Session 22: Primary TKA: Video Vignettes

Learning Objectives
Upon completion of this activity, participants should be able to:

1. Illustrate the surgical perils of deformity correction in primary total knee arthroplasty required to obtain proper alignment via the harmonization of bony resection and soft tissue balance.

2. Illustrate the avoidance of pitfalls in the surgical technique of balancing a total knee arthroplasty.

Moderator
Adolph V. Lombardi, Jr, MD, FACS
Clinical Assistant Professor
Department of Orthopaedics and Department of Biomedical Engineering
The Ohio State University
New Albany, Ohio

The Varus Knee

W. Norman Scott, MD, FACS
CEO
International Congress for Joint Reconstruction

Founding Director
Insall Scott Kelly Institute for Orthopaedics and Sports Medicine
New York, New York

Clinical Professor of Orthopedic Surgery
Albert Einstein College of Medicine
Bronx, New York

Associate Attending Orthopaedic Surgeon
Lenox Hill Hospital and North Shore LIJ Heath System

In most arthritic knees, some degree of instability, deformity, or contracture will be found.1-3 Contracture of soft tissues generally arises as a consequence of long-standing angular malalignment. Investigations suggest that a critical factor for long-term survival in total knee arthroplasty (TKA) is anatomic alignment, which depends on accurate bone resection and ligament balancing.4-9 Every attempt should be made to balance the knee before increasing the degree of constraint.

Varus deformity is any femorotibial angle less than normal anatomic valgus. The development of asymmetric varus instability typically follows the loss of medial compartment cartilage and bone, imparting a varus moment to the joint. The varus moment, the periarticular inflammation associated with arthritis, and the medial
osteoophytes result in fibrosis and contracture of the medial collateral ligament (MCL), leading to a fixed deformity. Simultaneously, adaptive elongation of the lateral collateral ligament (LCL) and capsule occurs, culminating in “varus thrust” of the knee during the stance phase of gait.

Whether “measured-resection,” “gap-balancing,” or a combination of techniques is used, attention must be paid to the soft tissues. Ligament balancing in a varus knee is achieved by progressively releasing the medial soft tissues until they reach the length of the lateral ligamentous structures. The end point of the release is a stable knee with a plumb line extending from the hip through the centers of the knee and ankle.

The medial release is done by first removing medial osteophytes and raising a sleeve of soft tissue from the upper medial aspect of the tibia. The sleeve consists of periosteum, deep MCL, the insertion of the pes anserinus, and the superficial MCL. More posteriorly, the sleeve is continuous with the semimembranosus insertion and posterior capsule. In this manner, correction of deformity occurs in a graduated fashion with no transverse discontinuity of the medial soft-tissue structures. Attention must also be directed to component positioning and the potential tethering effect of the posterior cruciate ligament (PCL). The result is a balanced knee with some overall lengthening of the limb.

References:
Video Vignette: The Valgus Knee

Henry D. Clarke, MD
Consultant, Department of Orthopedic Surgery
Mayo Clinic Arizona

Assistant Professor of Orthopedic Surgery
Mayo Clinic

Background: During total knee arthroplasty (TKA) symmetric and balanced flexion and extension gaps must be created through soft tissue releases. In the valgus knee, contraction of the lateral soft tissues structures must be addressed. The pie crust or multiple puncture technique has been well described and used with excellent results and safety in both cruciate-retaining (CR) and posterior stabilized (PS) TKA. 1-3

Technique4:

- Basic bone cuts are performed.
- A spacer block with extramedullary alignment rods is used to evaluate the tibial cut and mechanical axis of the leg.
- Medial and lateral soft tissue tension is evaluated with a spacer block in flexion and extension.
- If the lateral side is tight, a pie crust soft tissue release is performed.
- A laminar spreader is inserted in the medial femoro-tibial space with the knee in extension.
- The popliteus tendon is protected during the entire procedure as it provides an important stabilizer in flexion.
- At the level of the tibial bone cut, a #15 surgical blade is used to make a transverse incision through the postero-lateral capsule, anterior to the popliteus tendon.
- Next, multiple horizontal stab incisions are made through the ITB and lateral capsule until medial-lateral soft tissue balance is achieved.
- An appropriately sized spacer block that fills the flexion space is used to evaluate the medial and lateral balance.
- The knee is then extended and the symmetry of the flexion and extension gaps is assessed.
- If symmetric flexion and extension gaps have been produced, the medial and lateral balance in extension is re-examined.
- If soft tissue tension is not symmetric, additional pie crusting is performed.
- When femoro-tibial alignment exceeds 20 to 25 degrees valgus, use of an alternative technique may be required, such as sequential release of the LCL and popliteus tendon from the lateral femoral condyle (or lateral femoral epicondyle osteotomy), followed by release of the ITB, posterior capsule, and lateral head of the gastrocnemius.
• When extensive releases are performed, the knee may be unstable in the flexed position and a constrained prosthesis may be required.5

References:

Correction of Flexion Contractures in Total Knee Arthroplasty

Adolph V. Lombardi Jr, MD, FACS
Joint Implant Surgeons, Inc.
The Ohio State University
Mount Carmel Health System
New Albany, Ohio

The success of total knee arthroplasty (TKA) has been well established. However, the clinical success is dependent on the surgical correction of deformity, attainment of optimal mechanical alignment, and meticulous soft tissue balancing. Flexion contractures are inherent in the pathophysiology of severe articular degeneration of the knee, either as a consequence of previous traumatic injury, advanced osteoarthritis, or inflammatory arthritis. Commonly, flexion contractures are related to an inability to maintain full knee extension secondary to the presence of painful synovitis, large joint effusion, prominent osteophytes at the posterior aspect of the femoral condyles, posterior adhesive capsulitis, as well as contractures of the posterior capsule, cruciate ligaments, and hamstrings. Fixed flexion contractures affect the gait cycle at initial contact, midstance and the terminal stance phases. To compensate for the flexed posture of the knee during gait, this disorder necessitates recruitment of the quadriceps, leading to additional energy expenditure. The pathologic gait pattern associated with a knee flexion contracture results in inefficient locomotion and accelerated fatigue and compromises the clinical outcome of TKA.

To ensure optimal postoperative range of motion and functional outcome, it is our belief that full correction of any flexion contracture should be performed at the time of surgical
intervention. The specific approach is dependent on the degree of flexion contracture present, which is classified according to severity. A mild contracture is considered to be 15° or less and is classified as Grade I. A moderate contracture is considered to be between 15° and 30° and is classified as Grade II. A severe contracture is considered to be greater than 30° and is classified as Grade III. Each grade requires a slightly different surgical approach, and accurately assessing the degree of flexion contracture will guide the surgeon as the contracture is addressed with a combination of soft tissue releases and bony resection.

Operative Algorithm for Correction of Grade I, II, and III Flexion Contractures:
- **Step 1:** Medial exposure, osteophyte removal, and posterior capsule release.
- **Step 2:** Distal femoral resection using measured resection technique and additional distal femoral resection of 2 mm. CR trial with complete ligament balancing.
- **Step 3:** If full correction of flexion contracture is not accomplished, then the PCL is released and a PS is trialed.
- **Step 4:** If contracture persists, additional distal femoral resection of 2 mm is performed and a PS is trialed.
- **Step 5:** If contracture persists, additional soft-tissue releases from contracted side of coronal deformity is performed until full extension is achieved. If this results in ligamentous instability, a PSC device is used.
- **Step 6:** If instability persists following achievement of full extension, a rotating hinge design is used.

Pearls and Pitfalls:
- Preoperative evaluation should include careful measurement and classification of the flexion contracture as either Grade I, II, or III.
- The grade of flexion contracture has a direct impact on the level of constraint necessary for the prosthesis to maintain optimal range of motion and stability.
- Removal of overhanging posterior femoral condyle and posterior femoral osteophytes is critical.
- Careful establishment of the posterior recess should be performed before the distal femur is resected.
- If a PCR design is selected, no more than 2 mm should be resected from the distal femur to avoid compromise of PCL function. If more than 2 mm of distal femur is resected, a PS design should be considered.
• Grade II flexion contractures should be treated with a PS prosthesis design.

• Grade III flexion contractures warrant consideration of a constrained or rotating hinge prosthesis.

• Postoperative rehabilitation programs should emphasize extension exercises with consideration of extension night-splinting for 6 weeks.

References:

Primary TKA Hyperextension

E. Marc Mariani, MD
Salt Lake Orthopaedic Clinic
Assistant Professor
University of Utah School of Medicine
Salt Lake City, Utah

Background and Premise of Talk: Genu recurvatum deformities prior to total knee arthroplasty (TKA) are unusual and occur in less than 1% of patients. This discussion will focus on the etiologies of genu recurvatum and the subsequent surgical issues one faces in correction of the deformity.

Materials and Methods: A literature review will be utilized to discuss the best way to surgically manage a hyperextension deformity in those patients with and without neuromuscular disease as the underlying etiology. The presence or absence of neuromuscular disease correlates with the end result following total knee replacement.

Conclusions: In the absence of neuromuscular disease, hyperextension deformities are most often associated with valgus angulation and following high tibial osteotomies. This group tends to not have a recurrence of their hyperextension following TKA.

Weak quadriceps from a neuromuscular disease such as polio or cerebral palsy can also lead to hyperextension deformity as the patient locks the knee into hyperextension during gait. This group is at risk for recurrence of hyperextension following TKA. Post-op pain relief is less as well.
Proper balancing of the ligaments as well as the flexion/extension gaps is critical in obtaining a good outcome. Poor quad function pre-op necessitates adjustment of the extension gap so as to allow for slight hyperextension postop. Otherwise, the patient’s ability to ambulate will be compromised.

Techniques to adjust the extension gap relative to the flexion gap will be discussed.

References:

Femoral and Tibial Rotational Landmarks

Mary I. O’Connor, MD
Chair & Associate Professor, Department of Orthopaedic Surgery
Mayo Clinic Florida
Jacksonville, Florida

*Background & Premise of Talk:* Correct rotation of the femoral and tibial components in TKA is critical for successful results. Malrotation can result in abnormal polyethylene wear, loosening of implants, instability and patellofemoral problems.

*Methods and Materials:* Intraoperative video demonstrating bony landmarks for femoral and tibial rotation will be presented as well as a brief review of literature relative to techniques for determining proper rotation. The presentation will be based on the tibial cut being made perpendicular to the long axis of the tibia.

*Clinical Results:* Rotation of the femoral component can be determined by one of two common intraoperative techniques. With the bony landmark technique rotation is determined by fixed bony landmarks. With the tension gap technique, rotation is set by tensioning the knee at 90 degrees of flexion and cutting the femur parallel to the tibial cut (after soft tissue release performed in extension). Clinical data exists to support use of each technique. Fehring found more rotational errors with use of the bony landmark technique.¹ Hanada et al found the tension gap method achieved equal laxity but the knee shifted into varus in flexion, increasing the medial compressive stress and lateralizing the patellar groove, while the bony landmark technique resulted in near normal alignment, stability, load transfer, and patellar groove position.²

Rotation of the tibial component can be based on anatomic landmarks or via a range-of-motion technique allowing the tibial component to orient itself relative to the femoral
implant. Data is again conflicting regarding an optimal technique, with Siston et al reporting that no conventional or computer assisted technique is reliable for tibial rotation.

**Conclusions:** Experienced surgeons are knowledgeable of the various techniques to determine component positioning and will use aspects of various techniques to optimize outcome.

**Clinical Relevance:** Proper rotation of the femur and tibial components in TRA is critical to a successful outcome.

**References:**

**Discussion**
Henry D. Clarke; E. Mark Mariani, MD; Mary I O’Connor, MD; Mark W. Pagnano; W. Norman Scott, MD, FACS