

# Long-term outcomes of uncemented or cemented arthroplasty revision following metal-on-metal total hip replacement

**Wenli Chen**

Sun Yat-sen University First Affiliated Hospital

**Mao Shuai**

Sun Yat-sen University First Affiliated Hospital

**Jinluan Lin**

The Affiliated hospital of Fujian Medical University

**Baomin Chen**

Sun Yat-sen University First Affiliated Hospital

**Mingdong Zhao** (✉ [zhaonissann@163.com](mailto:zhaonissann@163.com))

Jinshan Hospital, Fudan University

**Xinchao Zhang**

Jinshan Hospital, Fudan University

**Weiguang Yu**

Sun Yat-sen University First Affiliated Hospital

**Guowei Han**

Sun Yat-sen University First Affiliated Hospital

---

## Research article

**Keywords:** Uncemented, Cemented, Total hip arthroplasty, Metal-on-Metal, Outcome

**Posted Date:** March 23rd, 2020

**DOI:** <https://doi.org/10.21203/rs.2.20209/v4>

**License:** © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Abstract

**Background** Which device(uncemented or cemented total hip replacement[UTR or CTR]) is more conducive to the revision of metal-on-metal total hip replacement(MoM-TR) is inconclusive. The purpose of this study was to assess the long-term outcomes of individuals who had undertaken UTR versus CTR following initial MoM-TR. **Methods** Two hundred and thirty-four individuals(234 hips) had received UTR or CTR following initial MoM-TR during 2007-2018 were reviewed . Outcomes reported in this analysis involving Harris Hip Scores(HHS) as well as the major orthopaedic complications(MOC) were gathered 3 months, 6 months, 12 months, and then every one year after revision. **Results** From the 12th month after revision to final follow-up, CTR yielded superior HHS than UTR. The MOC rates were 47.4% and 16.1% in the UTR and CTR groups, respectively. Between-group noteworthy divergences were noted regarding the rates of re-revision, prosthesis loosening, and periprosthetic fracture(10.3% for UTR vs 2.5% for CTR,  $p = 0.015$ ; 16.3% for UTR vs 5.9% for CTR,  $p = 0.011$ ; and 12.0% for UTR vs 4.2% for CTR,  $p = 0.045$ , respectively). **Conclusion** The superiority of CTR over UTR in terms of improving HHS and decreasing the MOC rate.

## Background

In recent years, the utilisation of metal-on-metal total hip arthroplasty(MoM-THA) has sharply declined as a result of the reported low 10-year survivorship and high failure rates associated with a host of issues(i.e., adverse reactions to metal debris[ARMD])[1-4]. Failure that occurs secondary to MoM wear tends to be a concern[5-7]. Poor bone stock could be attributed to the substantial osteolysis triggered by ARMD which is closely related to the failure of MoM-THA, resulting in the high rate of revision[8].

This growing rate of MoM-THA failure may also conduce to the increase in the utilisation of uncemented or cemented THA(UTHA or CTHA)[8, 9]. Several reports have reviewed major orthopaedic complications(MOC) following the conversion of MoM-THA to UTHA or CTHA[3, 7]. Interest in CTHA has been growing over the last decade, with reported superior Harris hip scores(HHS) and fewer MOC for CTHA than for UTHA[5, 10-12].

So far, no definitive consensus exists regarding the long-term outcomes of conversion from initial MoM-THA to UTHA or CTHA[11]. Thus, we performed a retrospective review to assess the long-term outcomes of the conversions.

## Methods

### Study population

An initial study cohort of 326 patients(326 hips) were identified from our joint registration database who were treated using UTHA or CTHA following primary MoM-THA from March, 2007 to January, 2018. The main reasons for revision involved ARMD, aseptic loosening, infection, dislocation, and fracture. The inclusion criteria included patients who undertook a conversion from initial MoM-THA(Zimmer Biomet,

Warsaw, IN) to UTHA(stem, Corail, DePuy, U.S.A; cup, Reflection uncemented, Smith & Nephew, U.S.A) or CTHA(stem, Exeter, Stryker, U.S.A; cup, Elite, Stryker, U.S.A); all conversion procedures were performed by three experienced orthopaedists(WY, XZ, MZ) via a direct anterior approach, as reported[13]. The main exclusion criteria involved cases without a MoM-bearing surface at the time of conversion; lacking study data; dyskinesia or bone-related diseases; tumours, organ dysfunction.

Data were collected according to a standard protocol. Follow-up occurred 3 months, 6 months, 12 months, and then every one year after conversion. The primary endpoint was the HHS; secondary endpoints were the MOC rate.

## Statistical analysis

Revision was defined as the removal of the entire endo-prosthesis. Prosthesis loosening was assessed according to previous reports[8, 14]. Continuous data were compared using Student's t-test. Categorical data were compared using Chi-squared tests or Fisher's exact tests, as appropriate. All statistical analyses were done using SPSS 24.0(IBM, Armonk, NY). A 2-sided  $p < 0.05$  was considered significant.

## Results

In total, 234 individuals(234 hips) undertaking conversion from initial MoM-THA to UTHA or CTHA were identified(UTHA:  $n=116$ , mean age,  $67.34[\pm 6.25]$  years; CTHA:  $n=118$ , mean age,  $67.45[\pm 6.21]$  years) (Figure 1). The mean time to failure after initial MoM-THA was 4.3 years(1.2-6.5 years) for UTHA and 4.4 years(1.1-6.4 years) for CTHA. The mean follow-up from conversion was 84.12 months(67-100 months) for UTHA and 84.23 months(66-101 months) for CTHA(Table 1).

### Primary endpoint

The mean HHS in Group UTHA and CTHA were  $79.14 (\pm 8.12)$  and  $79.28 (\pm 7.66)$  3 months after conversion,  $86.65 (\pm 6.62)$  and  $87.76 (\pm 7.44)$  6 months after conversion,  $88.17 (\pm 7.72)$  and  $91.43 (\pm 8.52)$  12 months after conversion, and  $79.18 (\pm 11.12)$  and  $84.32 (\pm 10.35)$  at final follow-up, respectively. The HHS revealed statistically greater differences in Group CTHA than in Group UTHA 12 months after conversion( $p=0.031$ ). From the 12th month after conversion to final follow-up, CTHA yielded superior functional outcomes than UTHA(all  $p < 0.05$ )(Table 2). Between-group differences in HHS were not significant 3 months or 6 months after conversion.

### Secondary endpoints

Eighty-three MOC were recorded in 116 UTHA cases versus 47 in 118 CTHA cases. Of 83, there were 12(10.3%) re-revision, 19(16.3%) aseptic loosening, 14(12.0%) periprosthetic fractures, and 6 (5.1%) unbearable hip pain. Of 47, there were 3(2.5%) re-revision, 7(5.9%) aseptic loosening, 5(4.2%) periprosthetic fractures, and 8(6.7%) intolerable hip pain, as shown in Table 3. The between-group difference in the re-revision rate was significant at final follow-up(10.3% for UTHA vs 2.5% for CTHA,  $p=0.015$ ). Approximately 82.1% re-revision for UTHA were attributed to aseptic loosening compared to

73.5% re-revisions for CTHA( $p=0.034$ ). The mean time from revision to re-revision was 3 years(1.4-3.5 years) for UTHA and 3 years(1.2-3.6 years) for CTHA( $p=0.154$ ).

## Discussion

The revision of initial MoM-THA using CTHA yielded superior long-term clinical outcomes compared to the use of UTHA. For all we know, this is the largest report regarding outcomes of conversion after MoM-THA.

The MOC of MoM-THA related to ARMD could be the occasion of increased metal ion levels, potentially increasing the risk of endo-prosthesis failure[8, 5]. These ions reduce the number and activity of osteoblasts by inhibiting the expression of osteoblast genes, eventually leading to intraosseous growth disorder[3, 7, 14]. The result of the metal ion is a challenge to UTHA or CTHA. In response to this challenge, the force on UTHA may be transmitted to one part of the bone, while it acts as a stress shielding to other bones[15-17]. On account of the limitation of stress buffering or conduction[4], UTHA can lead to further bone destruction, which will form a vicious cycle, and eventually lead to the failure of the prosthesis[11, 18, 19].

The risk of converting from MoM-THA to UTHA or CTHA remains an increasing concern[14, 8, 3]. Nonetheless, the reported literature on the outcomes of these conversions is underprovided[20, 4, 21]. Several studies have revealed noteworthy distinctions in clinical outcomes, although they are constrained by small sample sizes[3, 13, 8]. Undeniably, revision MoM-THA is related to a high rate of MOC[8]. Even so, we failed to detect noteworthy distinctions regarding the rates of MOC 1 year after conversion. There has been increasing concern as to whether there are substantial differences in the long-term results of these two types of conversions[3, 8, 17]. In 2009, Eswaramoorthy et al.[23] reviewed 76 cases who undertook conversion from MoM-THA to UTHA. Consistent with the current findings, a high rate of MOC (24%) was observed involving prosthesis loosening and periprosthetic fracture, predominantly attributable to a high rate of revision (7%).

The reason for the conversion has a significant effect on the result of the conversion[4, 7]. With the continuous updating of arthroplasty equipment and further development of surgical technology, the total re-revision rate due to MoM wear is low, regardless of whether long- or short-stem UTHA is used for THA[11, 15]. Periprosthetic fractures frequently result in high re-revision rates for UTHA[16, 19]. Consistent with our results. A possible explanation for these phenomena is that the stress transmission is severely disrupted by the periprosthetic fractures[20, 21]. It may be difficult to reconstruct the supporting structure by using long- or short-stem of UTHA[15, 18]. In this way, it is unlikely that long- or short-stem of UTHA will resist stress under the weight-bearing[2, 8]. However, for CTHA, the situation may be different, because cemented fixation itself is an antagonistic relationship to fracture or stress[6-8]. It can enhance the friction coefficient of the bone-cement interface, and also promote the tension of the entire femoral part, which is crucial for the hip stability after revision[13, 18].

Several limitations should be acknowledged in this study. Firstly, this is a retrospective study, and bias is inevitable. However, the results are basically quantitative because clinical outcomes are the focus of our attention. In addition, because there were no significant differences in baseline data in this comparative study, the effect of data on retrospective collection is limited. Secondly, subjective factors may play a key role in assessing baseline comorbidities in the absence of objective diagnostic data, which may result in unexplained baseline variables, which reduces the ability to draw reliable conclusions. Thirdly, the subjects we included have a large time span (more than 11 years), which may have limited the reliability of our conclusions. Because the clinical experience of surgeons is not fixed. With the accumulation of surgical volume, the surgeon's experience may be a potential variable, which plays an important role in postoperative outcomes.

## Conclusions

The long-term results reported in the current study provide a growing body of evidence that conversion to CTHA following primary MoM-THA is associated with more significant improvements in functional outcomes and lower MOC rate compared to conversion to UTHA.

## Abbreviations

UTHA: uncemented total hip arthroplasty; CTHA: cemented total hip arthroplasty; MoM-THA: metal-on-metal total hip arthroplasty; ARMD: adverse reaction to metal debris; BMD: bone mineral density; ISS: injury severity score; BMI: body mass index; ASA: American Society of Anesthesiologists; HHS: Harris hip scores.

## Declarations

### Acknowledgements

Not applicable.

### Funding

Funding for this study was obtained from the National Natural Science Foundation of China (81971315).

### Availability of data and materials

The data used during our study are available from the corresponding author upon reasonable request.

### Authors' contributions

WC, SM, JL, and BC carried out the data collection and analysis. MZ, XZ, WY, and GH performed the surgical procedures and participated in the study design and manuscript writing. All authors have read and approved the final manuscript.

## Ethics approval and consent to participate

This study was approved by the Investigational Ethics Review Board (The First Affiliated Hospital, Sun Yat-sen University), and an exemption from informed consent was gained from the review board.

## Consent for publication

Not applicable.

## Competing interests

The authors declare that they have no competing interests.

## References

1. Vovos TJ, Lazarides AL, Ryan SP et al. Prior Hip Arthroscopy Increases Risk for Perioperative Total Hip Arthroplasty Complications: A Matched-Controlled Study. *J Arthroplasty*. 2019;34(8):1707-10.
2. Langton DJ, Jameson SS, Joyce TJ et al. Early failure of metal-on-metal bearings in hip resurfacing and large-diameter total hip replacement A CONSEQUENCE OF EXCESS WEAR. *J Bone Joint Surg Br*. 2010;92B(1):38-46.
3. Borton ZM, Mumith AS, Nicholls AJ et al. The Outcome of Revision Surgery for Failed Metal-on-Metal Total Hip Arthroplasty. *J Arthroplasty*. 2019;34(8):1749-54.
4. Tauriainen TJT, Niinimäki TT, Niinimäki JL et al. Poor Acetabular Component Orientation Increases Revision Risk in Metal-on-Metal Hip Arthroplasty. *J Arthroplasty*. 2017;32(7):2204-7.
5. Rahman WA, Amenabar T, Hetaimish BM et al. Outcome of Revision Total Hip Arthroplasty in Management of Failed Metal-on-Metal Hip Arthroplasty. *J Arthroplasty*. 2016;31(11):2559-63.
6. De Haan R, Campbell PA, Su EP et al. Revision of metal-on-metal resurfacing arthroplasty of the hip - The influence of malpositioning of the components. *J Bone Joint Surg Br*. 2008;90B(9):1158-63.
7. Carlson BC, Bryan AJ, Carrillo-Villamizar NT et al. The Utility of Metal Ion Trends in Predicting Revision in Metal-on-Metal Total Hip Arthroplasty. *J Arthroplasty*. 2017;32(9):S214-S9.
8. Crawford DA, Adams JB, Morris MJ et al. Revision of Failed Metal-on-Metal Total Hip Arthroplasty: Midterm Outcomes of 203 Consecutive Cases. *J Arthroplasty*. 2019;34(8):1755-60.
9. Park KS, Yoon TR, Song EK et al. Cementless Acetabular Socket Revisions Using Metasul Metal-on-Metal Bearings. *J Arthroplasty*. 2010;25(4):533-7.
10. Robinson PG, Wilkinson AJ, Meek RMD. Metal ion levels and revision rates in metal-on-metal hip resurfacing arthroplasty: a comparative study. *Hip Int*. 2014;24(2):123-8.
11. Matharu GS, Pandit HG, Murray DW et al. Adverse reactions to metal debris occur with all types of hip replacement not just metal-on-metal hips: a retrospective observational study of 3340 revisions for adverse reactions to metal debris from the National Joint Registry for England, Wales, Northern Ireland and the Isle of Man. *BMC Musculoskelet Disord*. 2016;17:222.

12. Jameson SS, Baker PN, Mason J et al. Independent predictors of revision following metal-on-metal hip resurfacing A RETROSPECTIVE COHORT STUDY USING NATIONAL JOINT REGISTRY DATA. *J Bone Joint Surg Br.* 2012;94B(6):746-54.
13. Bouveau V, Haen TX, Poupon J et al. Outcomes after revision of metal on metal hip resurfacing to total arthroplasty using the direct anterior approach. *Int Orthop.* 2018;42(11):2543-8.
14. Zijlstra WP, Bulstra SK, van Raay J et al. Cobalt and chromium ions reduce human osteoblast-like cell activity in vitro, reduce the OPG to RANKL ratio, and induce oxidative stress. *J Orthop Res.* 2012;30(5):740-7.
15. Lainiala OS, Reito AP, Nieminen JJ et al. Declining Revision Burden of Metal-on-Metal Hip Arthroplasties. *J Arthroplasty.* 2019;34(9):2058-+.
16. Grechenig S, Gueorguiev B, Berner A et al. A novel locking screw hip stem to achieve immediate stability in total hip arthroplasty: A biomechanical study. *Injury.* 2015;46:S83-S7.
17. Pallaver A, Zwicky L, Bolliger L et al. Long-term results of revision total hip arthroplasty with a cemented femoral component. *Arch Orthop Trauma Surg.* 2018;138(11):1609-16.
18. Gross TP, Liu F. Outcomes After Revision of Metal-on-Metal Hip Resurfacing Arthroplasty. *J Arthroplasty.* 2014;29(9):219-23.
19. Fleischman AN, Tarabichi M, Magner Z et al. Mechanical Complications Following Total Hip Arthroplasty Based on Surgical Approach: A Large, Single-Institution Cohort Study. *J Arthroplasty.* 2019;34(6):1255-60.
20. Mueller LA, Schmidt R, Ehrmann C et al. Modes of Periacetabular Load Transfer to Cortical and Cancellous Bone after Cemented versus Uncemented Total Hip Arthroplasty: A Prospective Study Using Computed Tomography-Assisted Osteodensitometry. *J Orthop Res.* 2009;27(2):176-82.
21. Liow MHL, Dimitriou D, Tsai TY et al. Preoperative Risk Factors Associated With Poor Outcomes of Revision Surgery for "Pseudotumors" in Patients With Metal-on-Metal Hip Arthroplasty. *J Arthroplasty.* 2016;31(12):2835-42.
22. Sierra RJ, Cabanela ME. Conversion of failed hip hemiarthroplasties after femoral neck fractures. *Clin Orthop Relat Res.* 2002(399):129-39.
23. Eswaramoorthy VK, Biant LC, Field RE. Clinical and radiological outcome of stemmed hip replacement after revision from metal-on-metal resurfacing. *J Bone Joint Surg Br.* 2009;91B(11):1454-8.

## Tables

**Table 1 Baseline data**

Variable	UTHA (n=116)	CTHA (n=118)	p-value
Sex, M/F	52/64	53/65	0.409
Age, (y)	67.34±6.25	67.45±6.21	0.142
BMI, kg/m <sup>2</sup>	28.23±7.32	28.15±7.22	0.261
BMD	-3.47±0.26	-3.48±0.42	0.132
Side, L/R	56/60	57/61	0.277
Interval to failure after initial MoM- THA (y)	4.3(1.2 - 6.5)	4.4(1.1 -6.4)	0.331
Mechanism of injury, n%			0.780
Traffic	26(22.4)	28(23.7)	
Falling	51(43.9)	46(38.9)	
Tamp	39(33.7)	44(37.4)	
ASA scale, n%			0.920
I	22(18.9)	24(20.3)	
II	64(55.1)	63(53.3)	
III	30(26.0)	31(26.4)	
Preoperative HHS	56.33±17.36	56.43±16.92	0.164
Follow-up (mos)	84.12±16.62	84.23±17.49	0.214

UTHA: uncemented total hip arthroplasty; CTHA: cemented total hip arthroplasty; BMI: body mass index; BMD: bone mineral density; MoM-THA: metal-on-metal total hip arthroplasty; ASA: American Society of Anesthesiologists; HHS: Harris hip scores.

**Table 2 Long-term follow-up: functional outcomes**

HHS, month after conversion	UTHA (n=116)	CTHA (n=118)	p-value
3	79.14±8.12	79.28±7.66	0.212
6	86.65±6.62	87.76±7.44	0.181
12	88.17±7.72	91.43±8.52	0.031*
24	88.72±7.35	90.47±7.75	0.036*
36	87.14±8.43	89.43±8.27	0.027*
48	87.56±9.42	88.77±9.72	0.025*
60	86.32±9.68	87.73±11.25	0.014*
72	82.29±10.16	85.71±10.12	0.011*
84	79.78±11.65	84.72±11.82	<0.001*
Final follow-up	79.18±11.12	84.32±10.35	<0.001*

\*Statistically significant values.

UTHA: uncemented total hip arthroplasty; CTHA: cemented total hip arthroplasty; HHS: Harris hip scores.

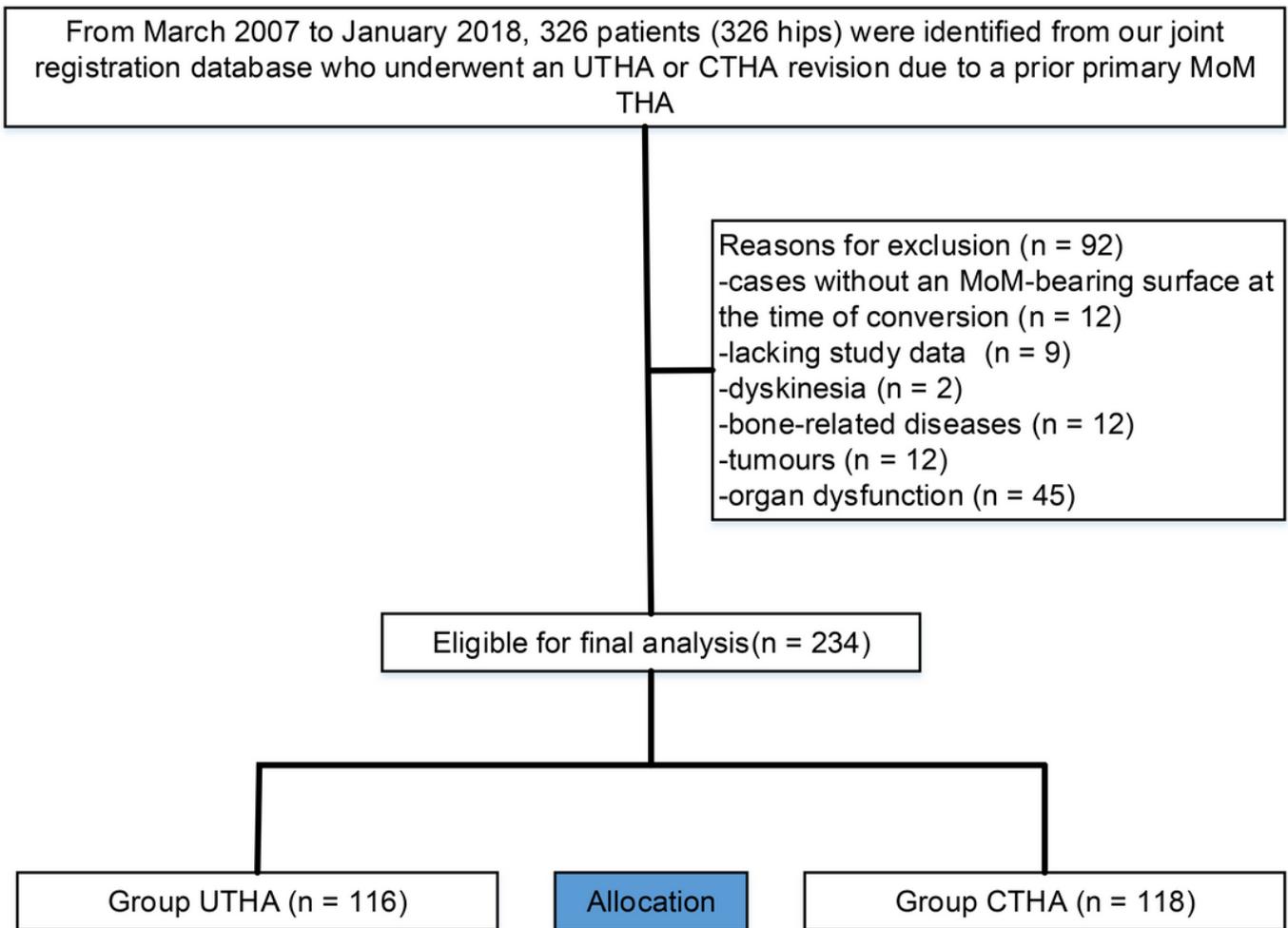
**Table 3 Long-term follow-up: prosthesis-related complications**

Variable, n%	UTHA (n=116)	CTHA (n=118)	p-value
Re-revision	12(10.3)	3(2.5)	0.015*
Aseptic loosening	19(16.3)	7(5.9)	0.011*
Periprosthetic fracture	14(12.0)	5(4.2)	0.045*
Dislocation	10(8.6)	4(3.3)	0.092
Femur shaft fracture	3(2.5)	3(2.5)	0.983
Unbearable hip pain	6(5.1)	8(6.7)	0.604

\*Statistically significant values.

UTHA: uncemented total hip arthroplasty; CTHA: cemented total hip arthroplasty.

## Figures



**Figure 1**

Flow diagram exhibiting methods for identification and exclusion of patients to compare the long-term outcomes of uncemented or cemented total hip arthroplasty (UTHA or CTHA, respectively) following initial metal-on-metal THA (MoM-THA).