Accuracy and Reliability of Total Hip Resurfacing Templating on Conventional Radiographs

Choi J K; 1W Wang; E Yoon; 1Nyce J D; 2Geller, J A; 3Macaulay W
1Center for Hip and Knee Replacement (CHKR), Columbia University, New York, NY
wm143@columbia.edu

INTRODUCTION:
Preoperative templating is important for complication avoidance and planning metal-on-metal hip resurfacing (MOMHR). However, the utility of preoperative templating for MOMHR on conventional radiographs has not been fully studied. The purpose of this study was to determine the accuracy and intra- and inter-observer reliability of templating on conventional radiographs to determine its usefulness for approximating acetabular and femoral component sizes in MOMHR.

METHODS:
Preoperative conventional low AP pelvis (CLAPs) radiographs from 80 patients were randomly selected from 169 patients who had undergone uncomplicated MOMHR using Birmingham Hip Resurfacing devices (BHRs, femoral component available in 4 mm increment sizes; prior to 2 mm increment sizes). Four independent observers templated CLAPs on 2 separate occasions with a minimum of 3 weeks between sessions. Templating was performed in a blinded manner using magnified templates provided by the implant manufacturer (Figure 1). The accuracy of templating was calculated as the percent agreement between the templated size and the implanted size for each component. Age, gender, preoperative WOMAC score, preoperative SF-12, BMI, diagnosis, surgical time, and component size were evaluated using multiple regression analysis to investigate the effect on the accuracy of templating. A chi-square test was used to evaluate the difference between the two components, acetabular versus femoral. Moreover, Kappa analysis was used to calculate reliability of inter-observer and intra-observer agreement.

RESULTS:
The overall accuracy of templating within one size of the actual components increased to 81.7% for the femoral component and 98.5% for the acetabular component (Table 2). The accuracy of the femoral component was significantly higher than that of the acetabular component for all surgeons (P<0.05). Overall, the intra-observer and the inter-observer reliability were substantial (k=0.61) and moderate (k=0.43) for the femoral component and fair (k=0.39) and fair (k=0.22) for the acetabular component respectively (Table 3). Surgical time was found as the only effective factor for the accuracy of acetabular component (P=0.03) while all other factors had no effect on accuracy.

DISCUSSION:
The current study is the first we are aware of to investigate the reliability of templating for MOMHR on conventional radiographs. Previous studies have reported that the accuracy of templating for total hip arthroplasty on conventional radiograph was 42-68% and that of digital templating for MOMHR was 47-54%. This study shows that templating on conventional radiographs for MOMHR is a comparatively useful method for planning the component size, especially as it relates to the femoral component. Reduced accuracy and reliability of the acetabular component as compared to that of the femoral component may be due to the fact that the size of the femoral component is essentially determined by the largest width of the femoral neck (which is often seen best on the CLAP). The three dimensional nature of the acetabulum makes precise prediction of the size of the acetabular component to be used more illusory. Also, the fact that the incremental difference in femoral component size was 4 mm (at the time of the performance of these MOMHR cases; now they are available in 2mm increments) In addition, there are two acetabular components available for each standard femoral component size in templates that we used in this study (figure 1). Therefore, the templated size of the acetabular component needs to be adjusted intraoperatively more often than that of the femoral component. The current study only found surgical time as the factor which affected the accuracy of templating. One possible explanation for this may have been that these cases were likely more difficult with a higher likelihood of anatomic deformity (dysplasia, osteophytes, focal bony deficiency), thus making them longer surgeries. Though BMI has been shown to have an effect on templating, it was not noted to have an influence on the accuracy of templating in this study because the BMI was informed to the observers when we templated.

CONCLUSION:
This study shows that templating conventional radiographs for MOMHR is a useful method of planning for component size. Additionally, the templating the size of the acetabular component (38%) is less accurate and reliable than templating the femoral component (65%). Therefore, by templating with this method, an experienced surgeon can have the proper implants in the OR (at the start of the case) 100% of the time by having the templated femoral component size including one size up and one size down (3 femoral components, and all acetabular component options which match these).

Accuracy: Acetabular | Accuracy: Femoral Side
---|---
1st | 2nd | 1st | 2nd
Surgeon 1 | 87.5% | 86.3% | 100% | 100%
(60/80) | (52/80) | (50/80) | (50/80)
Surgeon 2 | 73.8% | 86.3% | 98.8% | 100%
(49/80) | (50/80) | (50/80) | (50/80)
Surgeon 3 | 70% | 75% | 96.3% | 97.5%
(49/80) | (50/80) | (50/80) | (50/80)
Surgeon 4 | 82.5% | 83.8% | 98.8% | 98.8%
(49/80) | (50/80) | (50/80) | (50/80)
Average | 78.4% | 82.8% | 98.4% | 99.1%
80.6% | 98.8%

Table 2. Component Templating Agreement within 1 size

Accuracy: acetabular | Accuracy: Femoral
---|---
1st | 2nd | 1st | 2nd
Surgeon 1 | 0.54 | 0.73 | 0.00-0.02 slight
Surgeon 2 | 0.37 | 0.51 | 0.21-0.40 fair
Surgeon 3 | 0.17 | 0.30 | 0.41-0.60 moderate
Surgeon 4 | 0.47 | 0.90 | 0.61-0.08 substantial
Average | 0.39 | 0.61 | 0.81-1.00 almost perfect

Table 3. Inter-observer and Inter-observer Reliability

Figure 1. Conventional anteroposterior hip radiograph demonstrating acetabular and femoral component templating