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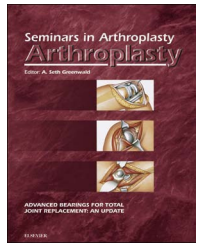

Cementless total knee arthroplasty: Patient selection and surgical techniques to optimize outcomes

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ABSTRACT

Cementless fixation is a reliable, durable fixation option for patients undergoing primary TKA and is especially attractive for younger and more active patients. Advances in fixation materials such as modern highly porous metals provide an additional adjunct in promoting osseointegration and longer-term success. Proper patient selection, adequate exposure, meticulous surgical technique, and modern implant designs are significant factors for enacting a successful outcome. This article outlines the essential elements and details the surgical techniques that should be considered to facilitate optimal results when utilizing cementless fixation in TKA.

1. Introduction

The demand for primary total knee arthroplasty (TKA) is increasing in the United States, with an estimated 3.4 million procedures annually by 2030, with almost 1/3 of these being patients under 65 [1,2]. Several fixation options exist, including cemented, cementless, and hybrid type fixation. Cemented fixation remains the gold standard for primary TKA, showing excellent long-term results and survivorship across multiple implant designs [3,4]. The purported benefits of cementless fixation for primary TKA include direct osseointegrative fixation, bone preservation, reduction of third body wear, and shorter operative times. It has been a preferred option for many surgeons in younger, more active patients in order to avoid the theoretical complications of increased stress at the cement/bone interface after many years. Several studies have supported these concerns, showing problems with long-term survivorship using cemented TKA in young (<55) patients [5,6]. When first introduced, however, cementless fixation was plagued with reports of early loosening and patellar failures, likely related to material properties and component design. With newer porous metals, implant designs, and surgical techniques, cementless TKA fixation has been shown to have excellent survivorship [7,8].

2. Patient selection

Cementless TKA relies on viable bone for osseointegration and long-term, durable fixation. Good bone quality is also essential in order to support the implant and maintain the intimate interference fit required to minimize micromotion during activities of daily living in the early postoperative period for successful osseointegration. Younger patients are ideal candidates for the procedure; however there is no strict age limit and patients should be selected based on their "physiologic age" and bone quality. All patients must be

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evaluated preoperatively for medical comorbidities, bone quality, and medications that may interfere with osseointegration. Patients with osteoporosis and other conditions that cause a decrease in bone quality must be especially scrutinized, especially given the superb long-term outcomes in older patients with cemented fixation [3,4], which remains the gold-standard in TKA fixation and durability in the general population. While clinical data does not currently exist to specifically outline bone quality or age as criteria for cementless fixation in TKA, biomechanical data demonstrates that the stability of cementless tibial components is substantially decreased in an osteoporotic bone model [9]. For this reason the senior author does not routinely perform cementless TKA in elderly patients or those patients with physiological conditions that decrease bone density, such as osteoporosis, rheumatoid arthritis or other autoimmune diseases.

3. Surgical technique

In order to achieve the required interference and press-fit with subsequent mechanical stability of the implants to allow osseointegration, accurate and planar cuts of the femur and tibia are essential during bony preparation for cementless TKA. This aspect of the surgical procedure cannot be overemphasized. The slight irregularities that cement can compensate for can be a source of poor initial fixation with a cementless implant, leading to subsequent implant failure. Several key technical tips are helpful when performing cementless TKA and are outlined in subsequent paragraphs.

The senior author does not alter the surgical approach when utilizing cementless fixation, as optimal visualization is mandatory whether using cemented or cementless fixation in TKA. Our preferred surgical approach is the median parapatellar approach and the incision should be adequate enough to provide excellent exposure to visualize the entire femoral and tibial and provide enough excursion to provide a clear path for execution of accurate planar saw cuts. The anterior fat pad is excised to enhance visualization and a standard medial release to the mid coronal plane is performed in all knees, and titrated appropriated to gain adequate visualization and protection of the surrounding ligamentous structures. The author prefers PCL-retaining implant systems, where the majority of cementless TKA clinical data exists, and the ACL is sacrificed.

Preparation of the femur begins with the distal femoral cut as usual for a PCL retaining component. The senior author uses navigation for the distal femoral cut for increased accuracy and to prevent blood loss from instrumenting the femoral canal [10]. Executing an accurate planar cut of the distal femur is of critical importance, as any error or irregularities will be magnified in the chamfer and condyle cuts due to the linked planar cuts through the four-in-one cutting guide. Therefore, the distal femoral cut must be performed with great attention to detail and accuracy to ensure a perfectly flat surface. Differential hardness of bone is frequently encountered and the surgeon must be cognizant of this during all planar cuts, including the distal femur, as the saw blade may tend to skive as it encounters sclerotic bone on the medial or lateral femoral condyle with varus or valgus knees, respectively. This can be checked and confirmed by placing the flat surface of the distal femoral guide or edge of the saw blade on the distal femoral cut and ensuring no gaps or undulations exist (Fig. 1A). The four-in-one cutting block is applied to the distal femoral cut, and the authors' preference is to anchor this particular guide to bone with threaded pins for extra secure fixation and adherence to

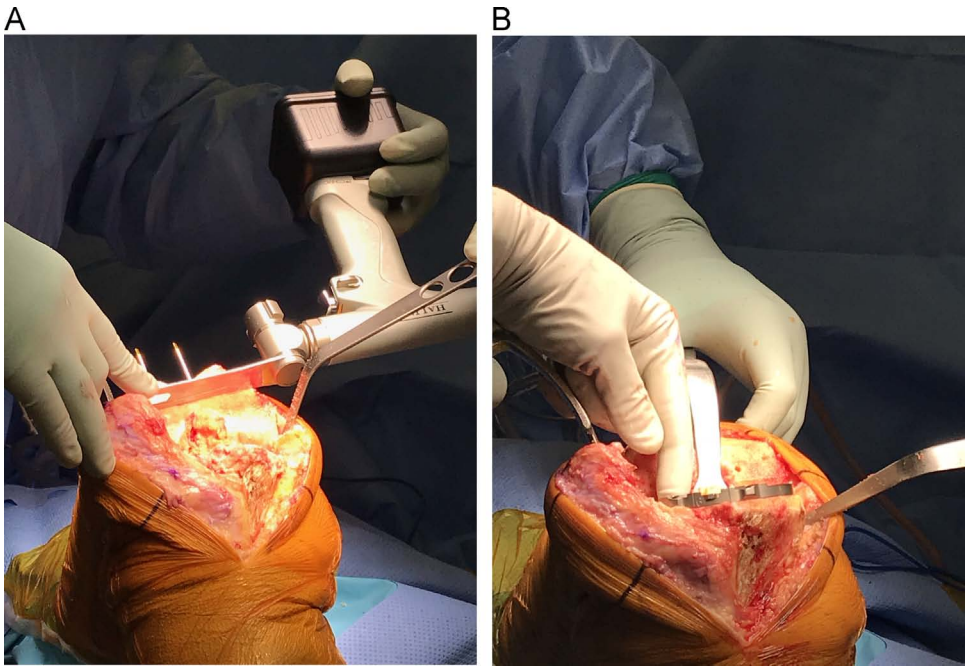

Figure 1 – (A) Ensuring planar distal femoral cut with saw blade. (B) "4-Corner Test" attempting to rock tibial baseplate on cut surface to assess the planar accuracy of the tibial cut.