Transverse Acetabular Ligament as an Anatomical Landmark for Intraoperative Cup Anteversion in Primary Total Hip Replacement

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ABSTRACT

Objective: To assess the results of the use of transverse acetabular ligament (TAL) as an intraoperative indicator for acetabular cup anteversion alignment during total hip replacement.

Study Design: Case series.

Place and Duration of Study: The Nursing Home Hospital in Baghdad Medical City Complex, Baghdad, Iraq, from October 2014 to June 2015.

Methodology: Patients were operated through a posterolateral approach for primary total hip arthroplasty (THA) in which transverse acetabular ligament (TAL) was identified and used as indicator for cup anteversion. Those with previous surgery and secondary osteoarthritis due to dysplasia or tumor were excluded. Postoperative anteversion angles were measured by using anteroposterior pelvic radiographs using Pardhan method by two different observers and the perceived quality of operative outcome was directly asked to the patient.

Results: There were a total of 31 patients. The anteversion angle ranged between 5.7 - 24.40°. In addition, the calculated mean angle of 14.7 degrees for the current study sample did not obviously or significantly depart from the required optimum angle of 15 degrees defined by Lewinnek (15 ±10°, p=0.82). For the perceived quality of operative outcome, good outcome (satisfied) was expressed by two-thirds (67.7%) of study subjects after four weeks of surgery.

Conclusion: Using transverse acetabular ligament as an intraoperative landmark is a simple, effective, and patient-specific method for proper cup anteversion placement in primary THA.

Key Words: Transverse acetabular ligament. Total hip arthroplasty. Acetabular cup anteversion.

INTRODUCTION

Total hip replacement is one of the most successful procedures in modernized orthopaedic surgery in which acetabular cup malalignment can lead to increase in the number of needed revisions. The number of dislocations markedly decreases when the acetabular anteversion is set at (15°±10°) and inclination at (40°±10°). This is the safe zone in which the standard placement for the acetabular cup should be defined in terms of anatomy and biomechanics of the hip joint.1-4

There are many studies on the optimal angles for acetabular cup orientation. Individualized orientation based on bony or soft tissue landmarks is emphasized; however, no single landmark is universally applicable as an ideal orientation method. Some studies used transverse acetabular ligament (TAL) which form a bridge across inferior notch as an indicator for cup orientation in primary total hip arthroplasty (THA) as it is a fixed point and easily visualized through posterior approach.1,2,5

TAL is a portion of the acetabular labrum but differs from it by having no cartilage cells among its fibers. It consists of strong, flattened fibers, which cross the acetabular notch, and convert it into a foramen. It prevents inferior displacement of head of femur and bridges the acetabular notch and joins the two end of the acetabular labrum, thus forming a complete ring which may play an important role in load transmission. Beneath it (through the acetabular foramen) pass nutrient vessels which enter the ligamentum teres which arises from the transverse ligament.6-9

THA is a common surgery used mainly to treat osteoarthritis and other hip diseases. In the normal acetabulum, the transverse acetabular ligament and labrum form a plane that comes just beyond the equator of the acetabulum, unlike the bony acetabulum which is non-spherical. If the hemispherical "cup sizer" (reamer) is positioned so as to be cradled by the transverse acetabular ligament and orientated so as to sit parallel to and just deep to the line formed by the transverse acetabular ligament and the remaining posterior labrum, this will be the ideal location for the cup. In this position there should be no anterior overhang.10

The aim of the study was to assess the results of the use of transverse acetabular ligament (TAL) as an intraoperative indicator for acetabular cup anteversion during primary THA.
**METHODOLOGY**

From October 2014 to June 2015, consecutive patients, who underwent primary total hip replacement, were included in this study. The indication was secondary osteoarthritis following avascular necrosis or fracture neck femur. All operations were done in the Nursing Home Hospital in Baghdad Medical City Complex and all done by the same surgical team. All patients were asked for consent to participate in this study. Exclusion criteria were any previous surgery to the hip, secondary osteoarthritis due to dysplasia, acetabular trauma or childhood disease of the hip as well as history of hip infection or tumor of the acetabulum or femur.

Patients received general or spinal anesthesia and were positioned in the lateral decubitus position with a lumbar and pubic support, all operations were through a posterolateral approach. The cup anteversion was defined by placing the cup parallel to the TAL; the abduction angle was set by using the aiming device. In all hips, the transverse acetabular ligament was visualized intraoperatively and the appearance of the TAL was classified according to the scale of four types described by Archbold et al.1

Postoperatively, the anteversion was assessed with anteroposterior pelvic radiograph using the method of Pardhan,11 by which anteversion equals the arc sin of the proportion of the large diameter to the small diameter of the opening ellipse of the component. The measurements were repeated by two different observers. The perceived quality of operative outcome was directly asked from the patient after four weeks of surgery.

The statistical analysis was computer-aided, using IBM SPSS version 23 computer software. The range, mean, standard deviation were used to present the calculated planar anteversion angle, since it was a normally distributed quantitative variable. A single sample t-test was used to test the hypothesis of no-difference between a sample mean and a hypothesized parameter. Frequency distribution of selected ordinal level variables was used and the 95% confidence interval for a calculated proportion was reported (p-value was taken at significance at p ≤0.05).

**RESULTS**

Patients include 22 (71%) men and 9 (29%) women aged 50-70 years with a mean age of 64 ±5.28 years, as seen in Table I.

The planar anteversion angles for study subjects were calculated according to the Pardhan formula, using postoperative AP view pelvic radiographs. This angle ranged between 5.7-24.4 degrees which obeyed the safe zone defined by Lewinnek of 15 ±10 degrees.

In addition, the calculated mean angle of 14.7 degrees for the current study sample did not obviously or significantly depart from the required optimum angle of 15 degrees defined by Lewinnek (p=0.82). About a third (38.7%) of study subjects had their calculated angle within ± 5 degrees of the optimum 15 degrees angle. This best category of postoperative outcome was expected to be observed in 23.2% to 56.2% of the reference population requiring total hip replacement. The remaining two-thirds of study subjects still had the planar anteversion angle within the safe limits, but their deviation from the optimum 15 degrees angle was ± >5 up to 10 degrees, Table II.

The perceived quality of operative outcome was directly asked to the patient after four weeks of surgery. A good outcome (satisfied) was expressed by two-thirds (n=21, 67.7%) of study subjects. It is expected to be observed in 23.2% to 56.2% of the reference population requiring total hip replacement. Nine patients expressed it as fair outcome (satisfied), while only one (3.2%) described the outcome as not good.

**DISCUSSION**

Hip replacement surgery is a very useful reconstructive procedure worldwide. It effectively relieves pain and improves hip function, and is an excellent treatment option for patients with late stage hip joint diseases giving a big hope to many disabled patients.12 Here, the author aimed at determining the effect of using the TAL as a patient-specific anatomical parameter for measurement of the degree of cup anteversion during primary THA to maintain good hip stability in order to prevent hip dislocation and improve the long term result of such creative surgery.

The cup orientation of the 31 patients found to be within the safe zone of Lewinnek for cup anteversion. This supports the efficacy of the TAL as a reference for intraoperative anteversion.

Some studies supports obtaining cup alignment with a fixed angle reference; however, this may neglect the

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<th>Table I: Patient details.</th>
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<th>Table II: Frequency distribution of the study sample by the categories of postoperative calculated planar anteversion angle.</th>
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<td>Planar anteversion angle-categories</td>
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patient-specific anatomy and biomechanics of the hip joint.\textsuperscript{10,13} Furthermore, if the ideal alignment was achieved by other means during surgery, the pelvic alignment would change easily depending on patient position (sitting, standing), so the ideal orientation might not be maintained during daily activities.\textsuperscript{10,13}

In a cadaveric study by Viste et al., TAL proved to be a specific landmark for cup implantation for each patient. They found that the anatomical anteversion of TAL ranged from minus 8 to 13.3 degrees in 14 hips.\textsuperscript{5} Pearce, Sexton and Davies performed a radiographic angle measurement for cadaveric hips and reported a range of 11.3 to 24 degrees with an average anteversion of 15.4 degrees.\textsuperscript{14}

More recently, the importance of accuracy of cup anteversion in total hip replacement was stressed with regard to the issue of the implant-on-implant impingement (cup-on-stem) which was found to be a major complication following THA that may lead to clinical failure and the need for revision surgery. In the majority of previous clinical studies, only cup anteversion was discussed without referring to the stem anteversion.\textsuperscript{15}

Fukunishi and co-workers showed that accurate implant seating is crucial to decrease the possibility of postoperative instability and impingement. When optimizing prosthetic alignment, the rotational alignment of both acetabular and femoral implants should be taken into consideration.\textsuperscript{15} Ranawac and Maynard addressed the significance of combined anteversion and proposed that there values should be within the range of 25 to 35 degrees in men, and 25 to 45 degrees in women to avoid problems caused by inappropriate prosthetic alignment.\textsuperscript{16}

Jolles, Zanger and Leyvraz discussed the different causes of dislocation following total hip surgery. They stated that there was a 6.9 times increase in the rate of dislocation after surgery when the combined anteversion value was outside the range of 40 and 60 degrees.\textsuperscript{17} The long term outcome and clinical results need to be verified and should be the scope of another study.

CONCLUSION

The use of TAL as an intraoperative landmark for cup anteversion in primary THA was found to be a simple, reliable and practical method for optimal cup implantation, which may closely restore the individual anatomy of the hip joint of a patient.

REFERENCES


14. Pearce CJ, Sexton SA, Davies DC. The transverse acetabular ligament may be used to align the acetabular cup in total hip arthroplasty. \textit{Hip Int} 2008; \textbf{18}:7-10.

