An Update to a Novel Technique for Centering the Femoral Stem in Primary Total Hip Arthroplasty

OLIVIA J. BONO, BA
CLINICAL RESEARCH FELLOW
DEPARTMENT OF ORTHOPAEDIC SURGERY
NEW ENGLAND BAPTIST HOSPITAL
BOSTON, MASSACHUSETTS

ABSTRACT

Careful surgical technique is a critical component of total hip arthroplasty. Femoral preparation and component positioning are vital to improving outcomes and preventing complications. Femoral preparation begins with creating an entry hole in the proximal femur. Various tools have been used for this purpose which resemble a “cookie cutter.” An axial starter reamer, or awl, is then inserted through the entry hole in the proximal femur to aid in opening and centralizing the canal for sequential reaming or broaching. A novel technique was described previously which allows the awl to center itself in the canal with little risk of deviation from midline or cortical perforation. Since describing this technique in 2014, the senior surgeon has further modified the method of preparing the entry hole in the proximal femur. The surgeon now uses a 1/8” drill bit to penetrate the piriformis fossa, instead of a “cookie cutter” or osteotome. A 1/8” entry hole eliminates gaps between the bone and the implant, results in lateralization of the stem, and avoids varus malposition. We evaluated 300 primary hip arthroplasties by a single surgeon using one of the three techniques: traditional clockwise technique (Group 1), our previously published novel counterclockwise technique...
Total hip arthroplasty (THA) has been referred to as “the operation of the century” due to the impact it has had on the treatment of disabling hip osteoarthritis. Meticulous surgical technique and component positioning are critical to avoiding complications and improving clinical outcomes. Careful femoral preparation is crucial to prevent cortical perforation, undersizing, and varus-valgus and anterior-posterior (AP) malposition of the femoral component. Perforations can lead to intraoperative or postoperative fractures or a divergence from the typical postoperative protocol. Deviation in the varus-valgus and anterior-posterior planes can lead to undersizing with subsidence, thigh pain, and loosening.

Numerous devices and instruments have been developed to open the femoral canal to start femoral preparation. These devices include awls, box osteotomes ("cookie-cutter"), and various other canal-finding devices. The goal of all these devices is to access the intramedullary canal in an orientation that ultimately enables optimization of femoral component position. The design of the tapered wedge, broach-only systems provides excellent mediolateral stability, while the anteroposterior position of the stem is largely determined by the initial pass with the awl. In 2014, we developed a novel technique for placement of the starter awl that centers the awl and minimizes the risk of cortical perforation (Fig. 1). Today, we are following up with a modification to the technique of preparing the entry hole in the proximal femur to further optimize awl start-point and femoral component alignment.

**Materials and Methods**

After the femoral neck is cut, an entry hole into the proximal femur is made. This can be accomplished with a standard “cookie cutter” instrument which can be rectangular or circular, an intramedullary (IM) initiator, or free-handed with an osteotome. These instruments often create an opening to the proximal femur which may not be in the right position and is often larger than the implant itself, leading to gaps between the implant and the bone around the entry hole.

Since publishing the novel technique in 2014, the senior surgeon has modified the technique of preparing the entry holes in the proximal femur. The surgeon now uses a 1/8” drill bit to penetrate the piriformis fossa. This results in lateralization of the stem and avoids varus malposition. Furthermore, a 1/8” entry hole eliminates gaps between the bone and the implant, increasing surface area for osteointegration. Clearing of soft tissue from the fossa is not necessary, saving time as well as leaving more native anatomy undisturbed. The lateralized position of the starter awl is maintained by the small diameter of the entry hole (1/8”) in the dense bone in the piriformis fossa.

After the entry hole is prepared, the awl is placed at the starting site and turned counterclockwise while only gentle pressure is applied to the handle. The awl then pulls itself into the canal and self-centers, limiting deviation from midline.

In the previous publication, Shields et al. performed a retrospective review of 200 primary total hip arthroplasties, half of which were performed with the traditional clockwise technique (Group 1) and the other half performed with the novel counterclockwise technique (Group 2). To compare the outcome of this updated entry hole preparation to the original novel technique and the traditional clockwise technique, we reviewed 100 primary total hip arthroplasties performed with the updated novel technique (Group 3). Selection criteria were all primary hips done with the Accolade stem (Stryker Orthopaedics,
Mahwah, New Jersey) and the awl from the kit was used (Fig. 1). The hips were done through a standard posterolateral approach with an anatomic capsular repair by the same surgeon. For each hip, postoperative radiographs were obtained at routine follow-up intervals and included AP pelvis and Lowenstein lateral views at each visit. Component positioning was analyzed on the lateral view, and the deviation from midline was recorded. Radiographs were analyzed on the IMPAX Radiology Image Web Server. A two sample T test was used to compare the deviation from midline in each group.

### RESULTS

Group 1, using the traditional clock-wis technique, had a mean deviation from midline of 0.85° with a standard deviation of 1.15°. Group 2, utilizing the counterclockwise technique, had a mean deviation from midline of 0.34° with a standard deviation of 0.77°. Group 3, utilizing the described entry hole preparation with the counterclockwise technique, had a mean deviation from midline of 0.44° with a standard deviation of 0.30°. Group 1 was found to stray from the midline a statistically significant amount more than Group 2 (p=0.0002) as well as Group 3 (p=0.0006), as seen in Table I. The mean deviation from midline of Group 3 is not significantly different from the mean deviation of Group 2 (p=0.228).

### Table I

Mean deviation from midline in each technique group

<table>
<thead>
<tr>
<th>Technique</th>
<th>Lateral Angle (mean ± standard deviation)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 3</td>
<td>0.44 (0.30)</td>
<td>p=0.228 (between Group 3 and Group 2)</td>
</tr>
<tr>
<td>Group 2</td>
<td>0.34 (0.77)</td>
<td>p=0.0006 (between Group 3 and Group 1)</td>
</tr>
<tr>
<td>Group 1</td>
<td>0.85 (1.15)</td>
<td>p=0.0002 (between Group 2 and Group 1)</td>
</tr>
</tbody>
</table>

Group 1 is the traditional clockwise technique, Group 2 is the novel counterclockwise technique, and Group 3 is the updated entry hole preparation with counterclockwise technique.

Failed to start femoral canal preparation sufficiently lateral can result in femoral canal perforation.\(^18\) Femoral canal perforation can result in intraoperative or postoperative periprosthetic fracture.\(^7\) When the canal is accessed in an appropriately lateral position using the drill technique, the risk of varus malposition and femoral canal perforation can be significantly reduced.

Our proposed technique can be utilized on all patients undergoing primary THA. The limitations of this technique are due to the extremely small size and precise location of the entry hole. Since the hole is only 5mm in depth and is localized to the piriformis fossa, the surgeon must proceed with caution to ensure that the tip of the drill does not slide and move away from the entry site.

### DISCUSSION

Femoral canal preparation determines appropriate femoral canal alignment, allowing appropriate sizing and alignment while preventing complications. By utilizing the 1/8" drill, the surgeon gains controlled entry into the femoral canal in a lateral position helping to prevent varus stem positioning. Once an appropriate start point has been created, femoral canal preparation continues in the appropriate manner for the selected femoral component, regardless of design. The authors recommend utilizing the awl in a counterclockwise fashion as discussed in a previous article to shield the abductor tendon and muscle from the sharp edges of the instrument and prevent injury, as the flutes of the axial starter reamer are razor sharp if used clockwise and blunt if used counterclockwise.\(^5\) The counterclockwise motion allows the awl to follow the path of least resistance as the helical design pulls itself into the center of the canal while keeping the flutes from cutting a new path away from midline.

Femoral preparation is vital to appropriate alignment and sizing and for preventing complications. Varus/valgus femoral component malposition alters offset and creates potential for stress shielding.\(^15\) Stress shielding has been shown to lead to significant bone resorption and subsidence as well as increased risk of periprosthetic fracture.\(^16,17\)

Failing to start femoral canal preparation sufficiently lateral can result in femoral canal perforation.\(^18\) Femoral canal perforation can result in intraoperative or postoperative periprosthetic fracture.\(^7\) When the canal is accessed in an appropriately lateral position using the drill technique, the risk of varus malposition and femoral canal perforation can be significantly reduced.

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![Figure 2. Femoral starting awl depicting the novel technique of centering the awl and turning in a counterclockwise fashion.](image-url)
We propose that our technique is a simple, reproducible solution to the centering of the femoral component, while avoiding unnecessary risk of cortical perforation. This technique is especially useful in difficult cases, elderly osteoporotic bone, obese patients, and in training orthopaedic residents and fellows. The modification that we have added on to our technique allows for improved preparation of the entry hole in the proximal femur using the 1/8” drill bit to penetrate the piriformis fossa. We recommend this simple technique to avoid potential pitfalls during femoral preparation.

Dr. James V. Bono reports royalty payments from Stryker.

All other authors have no conflicts of interest to disclose.

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BONO/SHEILD/S/PINSKI/SCHUETT/BONO

REFERENCES


AUTHORS’ DISCLOSURES

Dr. Schuett is an employee of the US Government and this work was performed on behalf of the US Government as part of his official duties. No statement in this article reflects the views of the Department of the Navy, Department of the Army, Department of Defense, nor the US Government. Nothing in the presentation implies any Federal/Department of Defense/Department of the Navy endorsement.