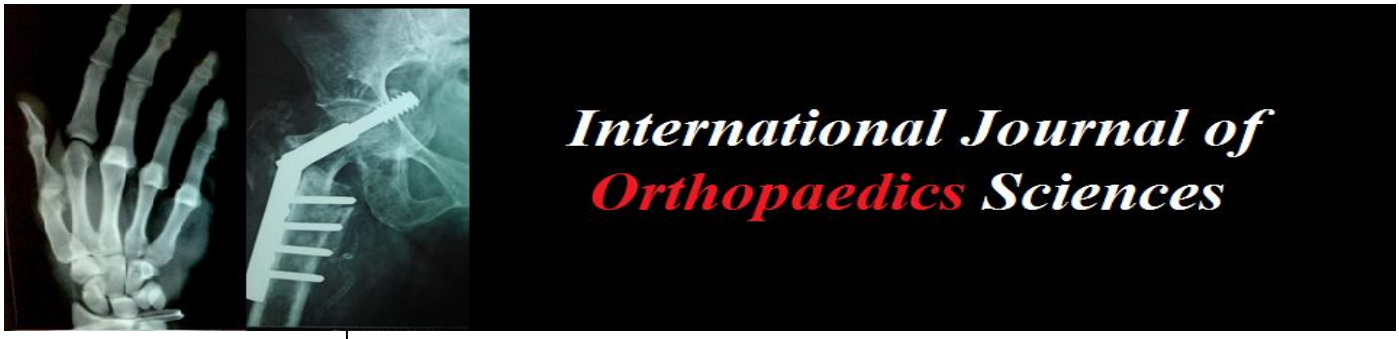

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(1): 1073-1077

www.orthopaper.com
Received: 19-11-2019
Accepted: 23-12-2019

Dr. Akshay Kumar Sharma
Orthopaedic Surgeon, Military Hospital, Dehradun, Uttarakhand, India

Dr. Kamparsh Thakur
Clinical tutor in Dept of orthopaedics, A.F.M.C., Pune, Maharashtra, India

Dr. CM Singh
Assoc Prof Dept of orthopaedics, A.F.M.C., Pune, Maharashtra, India

Dr. Yogesh Sharma
Former Prof and HOD orthopaedics at A.F.M.C., Pune, Maharashtra, India

Corresponding Author:
Dr. Akshay Kumar Sharma
Orthopaedic Surgeon, Military Hospital, Dehradun, Uttarakhand, India

Efficacy of conventional method of preoperative templating in implant size selection in patent undergoing total hip arthroplasty

Dr. Akshay Kumar Sharma, Dr. Kamparsh Thakur, Dr. CM Singh and Dr. Yogesh Sharma

DOI: https://doi.org/10.22271/ortho.2020.v6.i1n.1964

Abstract
Preoperative templating in total hip arthroplasty is useful in providing details to restore the normal biomechanics and also reduce the guess work. This study was done to asses the efficacy of traditional templating method in the modern times for implant size selection in patient undergoing total hip arthroplasty. We evaluated the accuracy of preoperative templating in 60 primary total hip arthroplasty. Exact size was predicted of 36.6 % acetabulum and 58.3% femoral component. Accuracy was increased to 88.8 % for acetabulum and 90% when one size variation was taken into account. Accuracy of size prediction was better for cemented as compared to uncemented implants. Cemented acetabulum was predicted 54.5% as compared to 26.6% for uncemented implants. Cemented femoral component was predicted in 77.3% vs 47.4% for uncemented femoral stem.

Keywords: Templating in total hip arthroplasty, cemented vs uncemented components, femoral stem

1. Introduction
Total hip arthroplasty (THA) is the most successful and most effective surgery in the world [1]. Success rate of this surgery in experienced medical centers are within 95%. Preoperative templating is an essential preoperative step in this surgery, which had been emphasized by Sir John Charnley also. Preoperative templating encompasses anticipation of type of implants to be used, anticipation of size and position, determining offset, calculation of limb length inequality and anticipating any potential intraop problem prior from preoperative radiographs [2]. In conventional method acetate template are overlaid over AP and Lateral radiographs and assessment is done for prosthesis to be used. Radiographs are evaluated not for size and position of prosthesis but also for bone loss, dysplasia, osteophytes, requirement of bone grafting etc.Reviewing literature we found numerous studies showing effectiveness of total hip arthroplasty providing good functional outcome however very few studies available to assess the effectiveness of preoperative templating in total hip arthroplasty [3]. The aim of this study is to evaluate the efficacy of preoperative templating technique in terms of determining the final implant size of both acetabulum and femoral component.

2. Material and Method
After obtaining ethical clearance from the institutional ethical committee, this study was conducted over a period of December 2015 to September 2017 in a tertiary care hospital in Maharashtra. Only patients undergoing primary total hip arthroplasty were taken into account and patient with b/l gross destruction of hip anatomy, b/l fixed external rotation deformity were excluded from study. Usually in case of monoarthritis hip if the involved hip can't be rotated internally then the templating done on opposite hip and results are reproduced on affected hip [4, 5].

2.1 Preoperative X-Ray
For accurate templating on radiographs, radiograph should be well exposed, well centered and properly positioned [6].

As compared to normal anteroposterior view of pelvis, the AP view is taken with centering on the pubic symphysis. In radiographs for templating the proximal extent is up to ASIS and greater extent of femoral shaft is seen. To calculate the offset of the hip accurately on radiographs, the anteversion of hip has to be taken into account. Offset can be calculated accurately by taking care of normal femoral neck ante-version. By internally rotating the both lower limbs, femoral neck is brought parallel to the film and offset can be calculated properly [7]. To determine the rotation on radiograph the lesser trochanter is assessed. In normal limb position which is 15° to 20° external rotation, lesser trochanter is more prominent and usually measures more than 5 mm from femoral cortex. However in 15°-20° of internal rotation the value lies between 2-5 mm and will not be seen or less than 2 mm in case of excessive internal rotation [6]. In cases involving both sides fixed external rotation deformities role of templating is not that advantageous. All the x-rays were obtained with 100 cm of distance from tube to x-ray plate. We controlled magnification by taking a standard object, metallic femoral head of 36mm in between both thighs near pubis in plane of greater trochanter. After x ray were evaluated and magnification of calibration object was assessed and noted down.

2.2 Landmarks on x-ray

Once x-ray were found to be of acceptable magnification and well centered then anatomical and mechanical landmarks marked on x-ray, as described by Scherlink [6].

2.3 Procedure of templating

Templating was preferably done on affected side but in cases of gross destruction of hip, templating was done on normal side and results were noted down.

2.4 Acetabulum

1. Landmarks on acetabular side marked were superolateral corner of acetabulum, illioischial line and tear drop on both side.
2. Line joining both teardrops were drawn on x-ray and this line extended both sides cutting proximal femur.
3. The inclination of acetabular component is decided by drawing a line 45° to inter-teardrop line at the tear drop.
4. Acetabular component was chosen so that its distal medial most part lie at or just lateral to teardrop with inferior margin of component at proxmial margin of obturator foramen.
5. Acetabulum component was chosen, not crossing the illioischial line with adequate preservation of subchondral bone.
6. While assessing lateral coverage large osteophytes not considered and component with adequate lateral coverage was chosen.
7. Component which fulfilled all above and also causing minimum loss of subchondral bone was chosen and centre of it marked on x-ray.
8. In case of planned cemented total hip arthroplasty, consideration was also given for adequate cement mantle.
9. Final acetabulum component selected and noted down on patient's record.

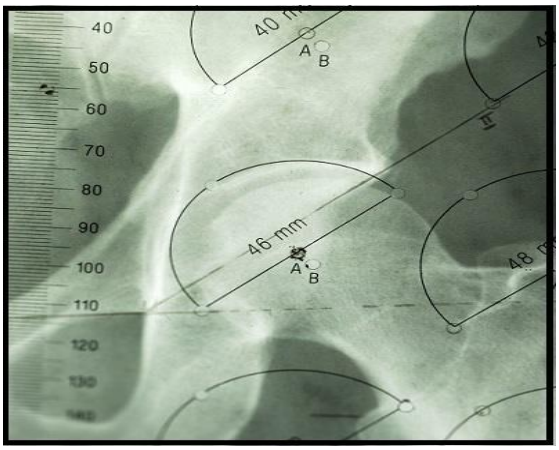

Fig 1: Uncemented acetabular component templating.

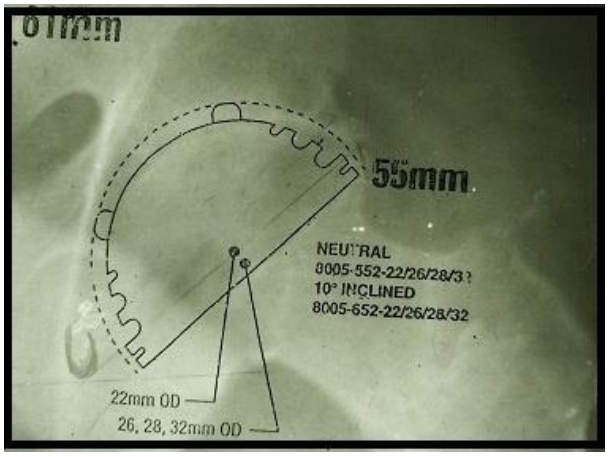

Fig 2: Templating for cemented acetabular component using same method, taking in account for cement mantle.

Femoral component

1. After acetabular templating the center of acetabulum component is marked and used as new center of rotation of hip
2. Axis of femoral shaft was drawn on AP and lateral x-ray.
3. Femoral component was chosen which perfectly fit the proximal femur.
4. Femoral component's axis aligned with femoral shaft axis.
5. Consideration was given for minimal loss of medullary canal.
6. In case of cemented implant consideration for cement mantle was given.
7. Center of femoral stem was marked and adjusted for limb length in relation to acetabular center of rotation.

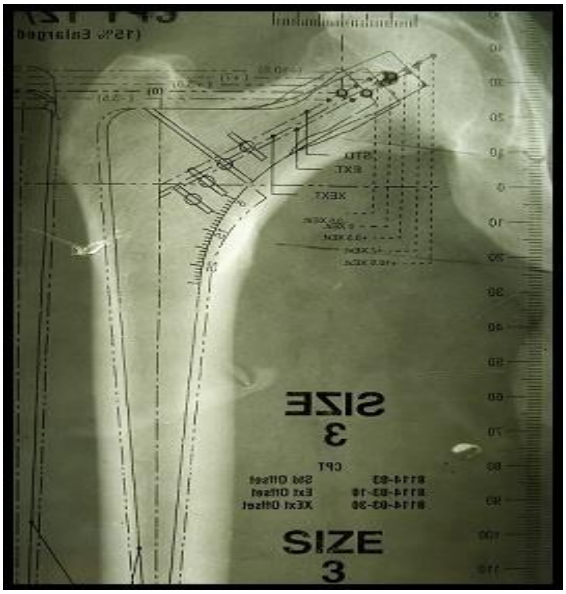

Fig 3: Templating for cemented femoral component on anteroposterior radiograph.

2.5 Operative procedure
For all total hip arthroplasty posterolateral approach was chosen.

2.6 Parameters which were recorded
1. Preoperative size selected for acetabulum and femoral component
2. Intraop final acetabulum and femoral component implanted.

3. Results
Data was analyzed using fisher t test, chi-square test and Z test for two proportions. Data was considered of statistical significant with p value less then 0.05. A total of 71 patients were included in the study, which were fulfilling the inclusion criteria. 11 patients were excluded from the study where magnification was not in 120%-130%.Cemented THA was done in 22 cases and 38 cases were of uncemented THA.

Mean age was calculated to be 55. 95 years (55.95 ± 9.73). 46.6% of patients were in age group of 51-60 years and only 5 % patients were more than 70 years of age. Indication for primary hip arthroplasty were avascular necrosis with secondary osteoarthritis in 24 patients, fracture neck of femur in 12 patients, inflammatory arthritis in 06 patients, primary osteoarthritis in 06 patients, post traumatic osteoarthritis in 08 patients, post infective arthritis of hip in 03 patient and one patient was of dysplastic hip with secondary osteoarthritis.

Preoperative templating resulted in accuracy of accurate prediction of size of acetabulum in 36.6% as compared to 58.3% of femoral components.

Table 1: Showing accurateprediction of acetabulum vs femoral components

Component	Accurate Prediction	Z Score	P-Value
Acetabulum	22/60	-2.3764	0.01372.
femoral	35/60		

Accuracy of preoperative templating in prediction of size was increased to 88.8% for acetabulum component and 90% when one size above and below along with predicted size were also considered. We were able to predict 53 acetabulum components and 54 femoral components when one size variation from exact predicted size was taken into account.

We also found preoperative templating was better predictor of sizes in cemented THA for both acetabular and femoral components. For acetabular component the accuracy in predicting exact size of preoperative templating was 54.5% in case of cemented component and 26.6% for uncemented acetabular components.When these results were statiscally analyzed using z test for two proportions significant p value was obtained. Similarly femoral component the Accuracy was 77.3% in cemented component and 47.4% for uncemented components. Also this is found to be statistically significant as shown in table below.

Table 2: Showing accuracy in size prediction of cemented vs cemented components.

Component	Cemented	Uncemented	Z Score	P Value
Acetabulum	12/22	10/38	2.1867	0.02852
Femoral	17/22	18/38	2.2642	0.02382

4. Discussion
Results for accuracy in prediction varies from studies to studies. The study conducted by Eggli *et al*. in 100 THA performed reported predicting more than 90% of the components size accurately [8]. However, further studies did not reproduce such significant accuracy in preoperative templating. Knight and Atwater [9] reported that accuracy in conventional implant sizing was achieved in 62% for acetabular cups, 78% for cemented femoral stems and 42% for uncemented stems. Study conducted by Untana *et al*. in 2009 [2], efficacy of preoperative templating for uncemented THA reported exact size was reported in 42.2% of acetabular component as compared to 68.8% in femoral components. Turgay efy *et al*. in study from university hospital Marburg, Germany in 2011 reported accuracy of 33.3 %for acetabular cup and 36 % for femoral component [10]. Study conducted by [11], showed an accuracy of 78.6% in predicting the size of the acetabular component and accuracy of 82.2% in predicting the femoral stem.

In our study we achieved accuracy in predicting acetabulum size exactly as used during intraop period was (38.3%) 23/60 and femoral component was accurately predicted in (58.3%) 35/60 number of patients. Knight *et al*. [9] in his study reported that this difference is due to difference in magnification. However his study found more accurate prediction of uncemented femoral component then uncemented acetabular cups. Eggli *et al* suggested that decrease in accuracy in prediction was due to peculiar feature of acetabular component [8]. He contributed this decrease in prediction mainly to intraoperative component used. Intraoperative component varied as it was difficult to control pelvic fixation during surgery and with change in position the acetabulum used different. Also surgeons experience also played a role in determining accurate position and achieving center of rotation of hip, resulting discordance of acetabular prediction.

Untana *et al*. [2] explained the increased accuracy for uncemented femoral components as compared to acetabulum components by mainly considering press fit technique. In press fit technique reaming is done 1-2 mm less for component to be implanted by press fit technique. He explained if the bone become soft, surgeon might lose the sensation of tightness between last reamer used and trial component and larger implant was placed in his study for achieving stability. He also explained the role of inadequate rotation of radiograph which distort the bony landmarks and make inadequate bony configuration giving inaccurate results.

Jung *et al* in his study also found this difference in prediction of acetabular component then femoral component. He suggested this discordance was due to three dimensional nature of acetabulum which make precise nature of acetabulum more challenging. While on the other hand femoral component can be predicted accurately as the size of femoral component was essentially determined by best fitting in proximal femur [13].

In our study we found cemented acetabular components were accurately predicted in 12/22(54.5%) and 10/38(26.6%) in case of uncemented acetabular cups implanted. Also in various studies similar results obtained suggesting more accuracy in predicting cemented acetabular shells as compared to uncemented shells. Della valle *et al*. in their study in 2005 [14], found that accuracy of templating for cemented acetabular component was 87% and 65% was for uncemented cups. However study by Eggli *et al*. reported predicted cemented acetabulum as accurately as 90% while studies conducted by Untana *et al*. predicted 42.2% for uncemented acetabulum [2] in 2009, 20% by standard onlay technique in study conducted by gamble *et al*. [15] In all the above studies as well our study it was observed templating results were better in case of cemented acetabular components. This could be explained as proposed by Untana *et al*. [2] that during uncemented component fixation for acetabulum press fit fixation technique is aimed at. Generally acetabulum is reamed 1-2 mm smaller then the acetabulum used. Inappropriate fitness of trial component as predicted due to soft bone may result in use of higher size for achieving stability then cemented components. For cemented components exact size as reamed is implanted and also consideration also given for cement mantle. As a result less variation in case of cemented component than uncemented components.

Results obtained while comparing cemented femoral stem with uncemented femoral stem suggestive of accurately predicting 77.3% in case of cemented component and 47.4% in case of uncemented femoral components. Results obtained by our study were showing the increase accuracy of templating for cemented femoral components. This is also shown in other studies like Eggli *et al*. [8] reported accuracy of cemented stem as high as 92%. Accuracy of uncemented femoral component calculated by Untana *et al*. [2] reported 68.8%. In 2009 and 40% by standard only technique by Gamble *et al*. in 2010. Accuracy in case of cemented femoral component can be explained by press fit technique. As press fit technique tend to ream 1size smaller, however if surgeon unable to achieve perfect fit, tend to implant larger implant.

In all the studies it has been shown that the accuracy of femoral templating improves when one size above/ below the template size also considered. Gamble *et al* in his study comparing preoperative templating accuracy on conventional with digital x-ray, reported increase of accuracy when within one size to exact size also considered. They reported improved accuracy in acetabulum to 60% and femoral component improved to 85%. Study conducted by Efe *et al*. showed prediction of +/- one size was reached in 77.5% for acetabular components and 82.3% for the femoral stems. Similarly study conducted by Riddick *et al*. [16] also reported increase in accuracy of templating to 87% in case of acetabulum and 90% for femoral component. Results obtained by our study also support the increased accuracy within one size of size predicted. Acetabulum prediction was increased to 88.3% as well as femoral component accuracy increased to 90%. This results helps in making implants available in the operating room which will significantly reduce the operating time as shown by Dalle Valle *et al*. [14]

5. Conclusion

In our study we concluded that preoperative templating still have important role in predicting implant size in THA. It reduces the guess work and also readily available implant might lead to reduction in operative time, we concluded that traditional preoperative templating was accurate more for cemented then uncemented THA, femoral component better predicted than acetabulum and significant improvement in size prediction if one size variation are also considered.

6. References

1. Carter LW, Stovall DO, Young TR. Determination of accuracy of preoperative templating of noncemented femoral prostheses. The Journal of arthroplasty. 1995; 10(4):507-13.
2. Unnanuntana A, Wagner D, Goodman SB. The accuracy of preoperative templating in cementless total hip arthroplasty. The Journal of arthroplasty. 2009; 24(2):180-6.
3. Krishnamoorthy VP, Perumal R, Daniel AJ, Poonnoose PM. Accuracy of templating the acetabular cup size in Total Hip Replacement using conventional acetate templates on digital radiographs. Journal of clinical orthopaedics and trauma. 2015; 6(4):215-9.
4. D'Antonio JA. Preoperative templating and choosing the implant for primary THA in the young patient. Instructional course lectures. 1993; 43:339-46.
5. Dore DD, Rubash HE. Primary total hip arthroplasty in the older patient: optimizing the results. Instructional course lectures. 1993; 43:347-57.
6. Scheerlinck T. Primary hip arthroplasty templating on standard radiographs: a stepwise approach. Acta Orthop Belg. 2010; 76(4):432.
7. Blackley HR, Howell GE, Rorabeck CH. Planning and management of the difficult primary hip replacement: preoperative planning and technical considerations. Instructional course lectures. 2000; 49:3.
8. Eggli S, Pisan M, Müller ME. The value of preoperative planning for total hip arthroplasty. J Bone Joint Surg Br. 1998; 80(3):382-90.
9. Knight JL, Atwater RD. Preoperative planning for total hip arthoplasty. Quantitating its utility and precision. J Arthroplasty. 1992; 7:4039.
10. Turgay E, El ZB. Precision of preoperative digital templating in total hip arthroplasty. Acta Orthopædica. 2011; 77:616-21.
11. Miashiro EH, Fujiki EN, Yamaguchi EN, Chikude T, Rodrigues LH, Fontes GM *et al*. Preoperative planning of primary total hip arthroplasty using conventional radiographs. Revista Brasileira de Ortopedia (English Edition). 2014; 49(2):140-8.
12. Devito FS, Chueire AG, Bonvicine C. Efficacy of the use of templating in total hip arthroplasty. Revista Brasileira de Ortopedia (English Edition). 2013; 48(2):178-85.
13. Jung KC, Jeffrey AG, Wenbao W, Jonathan DN, William M. The Accuracy and Reliability of Preoperative Templating for metal-on-metal hip resurfacing. The Journal of Arthroplasty. 2011; 26:765-69.
14. Della Valle AG, Padgett DE, Salvati EA. Preoperative planning for primary total hip arthroplasty. Journal of the American Academy of Orthopaedic Surgeons. 2005; 13(7):455-62.

15. Gamble P, de Beer J, Petruccelli D, Winemaker M. The accuracy of digital templating in uncemented total hip arthroplasty. The Journal of arthroplasty. 2010; 25(4):529-32.
16. Riddick A, Smith A, Thomas DP. Accuracy of preoperative templating in total hip arthroplasty. Journal of Orthopaedic Surgery. 2014; 22(2):173-6.