A Novel Method of Determining Acetabular Component Size to Guide Explant in Revision Hip Arthroplasty

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Revision hip arthroplasty is a frequently performed procedure and is projected to increase annually. Removal of a well-fixed acetabular component can involve loss of much needed bone stock. Contemporary instruments allow acetabular removal with minimal morbidity; however, their use requires accurate knowledge of the component size. We describe a technique that allows sizing to be determined accurately, without specialized equipment, in situations where component details are unavailable. Our technique multiplies ratio of head:cup on pre-operative X-ray by the diameter of the index femoral head which is removed intra-operatively to predict index cup size. This novel surgical technique appears accurate in prediction of cup size to guide explant in revision hip arthroplasty.

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that the calculation ($C_{xr}/H_{xr}$) intraoperatively during the revision surgery ($Hop$). We have found the predicted cup value for the revision cup. In our technique, the known diameter object is the femoral head which is removed intraoperatively during the revision surgery. We have found that the calculation ($C_{xr}/H_{xr} \times Hop$) can be performed quickly and easily intraoperatively to accurately predict acetabular cup size. This study aims to describe a technique to accurately predict index cup size in the absence of operation reports in revision hip arthroplasty.

**Surgical technique**

Preoperative radiographs are reviewed as part of the planning for revision hip arthroplasty surgery. The diameter of the acetabular cup ($C_{xr}$) and diameter of femoral head ($H_{xr}$) are measured. In our practice, digital imaging programs were used, but this technique could also be applied to Acetate film radiographs. Measurements were made using the Charnley Anteroposterior view. Figure 1 shows measurement of diameters using a digital imaging software program.

A ratio of cup:head is calculated. This ratio is then multiplied by the actual diameter of the index femoral head when it is removed and measured intraoperatively to give a predicted cup size value. The formula $C_{xr}/H_{xr} \times Hop$ gives predicted cup size ($C_{pred}$).

We write this formula on the board in the operating theater along with our standard templating measurements before scrubbing. We use the formula to calculate 3 possible cup sizes based on the common head sizes of 28 mm, 32 mm, and 36 mm. When the index femoral head is removed and measured, the surgeon consults the whiteboard to immediately find the corresponding cup diameter.

**Discussion**

Removing a well-fixed acetabular cup can be a challenging step in revision hip replacement surgery. Excessive bone loss or fracture of the acetabulum can compromise the fixation of a revision component [15–17]. Newer explant devices are available for the purpose of removal of a well-fixed acetabular cup while preventing excessive bone loss; however, knowledge of the size of the index cup is necessary to select the correct size explant device [18]. While this information is usually be obtained from operative reports, such things as case urgency, patient migration, record destruction, or clerical error may mean that it is not available.

As part of our preoperative templating, we calculate 3 predicted cup sizes as described. We consult this precalculated formula intraoperatively to immediately find the acetabular cup value which corresponds to the measured head size. We have found that this allows us to have the correctly-sized explant equipment available immediately in cases in which previous implant records or operative reports are unavailable.

The strength of this technique is its ease and simplicity. The materials needed are inexpensive and can be applied in most settings worldwide [19]. This step is easy to perform in addition to the standard preoperative templating measurements [9,20]. Knowledge of the correct size of acetabular cup can save time and decrease intraoperative complications by having the correct explant blade size selected and available to the surgeon without delay [17,18,21].

The main weakness of this technique is that it has yet to be put to widespread clinical use. We have found the formula accurate in determining the size of the existing cup; however a prospective study is required to validate the accuracy of our formula.

**Summary**

Use of this technique and formula for predicting acetabular cup size based on preoperative radiographs and measurement of the femoral head intra-operatively has the potential to reduce operating time and to decrease the risk of complications during revision hip arthroplasty surgery. It is simple and widely available to most surgeons. Prospective data is needed to validate this method, which appears to be effective in our practice.

**Conflict of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**References**

[1] Raves S, Davidson D, de Steiger RN. Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR). Hip, Knee & Shoulder Arthroplasty: 2019 Annual Report. Adelaide: AOANJRR; 2019. https://aoanjrr.sahmsi.com/annual-reports-2019.

[2] Goldberg VM. Revision of failure acetabular components with cementless acetabular components. Am J Orthop (Belle Mead NJ) 2002;31(4):206.

[3] Geerdink CH, Schaafsma J, Meyers WC, Grimm B, Tonino AJ. Cementless hemispheric hydroxyapatite-coated sockets for acetabular revision. J Arthroplasty 2007;22(3):369.

[4] Preiss RA, Patil S, Meek RM. The use of modular femoral head trials to centre the explant blade facilitates retrieval of well-fixed acetabular components with minimal bone loss. Arch Orthop Trauma Surg 2011;131(7):1003.

[5] Rawal JS, Soler JA, Rhee JS, Dobson MH, Konan S, Haddad FS. Modification of the explant system for the removal of well fixed hip resurfacing sockets. J Arthroplasty 2010;25(7):1170.e7.

[6] Archibeck MJ, Cummings T, Tripuraneni KR, et al. Inaccuracies in the use of magnification markers in digital hip radiographs. Clin Orthop Relat Res 2016;474(8):1812.

[7] Kosashvili Y, Backstein D, Safir O, Ran Y, Loebenberg ML, Ziv YB. Digital versus conventional templating techniques in preoperative planning for total hip arthroplasty. Can J Surg 2009;52(1):6.

[8] Marcucci M, Indelli PF, Latella L, Poli P, King D. A multimodal approach in total hip arthroplasty preoperative templating. Skeletal Radiol 2013;42(9):1287.
Meyer C, Kotecha A, Richards O, Isbister E. Acetate templating for total hip arthroplasty using PACS. Ann R Coll Surg Engl 2009;91(2):162.

Ranjitkar S, Prakash D, Prakash R. Magnification error of digital x rays on the computer screen. Nepal Med Coll J 2014;16(2-4):182.

Riddick A, Smith A, Thomas DP. Accuracy of preoperative templating in total hip arthroplasty. J Orthop Surg (Hong Kong) 2014;22(2):173.

Ries MD. CORR Insights®: acetate templating on digital images is more accurate than computer-based templating for total hip arthroplasty. Clin Orthop Relat Res 2015;473(12):3760.

Ranjitkar S, Prakash D, Prakash R. Magnification error of digital x rays on the computer screen. Nepal Med Coll J 2014;16(2-4):182.

Ridick A, Smith A, Thomas DP. Accuracy of preoperative templating in total hip arthroplasty. J Orthop Surg (Hong Kong) 2014;22(2):173.

Ridick A, Smith A, Thomas DP. Accuracy of preoperative templating in total hip arthroplasty. J Orthop Surg (Hong Kong) 2014;22(2):173.

Ridick A, Smith A, Thomas DP. Accuracy of preoperative templating in total hip arthroplasty. J Orthop Surg (Hong Kong) 2014;22(2):173.

Ridick A, Smith A, Thomas DP. Accuracy of preoperative templating in total hip arthroplasty. J Orthop Surg (Hong Kong) 2014;22(2):173.

Ridick A, Smith A, Thomas DP. Accuracy of preoperative templating in total hip arthroplasty. J Orthop Surg (Hong Kong) 2014;22(2):173.