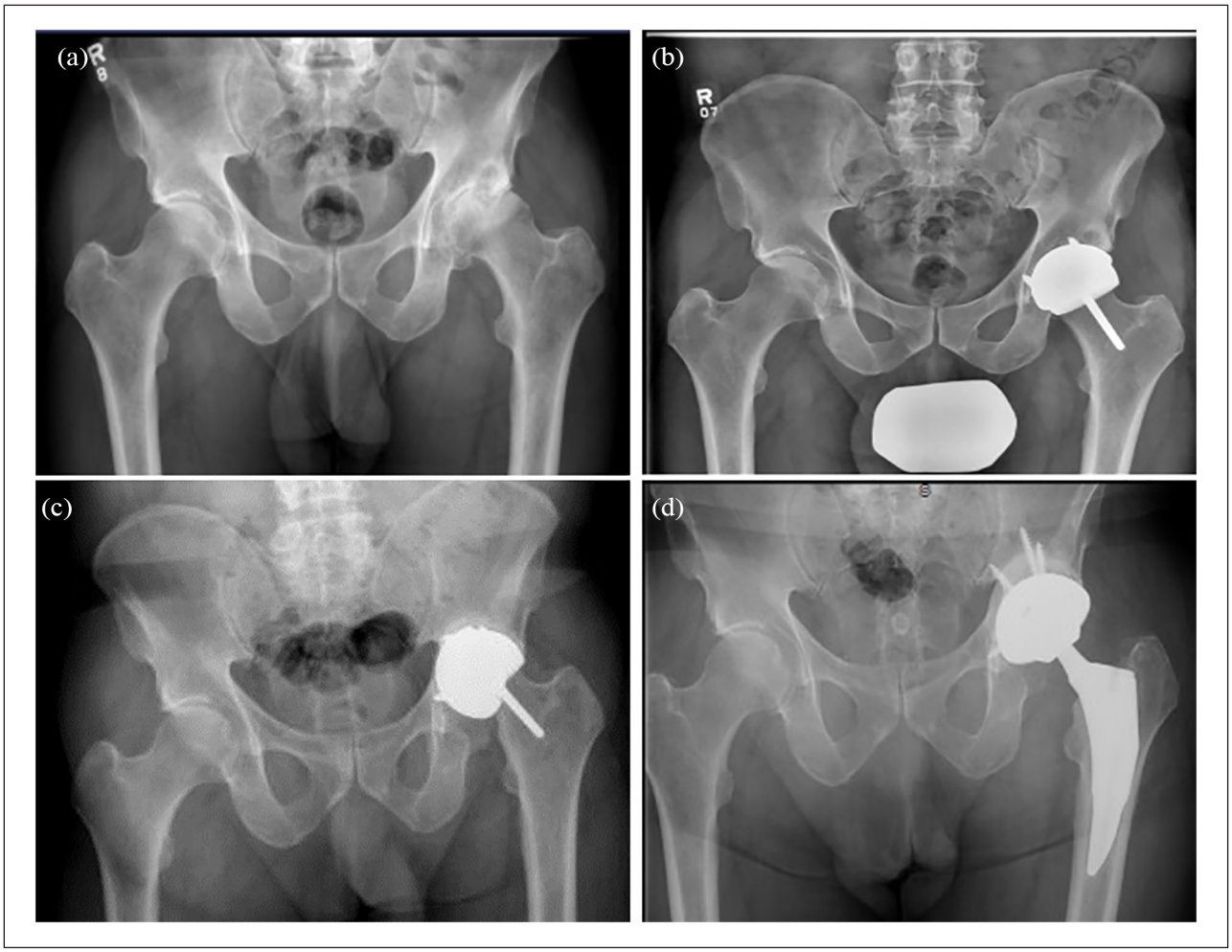

Figure 3. (a) Pre-operative 62-year-old male with left hip osteoarthritis. (b) Same patient underwent Conserve Plus Hip Resurfacing with a 50 size femoral component and 56 shell. (c) 13 years post-op presents with acetabular cup failure. (d) Undergoes revision to THA with a Trabecular Metal Shell (60 OD) and morsellised bone graft and Microplasty Femoral Stem (Zimmer Biomet, Warsaw IN) done through the Hueter-anterior approach.

This study additionally demonstrated HAA to be an effective method to improve patients' outcomes with significant improvement for all sub-categories of HOOS and all subcategories of WOMAC. There was an improvement in SF-12 Mental, SF-12 Physical and UCLA Score but they were not significant. Our findings

are in parallel with other studies that have shown similar improvement in PROMs, but typically more generic scores such as the UCLA and the SF-12 were not statistically significant.[29,37] Sandiford et al.[29] also demonstrated significant improvements in both Oxford Hip Score and Harris Hip Score, 2 other disease-specific scores. This phenomenon could potentially be explained in that most patients will have higher expectations for their surgery in terms of their overall performance, not only regarding their hip. Although we did not compare with normative controls in THA, other studies provided reasonable references for evaluating patient PROMs after HRA, THA and normative control subgroups.[25,38,39] Desloges et al.[25] looked at perioperative measures and outcomes score of HRA revision to THA compared to primary or revision THA and studied also these differences in femoral-only of both component revision in HRA. They determined in their 22 HRA to THA and matched primary THA that there was no difference in SF-12 scores, but lower WOMAC stiffness, function and total scores. Patients also had more pain (WOMAC pain) when undergoing femoral side only HRA Revision. Overall, they concluded that perioperative measures and outcomes scores of HRA revision were comparable to THA revision.

This study presents obvious limitations, including a small sample size and single-centre review of the revision cases. Although all procedures were performed through the same Huerter-anterior approach, there is also a heterogeneity of primary and revision components possibly impacting the PROMs and outcomes of the patients that were not addressed in this study. We also lack comparison of data regarding HRA to THA using a posterior-based approach. However, this is common with other studies in the literature regarding HRA conversions to THA. We also experienced some loss to follow-up as expected from younger cohorts of patients in prospective studies, as demonstrated in previous literature.[39] Despite this, our study is in keeping with many others that demonstrated the safety and efficacy of the anterior approach (HAA) for the conversion of HRA to THA using a variety of surgical implants.

Conclusion

The Hueter-anterior approach (HAA) is a viable surgical approach for revision of HRA to THA when performed for several indications. We noted that smaller initial HRA acetabular components generally lead to more acetabular bone loss at time of revision to THA. Patients reported improvement in symptoms and function following revision to THA and a lower risk of subsequent reoperation than what has previously been reported in the current literature. However, further studies are necessary to assess components type and size in terms of predictors of re-operation.

Declaration of conflicting interests

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