Hip resurfacing revision rates: radiological audit of risk factors

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ABSTRACT

INTRODUCTION We performed a retrospective radiological audit of the hip resurfacings carried out in our trust over a five-year period. Abnormal cup inclination angle (CIA) and stem shaft angle (SSA) are recognised risk factors for revision in hip resurfacing. Our aims were to identify the CIA and SSA for hip resurfacings in our trust, to determine the revision rate in a CIA of $\geq 60^\circ$ and an SSA of $>0^\circ$ varus, thereby identifying a high risk group for close, long-term follow up.

METHODS A total of 247 patients underwent hip resurfacing in our trust between April 2003 and March 2008. The CIA and SSA were recorded. Of the 247 patients, 26 were excluded as there were no appropriate radiographs and so results were analysed for 221 patients.

RESULTS The mean CIA was 47.6° . Over a third of the patients (34%) had a CIA of $>50^\circ$ and 13% had $>60^\circ$. The mean SSA was 1.4° varus. Over two-thirds of the patients (67%) had a varus SSA. There were six revisions but one was excluded as it was secondary to infection. The revision rate was 10% in patients with a CIA of $\geq 60^\circ$ and 1% in those with a CIA of $<60^\circ$ ($p=0.017$), and 1% in a varus and 4% in a valgus SSA ($p>0.05$) respectively.

CONCLUSIONS The measurement of the CIA and SSA in hip resurfacings has identified a high risk group for close long-term follow up. There is already a 10% revision rate in those patients with a CIA of $>60^\circ$. Hip resurfacing may generate a large revision burden in the 'average' surgeon's hands and all hospitals/surgeons should review their radiological outcomes critically and identify those at risk of revision.

KEYWORDS

Hip resurfacing – Cup inclination angle – Stem shaft angle

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Short- and medium-term clinical outcomes for hip resurfacing arthroplasty are promising.^{1–4} Resurfacing offers the potential advantages of the preservation of proximal femoral bone stock, hard bearings and a low risk of dislocation. However, there is concern regarding femoral neck fracture, systemic release of metal ions^{5–7} and early failures.⁸ We now know that component positioning may influence outcomes.⁷ Metal ion release is particularly higher in cups with a cup inclination angle (CIA) of $>50^\circ$.^{5,7} There is a biomechanical advantage of the valgus placement of the femoral stem.^{9,10} There is also evidence for an increased fracture rate with stems placed in varus.¹¹ Now that we have this information, it is vital for hospitals to identify patient groups at high risk of hip resurfacing so that these patients can be followed closely.

We have performed a radiological survey of hip resurfacings in our trust. The aims of this study were to identify the CIA and stem shaft angle (SSA) for hip resurfacings in our trust and to determine the revision rate in patients with a CIA of $\geq 60^\circ$ and an SSA of $>0^\circ$ varus, thereby identifying

a high-risk group for close, long-term follow up. Currently, there is a managerial push in most units against long-term follow up of all but a few patients with primary joint replacements. Identification of high-risk groups is necessary for long-term follow-up. For the purpose of our study we defined high-risk cases as hip resurfacings with either a CIA of $\geq 60^\circ$ or an SSA of $>0^\circ$ varus.

Methods

Hip resurfacings performed between April 2003 and March 2008 across two sites in our trust were identified from the medical records through coding. All the patients' pre and immediate postoperative radiographs were studied by the trainee surgeon (NR). Most of the measurements were performed on the picture archiving and communications system (PACS) electronic digital radiology system. The measurements for radiographs not available on PACS were studied on hard copies.

The CIA and SSA were measured for all available ra-

Table 1 Details of patients requiring revision

Age	Sex	Inclination	Valgus angle	Mode of failure
49	F	65°	3°	Loose cup
55	F	40°	0°	Loose stem
56	F	64°	-6°	Loose stem
57	M	40°	-5°	Loose cup
57	F	63°	4°	Loose stem

diographs. The CIA is the angle between a line connecting the two tear drops and one drawn along the two outermost edges of the cup (Fig 1, A). The patients' own femoral neck shaft angle was identified by measuring the angle between a line drawn along the long axis of the femoral shaft and one along the central axis of the femoral neck on the preoperative anteroposterior pelvis radiograph (Fig 1, B). The SSA is determined postoperatively by measuring the angle between a line drawn along the long axis of the femoral shaft and one along the peg of the femoral component on the anteroposterior pelvis radiograph (Fig 1, C). The SSA is the difference between the pre and postoperative measurements, with a negative value suggestive of a varus stem placement and a positive value suggestive of a valgus stem placement.

Revisions for hip resurfacings were identified during this period. The modes of failure for revision were noted. The statistical analysis of the results was performed using SPSS® v16.0 (SPSS Inc, Chicago, Illinois, US).

Results

A total of 247 patients underwent hip resurfacing in the trust during the period studied. Of these, 26 patients were excluded from the study as there were no standard anteroposterior radiographs of the pelvis. There were no revisions from this excluded group. Results were analysed for 221 patients. The mean age of the patients was 52.7 years (range: 22–68 years). There were 161 males and 60 females. There were seven consultant surgeons who performed or supervised the surgery. The range of follow-up was 6–62 months, with a mean follow-up of 34 months. There were six revisions from the group. One revision was secondary to infection and was therefore excluded. Table 1 summarises the revisions and the modes of failure.

The mean CIA was 47.63° (range: 24–76°). Figure 2 shows the CIA for all patients. Seventy-six (34%) and twenty-nine (13%) patients had a CIA of >50° and >60° respectively. There were 16 males and 13 females with a CIA of ≥60°. Three out of the twenty-nine resurfacings (10%) with a CIA of ≥60° had a revision. All these three revisions were in females. Only 2 out of the 192 resurfacings (1%) with a CIA of <60° had a revision. This was statistically significant ($p=0.017$, Fisher's exact test). The revision risk is 11 times higher if the CIA is ≥60° (odds ratio).

The mean SSA was 1.4° varus (Fig 3). A total of 149 patients (67%) had a varus SSA. Only 2 out of the 149 resurfac-

Figure 1 Radiograph showing how the radiological angles are measured

ings (1%) with a varus SSA had a revision whereas 3 out of the 72 resurfacings (4%) with a valgus or neutral SSA had a revision. Although there was a slightly higher revision rate in valgus stems in our study, this was not statistically significant ($p>0.05$, Fisher's exact test).

Only 1 out of 161 males (1%) had a revision while 4 out of 60 females (7%) had a revision. There were 47 females with a CIA of <60° and 13 females with a CIA of ≥60°. There was one revision (2%) in females with a CIA of <60° and three revisions (23%) in females with a CIA of ≥60°.

Discussion

Data from the fifth annual report of the National Joint Registry suggest a revision rate in hip resurfacings of 3% in the first three years compared with 1% in cemented hip arthroplasty in patients under 65 years.⁸ Our series has a 2.7% revision rate at a mean follow-up of nearly three years. From our study we have identified a high-risk group and will be able to follow these patients up closely.

Our paper stresses the importance of self-assessment of crucial radiological measurements in hip resurfacing. Our radiological study shows that there is an increased revision risk for a high CIA and varus SSA. In a multiple-surgeon, district general hospital environment there is a high proportion of resurfacing implants at risk of high metal ion release and early failure. This may represent the future revision burden associated with hip resurfacing and possibly large diameter metal-on-metal hip arthroplasty.

A drawback of our study was that the CIA and SSA were not correlated with clinical outcomes of the patients such as groin pain, function, satisfaction etc. We have considered component position and revision surgery as the main end-points for our study.

Biomechanical studies show that a varus placement of the stem can increase the bending moments at the femoral neck and can predispose it to fracture.^{9,10,12} A cadaveric study placed femurs in a relative varus placement of 10° and 20° and a relative valgus placement of 10° and 20° while Birmingham hip resurfacing components were placed. The results showed that the maximum load to failure was with 20°

valgus placement. Specimens with a varus placement were weaker compared with those with a neutral alignment.⁹

However, there is a risk of notching with more valgus placement of the stem. Beaulé *et al* reviewed 94 hips in patients under 40 years of age who had undergone hip resurfacing and found that an SSA of $\leq 130^\circ$ was associated with adverse radiological changes or early failure.¹¹ This rate of adverse outcome was 6.1 times greater than in the group in which the SSA was $>130^\circ$. Our study shows only 33% of patients having a neutral or valgus SSA. This suggests the difficulty in achieving accurate measurements intraoperatively. Nevertheless, in our study the revision rate is similar in patients with a varus and valgus SSA.

Regarding the CIA, the evidence suggests an increased metal ion production with a CIA of $>50^\circ$.^{5,7} One study showed increased levels of cobalt and chromium in whole blood and urine at one year, followed by a decreasing trend until the sixth year.¹⁵ In another study, 42 patients who had a revision of hip resurfacings were reviewed. An increased CIA resulted in 27 revisions in this series.¹⁴ Our study identifies the patients with a CIA of $>50^\circ$ and $>60^\circ$. Our results show similar trends of a high revision rate in a high CIA.

Our study also shows the increased risk of revision in females, especially with a high CIA. Our findings are similar to those for De Haan's series of revisions in hip resurfacings, with 30 female patients in 42 revisions.¹⁴

Conclusions

The measurement of the CIA and SSA in hip resurfacings has identified a high-risk group for close long-term follow-up in our trust. It is clear from the evidence and from our results that the risk of complications is higher in patients with a CIA of $>60^\circ$. Although our results show a slightly higher revision rate in valgus stems, it is prudent for us to follow these patients up in the long term to see any significant difference. Hip resurfacing may generate a large revision burden in the 'average' surgeon's hands and all hospitals/surgeons should review their radiological outcomes critically and identify those at risk of revision.

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