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Operative Techniques in
Orthopaedics

All-Polyethylene Tibial Components for Unicompartmental Knee Arthroplasty

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All-polyethylene and metal-backed tibial components are available for unicompartmental knee arthroplasty. Although the early design of all-polyethylene component was largely replaced by metal-backed components, improvements in polyethylene wear characteristics, component design, and surgical technique have renewed interest in all-polyethylene (InLay) components. In comparison with metal-backed (OnLay) designs, InLays require less bone resection and are easier to revise total knee replacements. Early aseptic loosening, tibial component subsidence, and anterior knee pain were found to be the primary contributors to failure of InLay designs. Controversy remains whether InLay or OnLay components are preferable for unicompartmental knee arthroplasty. Despite the component design, proper component alignment, cementation technique, and ligamentous balance remain crucial for implant survival and are highlighted in this article along with a comparison of InLay and OnLay results.
Oper Tech Orthop 25:114-119

Introduction

Marmor introduced[1] the first modular unicompartmental knee implants in the 1970s. The unconstrained system consisted of an all-polyethylene tibial component and a narrow femoral component. The Marmor knee provided survival rates of 70% at 10-13 years.[2,3] However, subsidence of tibial component was found to be a cause for early failure of this system.[2,3] The available polyethylene at that time was susceptible to cold flow, a slow expansion of the tibial component under pressure with time that led to increased stresses and deformation of the polyethylene component.[4] Metal backing was found to decrease cold flow and increase durability of the polyethylene component.[4] Therefore, the use of all-polyethylene tibial components fell out of favor in the 1980s owing to improved outcomes and performance of metal-backed unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA) components.[5,6] However, improved component design and polyethylene wear characteristics have renewed interest in the use of all-polyethylene tibial components for TKA and UKA. Although progression of degenerative joint disease (DJD) in other knee compartments, component malpositioning, and improper patient selection are viewed as major factors in early failure of all UKA,[7-9] early aseptic loosening, tibial component subsidence, and anterior knee pain are the primary contributors to failure of all-polyethylene UKA.[7,10] However, bearing dislocation, disassociation, and backside polyethylene wear are associated with metal-backed implants. Several factors must be considered for successful application of all-polyethylene tibial components in UKA: proper component alignment, cementation technique, ligamentous balance, and patient selection.[11] Controversy remains whether metal-backed or polyethylene components are to be favored for UKA and how surgeon experience influences results.

Knee Joint Restoration

Ligamentous Balance

The overall goal of UKA is to restore the height of the affected knee compartment with well-aligned, well-fixed components

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 http://dx.doi.org/10.1053/j.oto.2015.02.003
1048-6666/

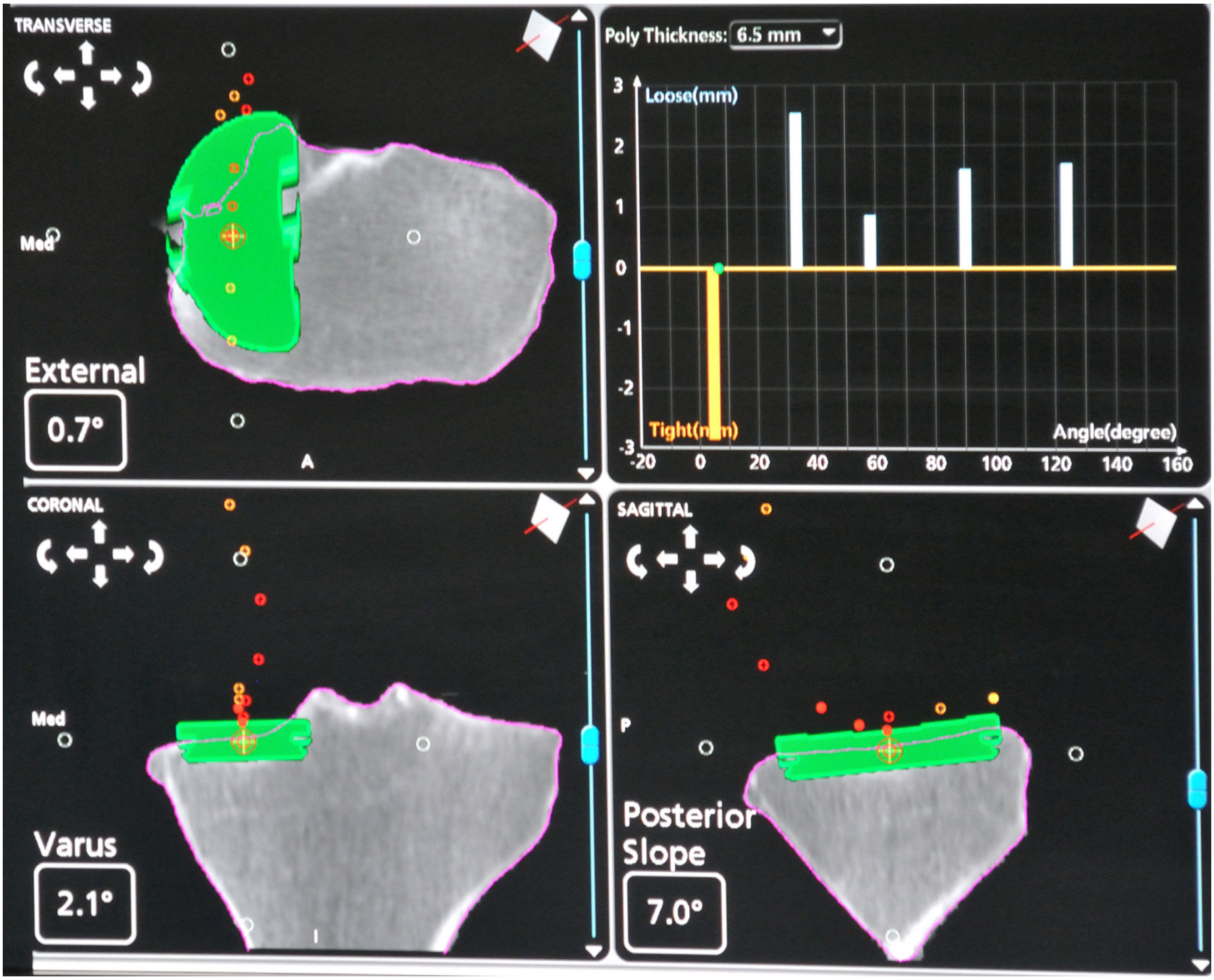

Figure 1 Intraoperative planning and ligament balancing of InLay component. (Color version of figure is available online.)

while preserving ligamentous stability and tension.[11] All-polyethylene tibial (InLay) components are introduced into a carved pocket on the tibial plateau and cemented in place. InLay components rely on sclerotic subchondral bone that developed during the degenerative disease process to provide stable fixation. Metal-backed components (OnLay) are introduced onto the tibial plateau after making a flat cut. Component stability is provided by the cortical bone of the proximal tibia and a single or multiple pegs or a keel on the undersurface. Compared with metal-backed UKA, all-polyethylene components require less bone resection thereby minimizing disruption of the capsular structures, which may improve knee proprioception. Significant improvements in proprioception with UKA compared with TKA have been revealed[12]; however, no such study has been performed comparing InLay with OnLay components for UKA.

The restoration of component height and ligamentous tension is imperative for UKA survival.[11] Using conventional UKA surgical techniques, soft tissue tension is assessed by applying subjective varus-valgus stress to the knee with the trial components in place. Robot-assisted techniques use dynamic real-time assessment of ligamentous tension through range-of-motion trials with a valgus-directed stress on the knee. The height and the position of the component are simulated using the computer system, and changes can be made to the position of the femoral and tibia component to improve ligamentous tension (Fig. 1).[13]

Cementation Technique

Cementation is challenging during UKA, specifically for all-polyethylene UKA in which the tibial component relies on subchondral bone contact and risks subsidence. Various studies revealed that pulsed lavage increases cement penetration into the proximal tibia during cementation and impaction of the tibial component.[14-16] In a cadaveric study, pulsed lavage of the tibial surface led to a significant mean increase in cement penetration of 5.79 mm compared with conventional syringe lavage (4.62 mm)[15] (Figs. 2 and 3)

In our experience, the cement is pressurized and placed on the anterior and posterior portions of the tibial component followed by cement application to the tibia. The prosthesis is