



Brief Report

An Economic Analysis of Metal-on-Metal Versus Ceramic-on-Ceramic Hip Resurfacing: Costs and Clinical Implications

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Abstract: Background: Ceramic may be an alternative bearing surface that could be used to deal with the negative sequelae associated with the use of metal-on-metal (MoM) hip resurfacing implants, keeping the benefits of hip resurfacing without the risks. The aim of this study is to evaluate the additional financial and logistical implications that MoM hip resurfacing has, in comparison to its ceramic-on-ceramic (CoC) counterpart. Methods: Two different follow up protocols were analysed, according to current practice guidance, on how to follow up with hip resurfacing procedures. Reference costs were identified using the latest national cost collection data and data from the local biochemistry department. The results incorporated the number of hip resurfacings performed nationally. Results: The non-MoM protocol yielded a per operation lifetime follow up cost of £802.50, whereas the MoM protocol yielded a cost of £2132.83 at 25 years. Nationally, according to the 2023 data, this amounted to £561,750 versus £1,492,981 per year, respectively. MoM hip resurfacing is 2.6 times more expensive to be followed up with when compared to the standard protocol. Conclusion: The cost of the follow up of MoM bearings far exceeds that of non-MoM bearings. If CoC hip resurfacing is as clinically effective as MoM hip resurfacing, then the economics favour CoC bearing for resurfacing.

Keywords: hip replacement; hip resurfacing; metal-on-metal; ceramic-on-ceramic; health economics



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1. Introduction

From a peak in 2010 of 6000 (3.7%) metal-on-metal (MoM) hip resurfacings per year among all of the hip procedures in the United Kingdom, the usage of this implant has declined to around 700 (0.7%) due to concerns of high failure rates, aseptic lymphocyte dominated vasculitis-associated lesions (ALVAL) and pseudotumours [1–5]. Subsequently, the latest update from the Medicines and Healthcare products Regulatory Agency (MHRA) was published in 2017, with regards to MoM hip resurfacing follow ups [6].

To counter the problems identified with MoM hip resurfacing, ceramic-on-ceramic (CoC) bearings have been developed for hip resurfacing. They are made from zirconia toughened alumina, an inert substance, which has been used in THA for over 16 years with excellent biocompatibility and low wear rates [7,8]. Currently, multiple CoC implants are being investigated and the early results are promising [9].

Therefore, the aim of this study is to evaluate and compare the economic cost and logistical practicalities of follow ups after MoM hip resurfacing, compared to a ceramic resurfacing.

2. Methods

According to the 20th NJR annual report 2023, hip resurfacing constitutes 2.9% of all primary hip operations, equating to a total of 42,260, with 249 being CoC, 41,886 MoM and 125 coded as other hip resurfacing methods. In the last few years, around 700 (0.7%) patients had a hip resurfacing procedure, which has remained a stable figure [1,2]. We

formed two different follow up protocols and divided them as a standard follow up, as per National Health Service advice, and MoM protocol (Tables 1 and 2) [1,6]. The follow up protocols spanned for 25 years, as we can expect that 83.5% of patients will survive for at least 25 years, according to the latest publication [1]. The best-case scenario of no symptoms, further radiological and surgical interventions was selected for this study. The standard protocol comprised a clinic review at 6 weeks after surgery, and then clinical and x-ray reviews at 1, 5 and 10 years after surgery. The MoM protocol comprised a clinic review at 6 weeks after surgery, and then clinical, biochemical and x-ray reviews at 1, 7, 10, 13, 16, 19, 22 and 25 years after surgery.

Table 1. Standard and MoM follow up protocols used for analysis outlining costs and attendance practice for the first 25 years post operatively.

Protocol Name	Details of Protocol	Cost
Standard	Clinic review at 6 weeks after surgery, and then clinical and X-ray review at 1, 5 and 10 years after surgery	£802.50
MoM	Clinic review at 6 weeks after surgery, and then clinical, biochemical and X-ray review at 1, 7, 10, 13, 16, 19, 22 and 25 years after surgery	£2132.83

Table 2. Standard and MoM follow up protocol representation of clinic attendance, blood and radiological assessment for the first 25 years post operatively.

Follow Up	Standard			MoM		
	Clinic Visit	X-Ray	Bloods	Clinic Visit	X-Ray	Bloods
6 weeks	X			X		
1 year	X	X		X	X	X
5 years	X	X				
7 years				X	X	X
10 years	X	X		X	X	X
13 years				X	X	X
16 years				X	X	X
19 years				X	X	X
22 years				X	X	X
25 years				X	X	X

The costs for each aspect of the follow up were identified by looking at the latest national cost collection data [10] and by the local biochemistry department (Table 3). To simplify our analysis, the costs remained stable for the duration of the protocols. Microsoft Excel was utilised to gather the different costs.

Table 3. Hospital costs of outpatient attendance and associated investigations.

Intervention	Cost
Outpatient orthopaedic follow up appointment	£138.51
X-ray: anteroposterior pelvis and lateral hip view	£82.82
Magnetic resonance imaging	£188.11
Blood test for cobalt and chromium ions	£27.96

3. Results

The non-MoM protocol for follow ups, according to our calculations, costs £802.50, whereas the MoM protocol costs £2132.83, at 25 years (Figure 1). If we look at the cost of the 700 hip resurfacings taking place per year, this amounts to £561,750 versus £1,492,981, respectively. The MoM protocol is 2.6 times more expensive when compared to the standard protocol in the United Kingdom in 2023.

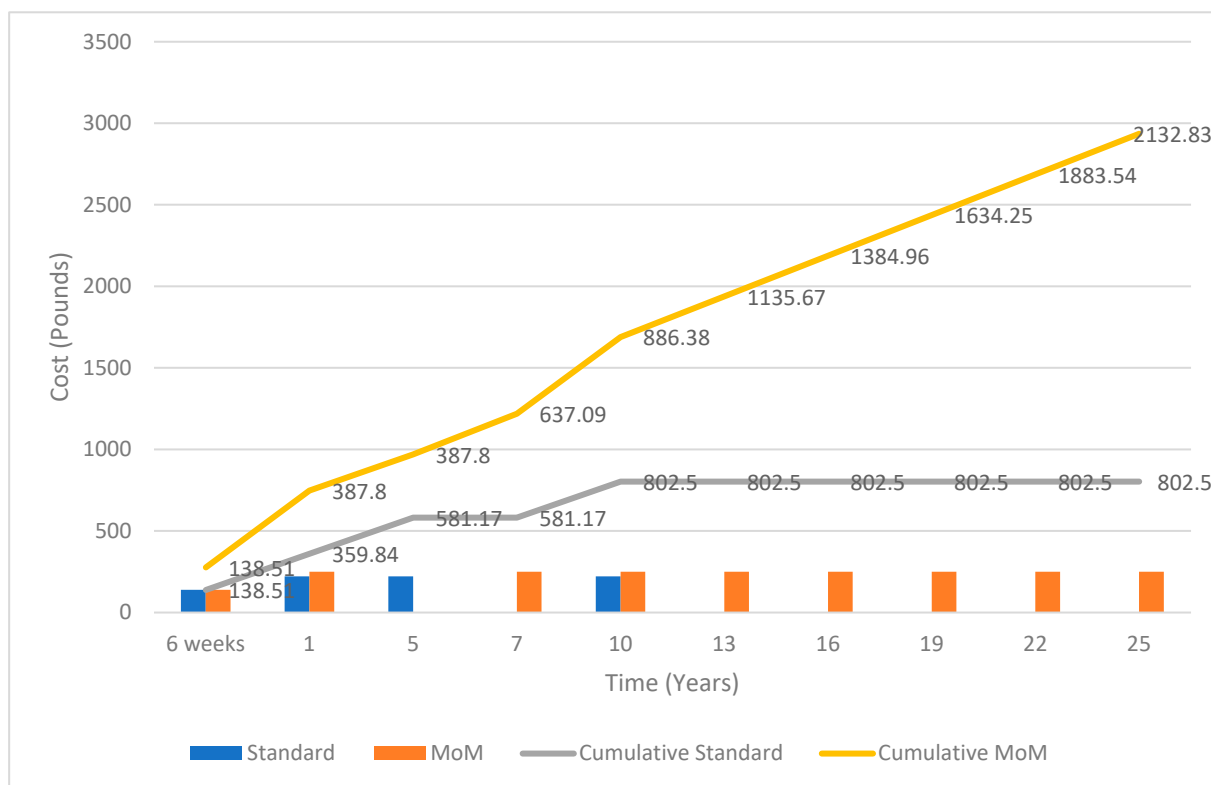


Figure 1. Cumulative cost in pounds for standard and MoM protocol for 25-year follow up.

4. Discussion

This is the first study to compare the follow up costs of MoM versus CoC hip resurfacing over a 25-year follow up period. Findings suggest that MoM hip resurfacing is 2.6 times more expensive, costing an additional £1330.33 per case. A potential change in bearing surfaces from MoM to CoC would be projected to equate to savings of £931,231 per 25-year follow up. It should, however, be mentioned that this figure does not include any potential change in volume of hip resurfacings performed.

The latest publication at 25 years for the Birmingham Hip Replacement (BHR, Smith and Nephew, Warwick, UK) gave us a cumulative 83.5% survival rate at 25 years post-surgery. It also divided the survival rate by gender, with males having an 89.5% and females having a 66.9% survival rate [1]. The evidence they provided, further strengthens the MHRA guidance, which advocates that a young age, the male gender and hip diameter > 48 mm produce higher chances of survival [6]. Out of the 20 revisions they had, half of them were performed in the first decade for 5 periprosthetic fractures, 4 pseudotumours and 1 aseptic loosening. These are believed to be due to a learning curve, early presentation of pseudotumours and also the better understanding of the appropriate version of the cup [1].

Furthermore, MoM hip resurfacing has an increased cost in surveillance when patients are symptomatic and at an increased risk of revision. This is because patients will need additional investigations, with a closer follow ups and an increased need for magnetic resonance imaging and revision surgery [11]. The designer group argued that their cumu-

lative revision rate of 83.5% at 25 years is comparable to the literature concerned with a conventional Total Hip Arthroplasty (THA), and sometimes exceeds it [1]. In particular, the survival rate of the Exeter femoral stem (Stryker, UK) was 82.9% at 22.8 years, although this was an older population study cohort [12]. When comparing the survival in Exeter THA patients under 50 years old, the survival rate is 74.9% at 22 years [13].

The level of cobalt and chromium ions in the blood and their association with pseudotumours is still not understood in depth [11]. The literature suggests that, in some patients, the concentration of metal ions begins to rise again after an initial 5-year fall [14]. Our understanding is that most pseudotumours are picked up in the first few years following MoM hip resurfacing [15]. The presence of pseudotumours is more prominent in young females, with a 13% prevalence when they are under 40 years and have undergone hip resurfacing. The study population had a prevalence of 4% at 8 years [16]. This further strengthens the advice that young females should avoid hip resurfacing [6,16]. This will only cause an increase in follow ups and investigations required for this cohort of patients, with an overall increase in costs.

Although the survival rates published by the BHR (Smith and Nephew, Warwick, UK) shows young males to be performing better with MoM hip resurfacing (89.5%) when compared to a more conventional THA [1], the economic and logistical costs are significantly higher. A solution to this may be using CoC hip resurfacing, with the literature reporting no adverse reactions noted in the short term, due to the inert nature of ceramics [7]. Lin et al. [9], reported that in a cohort of 200 CoC hip resurfacings, only 2 were revised, one for a malpositioned cup and one due to debonding of the titanium hydroxyapatite coating from the ceramic. Both revisions were in female patients at their 2-year follow up [9]. This is encouraging, as CoC could solve the MoM problem and its associated economic burden. Although, the burden of MoM hip resurfacing is dependent on the volume of cases and follow up protocol implemented. Ultimately, more substantial studies that include a longer follow up period are required to assess the outcome of the CoC implant.

Currently, CoC hip resurfacing is performed as part of trials or humanitarian access in the United Kingdom, Australia, South Africa, Canada and Belgium [7]. The H1 [17] and ReCerf [9] CoC hip resurfacing designs have been developed with only short-term data. Recently, the latter has gained regulatory approval to be used in Australia [18]. This will only increase the use of CoC hip resurfacing worldwide. At the moment, MoM hip resurfacing has an increased economic burden due to the surveillance required. CoC has the potential to solve this and re-popularise hip resurfacing.

CoC THA has been complicated with fractures and clicking or squeaking noises, which could deter patients from having a CoC hip resurfacing. However, Gamble et al. [8] discussed the issues of CoC and found that the majority were seen in older generation ceramics. Squeaking or clicking noises are believed to be due to lubrication surface mismatch [8], and so, long-term data for CoC resurfacing will be required to assess if these issues arise and if it will decrease the popularity of this implant.

MoM hip resurfacing is limited to males with a normal anatomy and a head diameter size of 50mm or more, due to the risk of ALVAL and pseudotumours. If trials of CoC hip resurfacing prove to be clinically successful, this implant may be available to a wider population group with the benefit of the reduced cost of follow ups and may cause the rebirth of hip resurfacing.

The limitations of this study are that the costs calculated are those for the best-case scenario, without considering the increasing surveillance costs in symptomatic patients. Additional costs, such as the phlebotomist salary, setting up of the clinic and follow up of each implant, are not added. The long-term data of CoC hip resurfacing are not available yet. The initial cost of the implants is not included and there is currently limited literature about CoC due to the novelty of the implant.

5. Conclusions

If CoC hip resurfacing proves to be at least as clinically successful as MoM hip resurfacing, the economics strongly favour CoC bearing for resurfacing.

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