The Validity of Preoperative Templating inCementless Total Hip Arthroplasty: A Pilot Study

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ABSTRACT:

BACKGROUND:

Preoperative templating plays an important role in orthopaedic surgery for achieving a successful outcome in THA. This includes not only selecting the type and size of implant, but also deciding on the alignment, position, and orientation of these implants, relying on anatomically defined landmarks

OBJECTIVE:

The first goal of this study was to evaluate the validity of preoperative templating technique in terms of determining the final implant size and position.

The second goal was to investigate the interobserver and Intraobserver reliability of template readings on conventional radiographs.

METHOD:

In Aljumhorei hospital, Mosul city a case series; pilot study has been carried for twenty-eight patients had preoperative templating for total hip arthroplasty between 21/10/2009 to 16/5/2012 was carried by the operating surgeon. Preoperative templating by same two orthopedic surgeons carried for 12 patients from the total. Preoperative templating for Seventeen patientsout of the total were studied with the same operating surgeon after 2 years of experiences.

RESULTS:

29% compatibility for shell between preoperative templating with intraoperative for the operator, P_ 0.023. While for stem 39%P_ 0.257. Second surgeon 58% compatibility with P_0.564, Stem differences represent 33% (P_ 0.248). Differences with two years experiences for the operating surgeon indicate 35% compatibility both for shell and the stem with non-significant differences.

CONCLUSION:

Preoperative templating appeared to be more accurate for femoral stem measurements than the acetabular templating in determining the accurate sizes. Two years experienced added no more in templating measurements. There were significant differences for interobserver measurements .

KEY WORDS: preoperative templating, cementless total hip arthroplasty.

INTRODUCTION:

Preoperative templating plays an important role in orthopaedic surgery for achieving a successful outcomein THA. This includes not only selecting the type and size of implant, but also deciding on the alignment, position, and orientation of these implants, relying on anatomically defined landmarks. Optimizing implantsize and position by way of preoperative templating mayhelp to improve hip joint kinematics and enhance the longevity of the joint replacement,recently implementation of digital image has been used increasingly[1,2].

Gamble et al found that templating using standard hardcopy radiographs and transparent magnified on lay templates has proven to be an accurate and effective method in predicting prosthesis sizes, minimize guesswork and anticipate potential intraoperative problems [3].

The introduction of digital technology has proffered the viewing physicians with many advantages, including image manipulation and magnification. Furthermore, with new software, orthopedic surgeons can now digitally template directly onto the digital images[4] .

The first aim of this study is to evaluate the validity of preoperative templating technique in terms of determining the final implant size and position. The second aim of this study is to investigate the interobserver and Intraobserver reliability of template readings on conventional radiographs.

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PATIENTS AND METHODS:

Twenty-eight patients were included in the study between 21/10/2009 to 16/5/2012. Age varies between 21-60 years, mean ages 40.5 ± 7 SDyears.

Indications for total hip arthroplasty (THA) varies between primary osteoarthritis (O A) of the hip, acetabular dysplasia of DDH with O A , a vascular necrosis post cortisone therapy, hip fracture and dislocation with O A , perthes disease, chronic lymphocytic leukaemia (C L L) , hip arthrodesis post infection, multiple sclerosis with O A patient(tab 1).

Fifteen patients were males and thirteen werefemales. Thirteen patients had right hip involvementand fifteen patients had the left hip involvement.Preoperative templating was done for twenty-eightpatients and compared with intraoperative measurements by the first surgeon. Preoperative templating was done for twelve patients from the total byoperating and second orthopedic surgeons .Seventeen patients from the total were studied with the operatingsurgeon after 2 years of experience.

Inclusion Criteria:

Patients who underwent a primary uncemented THA with a Trident acetabular cup and Omni fit femoral stem (Stryker, Mahwah, NJ) were considered for inclusion in the study.

We obtained informed consent before acquiring standard hard-copy film-screened radiographs (conventional radio-graphs). Anteroposterior views of the pelvis were taken with the patient lying flat on the table; the tube beam was placed over the pubic symphysis. The hips were internally rotated 10° to 15° to compensate for the physiologic anteversion. All the preoperative and postoperative radiographs were obtained with a standardized 100-cm distance from the tube to the x-ray plate. An average magnification of 20% ± 6%.visualisation of the proximal third of the femur was necessary for full femoral stem templating [4,5,6].

The templating (Fig 1) of the acetabular cup began by drawing a reference line through the base of the acetabular tear drops, and then the size of the acetabular component was template. We selected the size of the drawn transparency that best fit the acetabulum. If the acetabular anatomy and component size were difficult to discern because of joint destruction, the opposite relatively normal or previously replaced hip was used as a guide for the best approximation.

The femoral templates(Fig 2) placed over the radiograph such that the optimal fill of both the intramedullary canal and the proximal femoral metaphysis was achieved. The size of the femoral component is determined by adjusting its medial side to the medial wall of the medullary canal. The sizes of the prosthesis selected wrote on the paper to be compared later on with the postoperative final prosthesis sizes.

Still we use hard-copy radiographs in theoperative suite because they are convenient andare not subject to computer outages. Furthermore, all the templates and radiographs that we use for the primary and revision cases are not available onthe computer.

All observers were orthopaedic surgeons with a minimum of 5 years 'experience consultants in orthopaedic surgery with an interest in joint arthroplasty. The observers worked independently.

Statistical analysis carried by ,t-test and CI for One Proportion, test and CI forZ-two Proportions, Chi-Square Test,Significant P value ≤ 0.05 were consider.

RESULT:

Table 2: Showed 29%compatibility,(18-21%) (-2,+2),14% (-4,+4), (4%) with (+6) differences sizes consequently for shell between the preoperative templating with intraoperative for the operator, P_ 0.023. While for stem 39% ,(11-21%) (+1,-1) , 14% (-2), 14% (-3)consequently with. P_ 0.257

Second surgeon 58% compatibility,25% two sizes above (+2), 17% (-4) four sizes below differences, with P_0.564 . Stem compatibility represent 33%, 33% (0, -1),17% two sizes below (-2),8%-33%one size above and one below (+1,-1) , 33% three sizes below (-3)consequently with P_ 0.248.

Figure 1: A-P Silhouettes X–Ray Analysis Templates for Acetabular Cup Side.

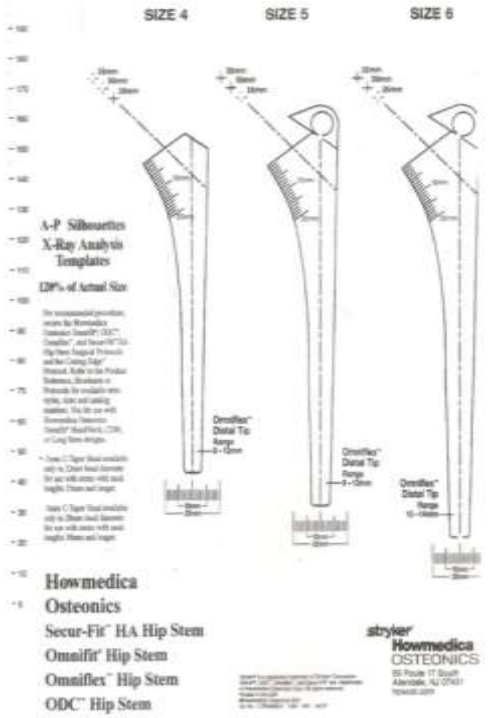

Figure 2: A-P Silhouettes X–Ray Analysis Templates for Femoral Side

Comparing differences of shell between both surgeon was revealed that compatibility with 35%,12% two sizes above (+2), 8% two below (-2),6% four sizes above and below (±4) consequently, with significant P_ 0.002. While for stem compatibility 35% ,18% one size above (+1),24% one sizes below (-1), 12% two sizes above (+2), 6% for three and four sizes below (-3,-4)consequently, with non-significant P_ 0.225.

Differences shell sizes with two years experiences for the operating surgeon indicate 35% compatibility ,two sizes above and below (± 2) 12-18%,6% four sizes above and below (±4) , 6-18% six sizes above and below (±6) consequently, with non-significantP_0.225. While for stem 35% compatibility,29% one size above and below (± 1), 24% two sizes below (-2), 6% one and three sizes above (+1,+3) consequently,non-significant P_0.225.

Table 3: Indicate 69.2% ,71.4% with non-significant differences P_0.811, X2 =0.057 for shell, while stem differences varies between 69.2% , 61% which exhibit also non-significant differences P_ 0.390,X2=0.738.

DISCUSSION:

Preoperative templating is a common tool by the surgeons how use to plan both component selection and placement,Today, it is important try to restore normal mechanics of the hip joint, determine the anatomical center of the acetabulum and normalize the relation between the pelvic bone and femur as much as possible.(7-8).

The current study suggested that preoperative templatingShowed 29% compatibility , the reliability varies (18-21%) (±2) with two sizes above and below, 14% (±4) four sizes above and below, (4%) with (+6) six size above consequently for shell between the preoperative templating with intraoperative measurements carried by the operator with (P_ 0.023). Stem compatibility reach to 39% , the percentage of compatibility was reduced to(11-21%) for one size measurements above and below (±1) , 14% two sizes below (-2), 14% three sizes below (-3)consequently with non-significant (P_ 0.257).

In comparison for others preoperative templating was associated with higher accuracy in predicting the final prosthetic size; however, this finding was found only for the femoral component. The exact size of the prosthesis to be used can be accurately predicted in only 42%for the acetabular component and 68% for the femoral component(1).While preoperative templating accuracy represents about 62% for acetabular cups, while low accuracy 42% for uncemented femoral stems, 50% for femoral components and 65% for uncemented acetabular components[7,9,10] .Michael Olsen added that preoperative templating was accurate selecting the correct acetabular component in 47% ,and the correct femoral component in 54% of templates performed .The prediction of final prosthetic component size increased to80.6% within ±1 size for the acetabular component and98.8% within ±1 size for the femoral component .For the acetabular components, the predictability and reliability of templating were much lower than those for the femoral component[7].

Unnanuntana stated alow accuracy For cementless acetabular components measurements can be explained by several factors. First, the rotation of preoperative radiographs Second, a mildly dysplastic acetabulum, taking preoperative templating more difficult. Third, because of the press fit technique, which required 1 to 2 mm of underreaming, made the surgeon could lose sensation of tightness between the last reamer and acetabular bed [1].

Jung addedreduced accuracy and reliability of the acetabular component as compared with those 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 .In contrast, the3-dimensional nature of the acetabulum makes precise prediction of the size of the acetabular component to be used more challenging[11].

In the present study second surgeon measurements represent 58% compatibility for the shell ,which was reduced to 25% (+2)sizes above , and to 17% (-4)sizes below.While stem measurements exhibit 33% compatibility which is more or less near to the reading was performed by the first operator. It was reduced to 17% (-2)sizes below, 8%-33% (±1)sizes below and above , 33% (-3)sizes below consequently with non-significant P_ 0.248. In comparison between both surgeons for shell measurements was revealed that compatibility with 35% with significant P_ 0.002. While for stem compatibility 35% with non-significant differences P_ 0.225.

Kosashvilietal mentioned in their study a more

detailed description of the kappa statistic can be found in Intraobserver agreement which was excellent for the femoral component (κ = 0.92/1.0), Very good for the acetabular component (κ = 0.60/0.77). Interobserver agreement was excellent for the femoral component (κ = 1.0/1.0), Fair to moderate for the acetabular component (κ = 0.36/0.45) this results indicate that conventional templating techniques is reliable[12].

In the present study there were non-significant differences after two years' experience which exhibit the role of measurement's which has been followed was the same and practice was not able to predict a lot of component size differences .

In other study Interobserver and intra-observer reliability measurements of the preoperative plans were never very good Q (0.81-1.00). The poor reliability suggests that using these templates correctly which may be because of a lack of reliable anatomic landmarks[14,15].

On the contrary to our study the accuracy of surgeon who is the most experienced at performing hip was able to predict the component size in 95% of cases, in comparison to 88 and 82% for the less experienced planner[9,13,15] .

Table 1: Distributions of the operating patients with (T H A) according to their complained.

Diseases of the involved patients	Number of patients	Percentage %
Primary osteoarthritis of the hip.	3	11
Acetabular hip dysplasia	6	21
Avascular necrosis femoral head post cortisone therapy.	3	11
Hip fracture and dislocation.	9	32
Perthes disease	2	7
Chronic lymphocytic leukaemia	1	4
Hip arthrodesis post infection	2	7
Multiple sclerosis	1	4
Exposure to irradiations	1	4
Total	28	100

Table 2: Exhibit differences for shell and stem sizes measurements between preoperative templating and intraoperative actual sizes for operating, and second orthopedic surgeons.

		Differences in size measurements													
		Sizes above and below													
Component prosthesis	%	0	+1	-1	+2	-2	+3	-3	+4	4-	5+	5-	6+	-6	P_value
Shell for operating surgeon	percentage	29	*	*	21	18	*	*	14	14	*	*	4	*	0.023*
Stem for operating surgeon		39	11	21	*	14	*	14	*	*	*	*	*	*	0.257
Shell for second surgeon	percentage	58	*	*	25	*	*	*	*	17	*	*	*	*	0.564
Stem for second surgeon		33	8	33	*	17	*	8	*	*	*	*	*	*	0.248
Shell for both surgeon	percentage	35	*	*	12	18	*	*	6	6	*	*	6	6	0.002*
Stem for both surgeon		35	18	24	12	*	*	6	*	6	*	*	*	*	0.225
Shell for 2 years surgeon experiences	percentage	35	*	*	12	18	*	*	6	6	*	*	6	18	0.225
Stem for 2 years surgeon Experiences		35	6	29	*	24	6	*	*	*	*	*	*	*	0.225

Table 3: Showed the chi-square ,P_value two years experiences between 2010 , 2011, both for shell and stem measurements.

	No. of patient 2010	%	No. of patient 2011	%	Total	%	P_value	DF	X^2
Shell	4	30.8	4	26.7	8	28.6	0.811	1	0.057
	9	69.2	11	73.3	20	71.4			
	13	100	15	100	28	100			
Stem	4	30.8	7	46.7	11	39	0.390	1	0.738
	9	69.2	8	53.3	17	61			
	13	100.0	15	100.0	28	100			

Significant P value ≤ 0.05

CONCLUSION:

Preoperative templating appeared to be more accurate for femoral stem measurements than the acetabular templating in determining the accurate sizes. Two years experienced added no more in templating measurements. There were significant differences for interobserver measurements **.**

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