HTO Versus Unicondylar Knee Arthroplasty

Thomas M. DeBerardino, MD

Professor of Orthopaedic Surgery, Baylor College of Medicine

Co-Director, Baylor-BRIO Texas Sports Medicine Fellowship

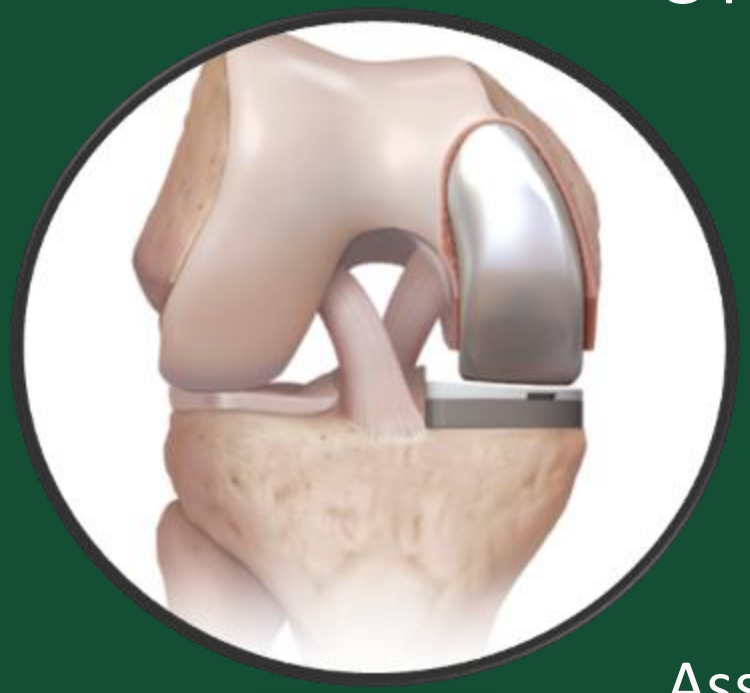
Medical Director, Burkhart Research Institute for Orthopaedics

TSAOG Orthopaedics

SINCE 1947 TSAOG ORTHOPAEDICS Experience. Innovation. Expertise.

BRIO Burkhart Research Institute for Orthopaedics

Current Solutions for Unicompartmental Arthritis: iBalance HTO & UKA



Thomas M. DeBerardino, MD

Associate Professor, UConn Health Center

Team Physician, Orthopaedic Consultant
UConn Huskie Athletics

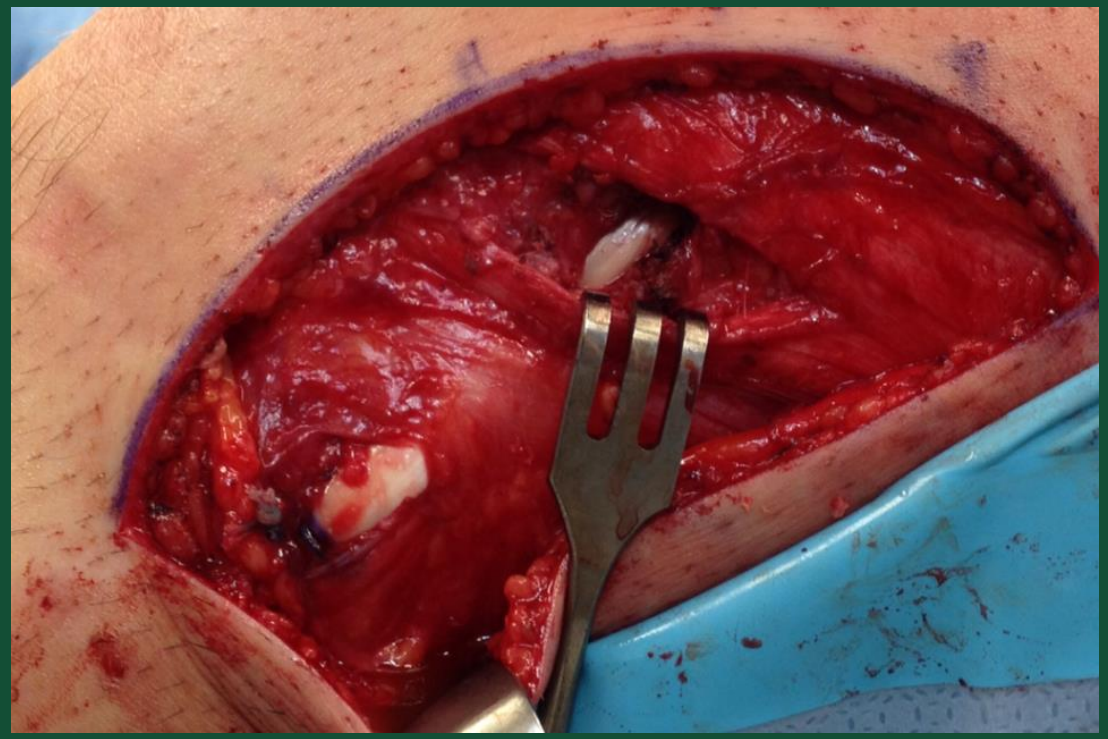
Pittsburgh, PA

HTO Indications

- <60 y/o active patient
- Varus knee (5 - 15^0)
- Medial compartment ≤ grade III
- Intact lateral & P-F compartments
- Flexion >120 degrees
- Stable joint

HTO Indications Expanded

- Posterolateral laxity
- Varus hyperextension thrust
- ACL deficiency & varus thrust or alignment
- Combined ligamentous laxity with varus or posterolateral thrust



Amendola A. The Role of Osteotomy in the Multiple Ligament Injured Knee. *Arthroscopy* 2003;19(1):11-13

Limb Alignment

Significance:

- Limb alignment is the MOST important factor to consider in lower limb reconstructive surgery

Results

- Many series have shown encouraging mid-term results after high tibial osteotomy
- Authors agree there is a gradual decline in quality of result with time
- Osteotomy demonstrated to be effective for 5 years in 85%–90% and 10 years in 65%

Insall JN, Joseph DM, Msika C. High tibial osteotomy for varus gonarthrosis. J Bone Joint Surg Am 1984; 66:1040–8

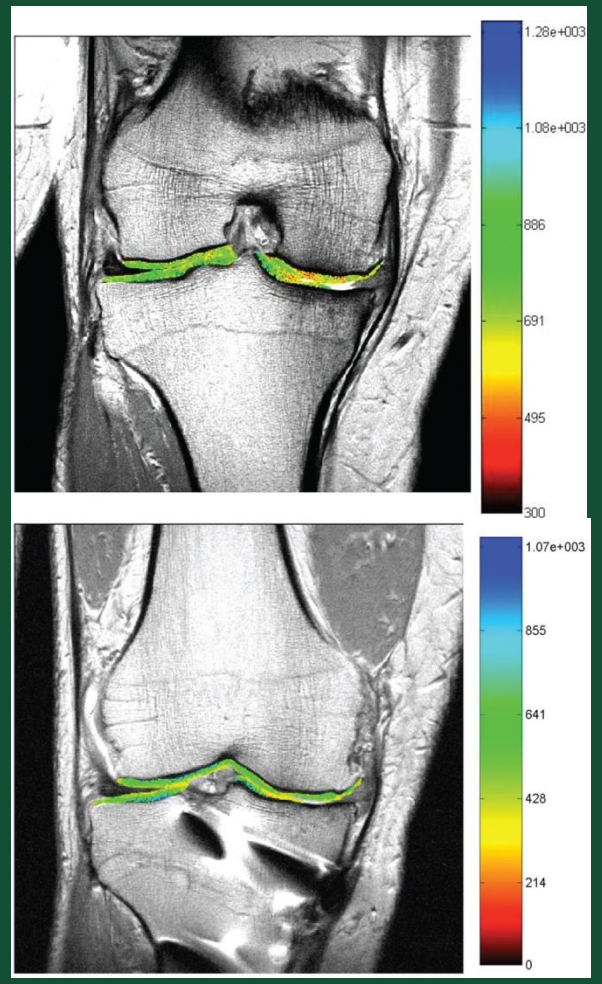
Aglietti P, et al. Tibial osteotomy for the varus osteoarthritic knee. Clin Orthop 1983; 176:239–51

HTO Complications

- Intraarticular fracture
- Lateral cortex fracture
- Vascular injury
  - Tears of anterior tibial artery reported, but only when extensive lateral approach to the tibia or the posterior vessels is performed
  - Prevent by flexing knee and using posterior retractor

What About The Cartilage?

- 10 patients s/p HTO: dGEMRIC methods preop and at 6, 12, 24 months
- Potential for articular cartilage recovery secondary to an improved mechanical environment



Parker DA, et al. Articular Cartilage Changes in Patients With Osteoarthritis After Osteotomy. Am J Sports Med. 2011 Feb 4

How Much to Correct?

- Coventry established corrective goals to shift the weightbearing line (WBL) through the lateral compartment
- Amount of correction for medial MAT or OCA has not been definitively established
- Recommended that the WBL be placed within the tibial spines and approach neutral mechanical alignment

Standardized Radiographs

- 4-view weight bearing anteroposterior (AP), lateral, notch, sunrise
- Bilateral weight bearing Rosenberg (450 PA)
- Bilateral weight bearing full-length hip-to-ankle radiographs

A Simplified Technique for HTO

- Technique focuses on preoperative templating for correction and its relationship to accurate plate selection
- No intraoperative, fluoroscopically guided mechanical axis with an alignment rod or Bovie cord is necessary
- Correction goal: have WBL pass through the center of knee but not greater than through the lateral tibial eminence (unless a terminal procedure is deemed necessary after arthroscopy

Todd MS, Lalliss S, DeBerardino TM. A Simplified Technique for High Tibial Osteotomy. Techniques in Knee Surgery 7(3):00–00, 2008

Measurement Steps

- Mechanical axis and desired axis measured drawn
- Desired mechanical axis drawn so weightbearing line drops between eminences
- Angle formed by lines from apex of planned osteotomy to current and desired mortise forms correction angle

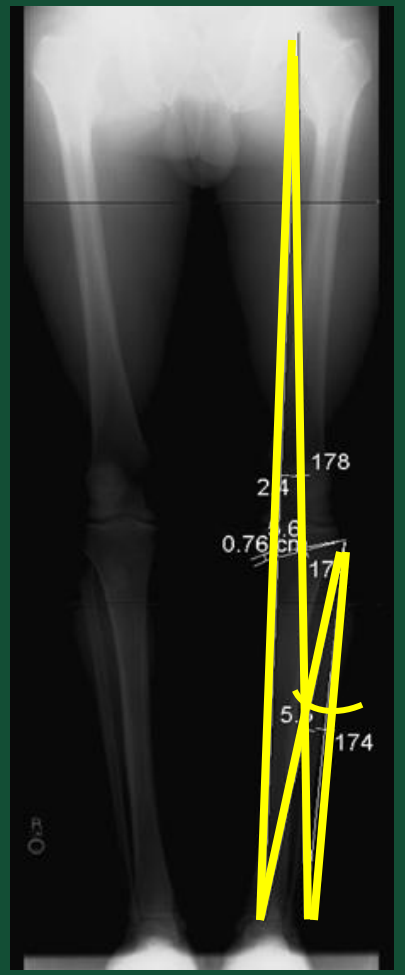
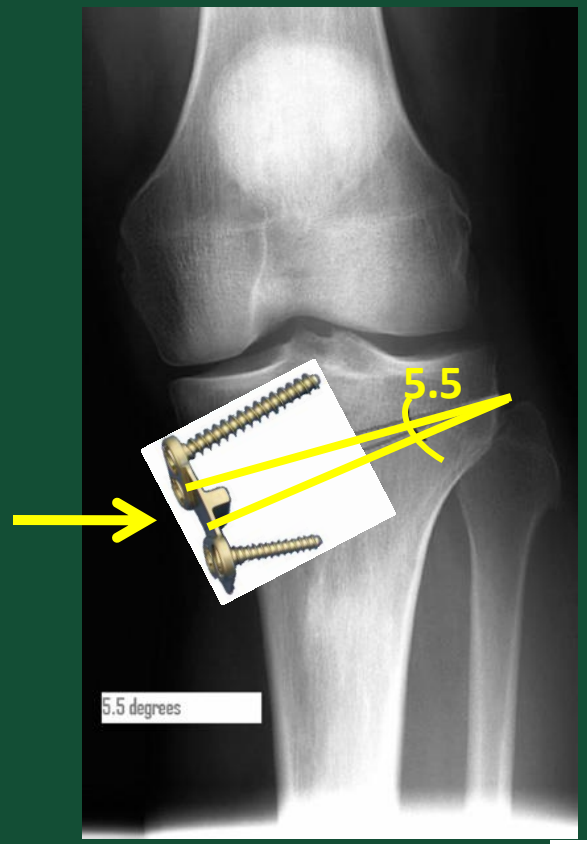


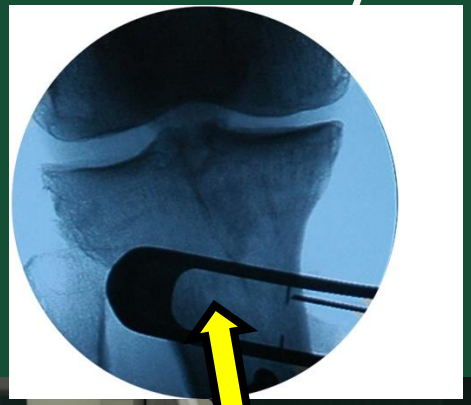
Plate Size Determination

- Desired angular correction is reproduced from the osteotomy rotational axis point and extended to the medial tibial cortex
- Distance measured lines at medial tibial cortex is equal to plate size



Surgical Technique

Bony Cut Aligned with Joint



Closeup of Bony cut

Blade Parallel to Joint

Retractor Protects Patellar Tendon

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Final HTO

HTO Technique Advantages

- Avoids proximal tib-fib joint and peroneal nerve
- Easier to perform two plane osteotomy in sagittal and coronal planes
- Single Cut
- Does not violate anterior compartment
- Bone Preserving
- May perform Intraoperative Adjustments of correction
- Conversion to TKA Easier
- May perform with combined Ligament Reconstruction, Meniscal Transplantation, Cartilage Restoration

Post-operative Treatment

- Brace in extension, locked brace
- CPM if cartilage restoration case
- Full weightbearing when off daytime narcotics and self-reported pain @ </= 3
- Full weight bearing based on radiographic healing of osteotomy

- Ongoing clinical trial since 2010: WBAT using PEEK implant

Technical Pearls for HTO

- Establish normal physiologic valgus
- Maintaining sagittal slope of tibia
- Secure fixation
  cancellous screws proximal cortical screws distal
- Osferion for defects greater than 7.5 degrees
- Consider early WBAT (pain </= 3 out of 10)

Evolving Hardware Options

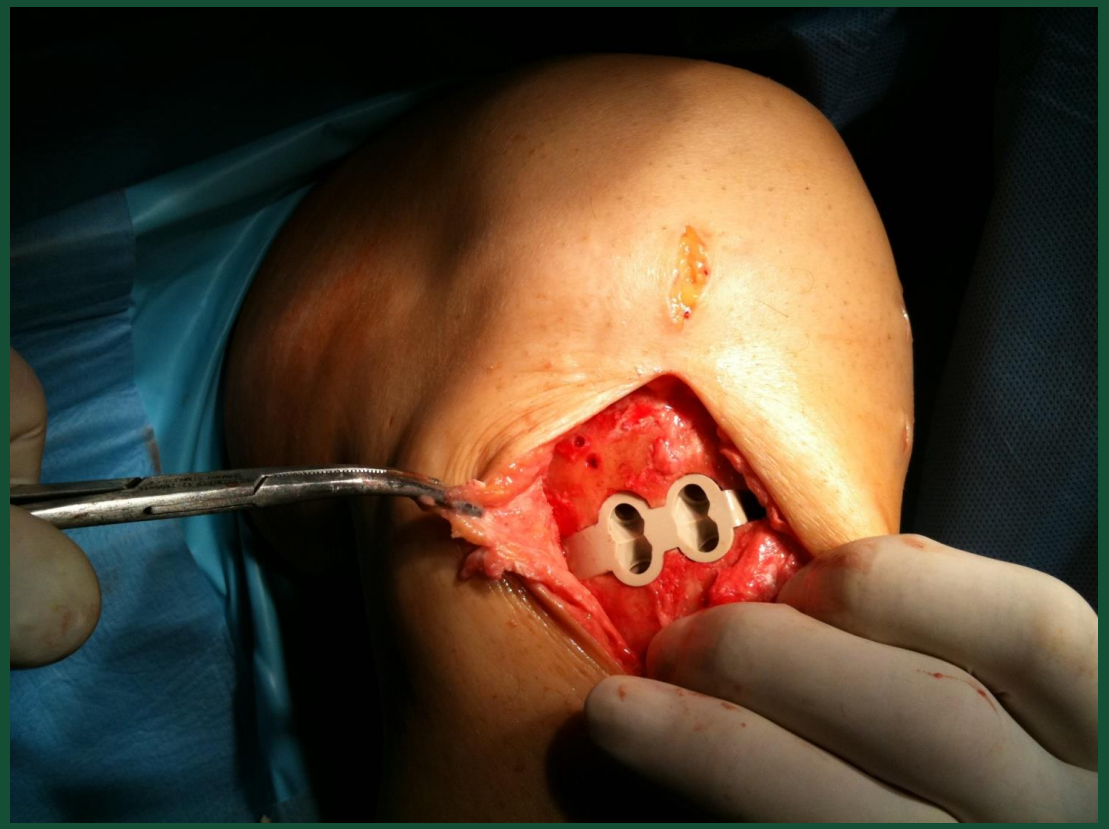
Standard Bulky Hardware

Inset PEEK Wedge Implant, ß-TCP Wedge Graft

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

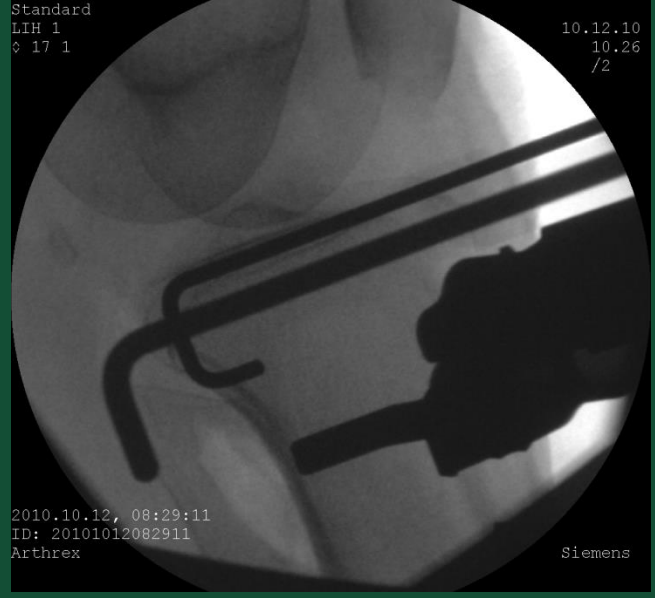
BRIO
Burkhart Research Institute for Orthopaedics

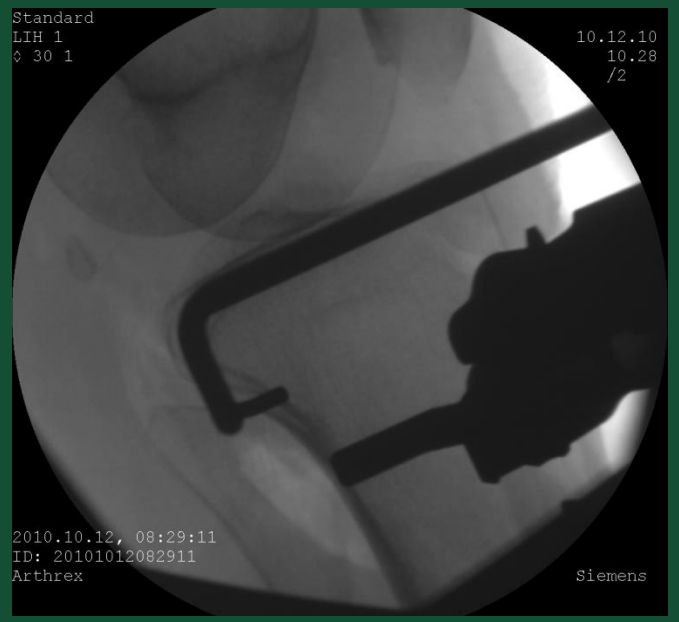
PEEK Wedge Plate

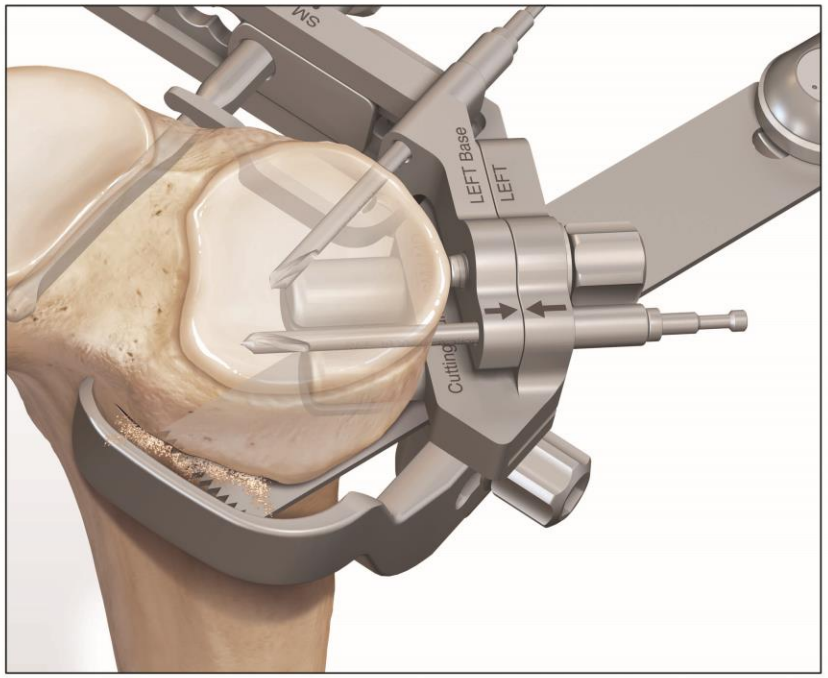


SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics





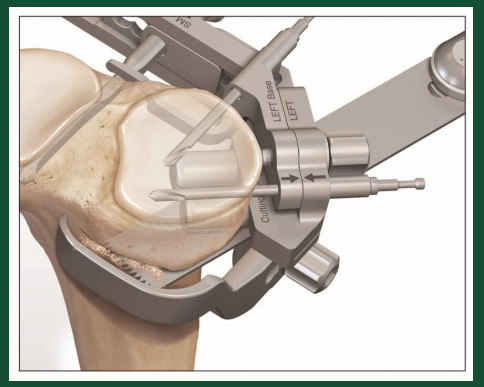


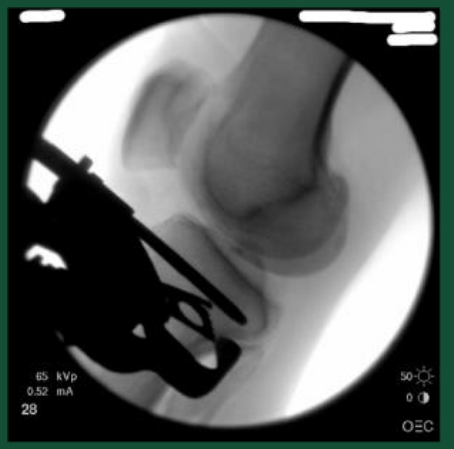
SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Safety Study 2007

Safety Envelope



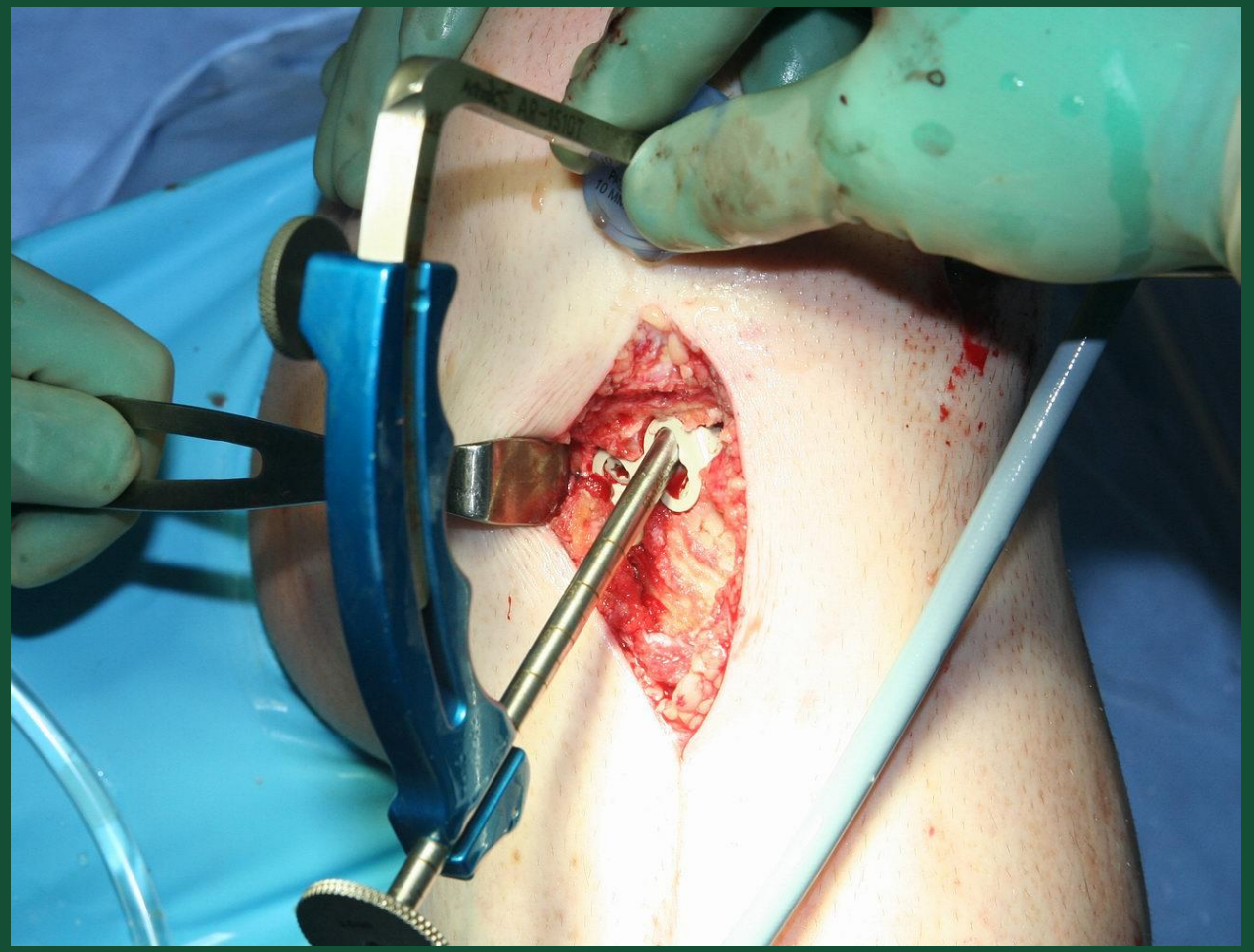


- Instrumentation designed to protect neurovascular and soft tissue structures
  - Christopher Harner, M.D., UPMC
    - "Vascular Safety During Medial Opening Wedge Osteotomy"
      - ISAKOS 2007 presentation
      - AOSSM 2007 poster
      - Published 2010 AJSM

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

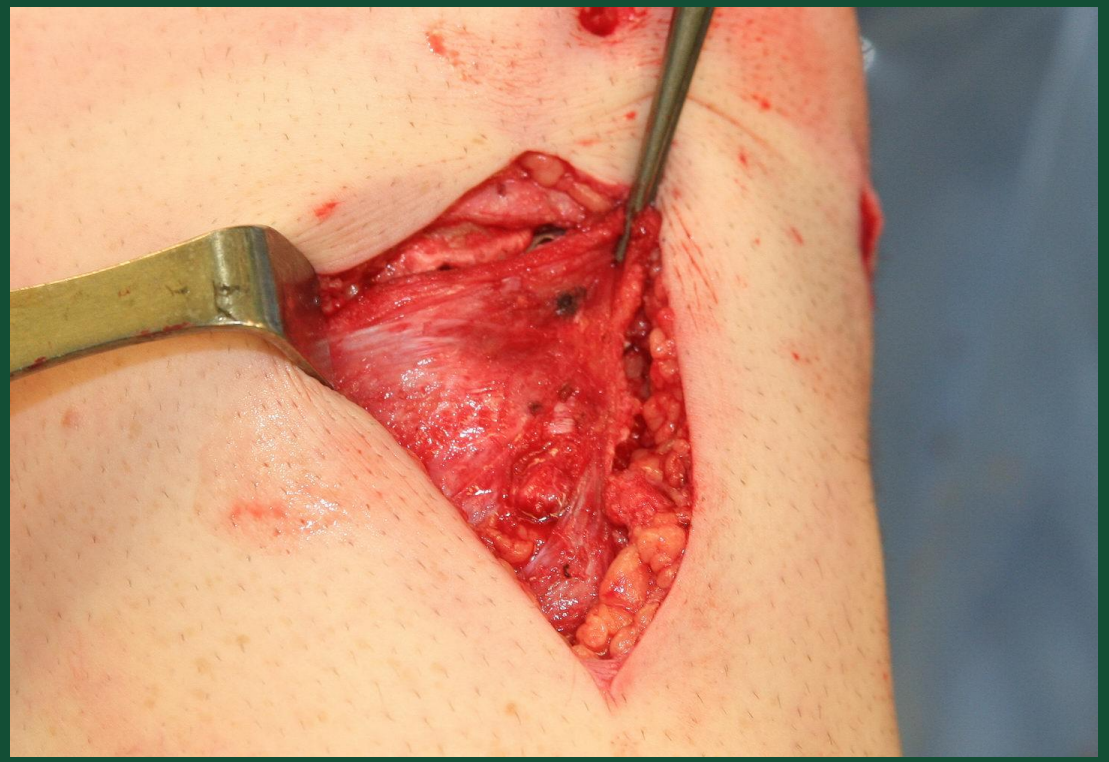
Combined HTO and AISB ACLR



SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Final Closure



SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

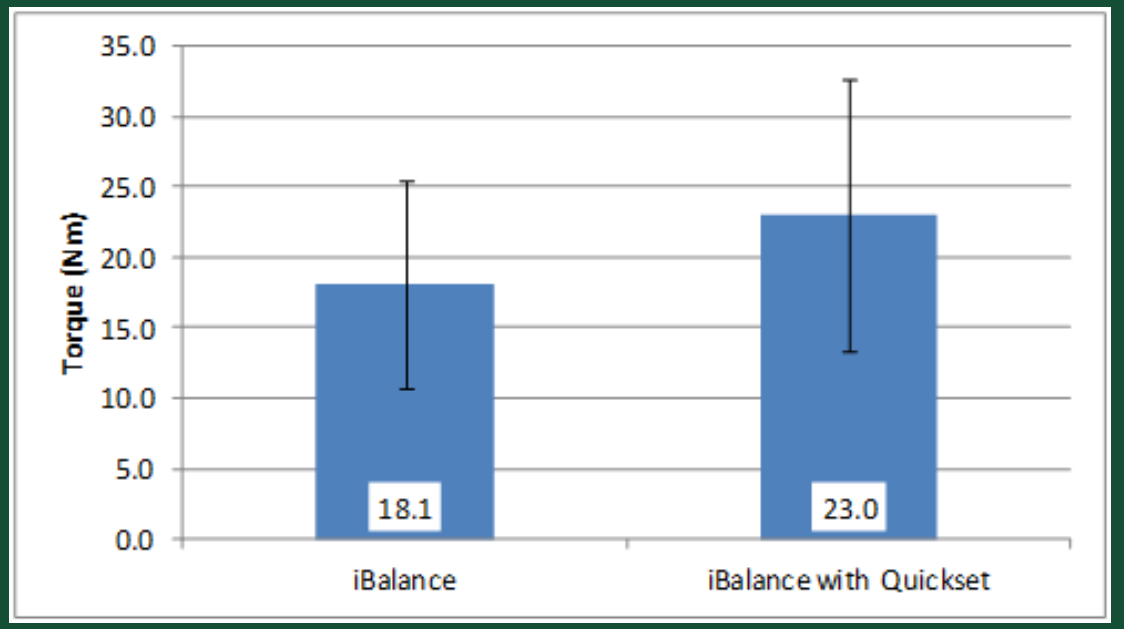
BRIO
Burkhart Research Institute for Orthopaedics

Quickset Injection with Mini C-Arm

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

iBalance Failure Torque



- iBalance with *Quickset* significantly greater than iBalance alone

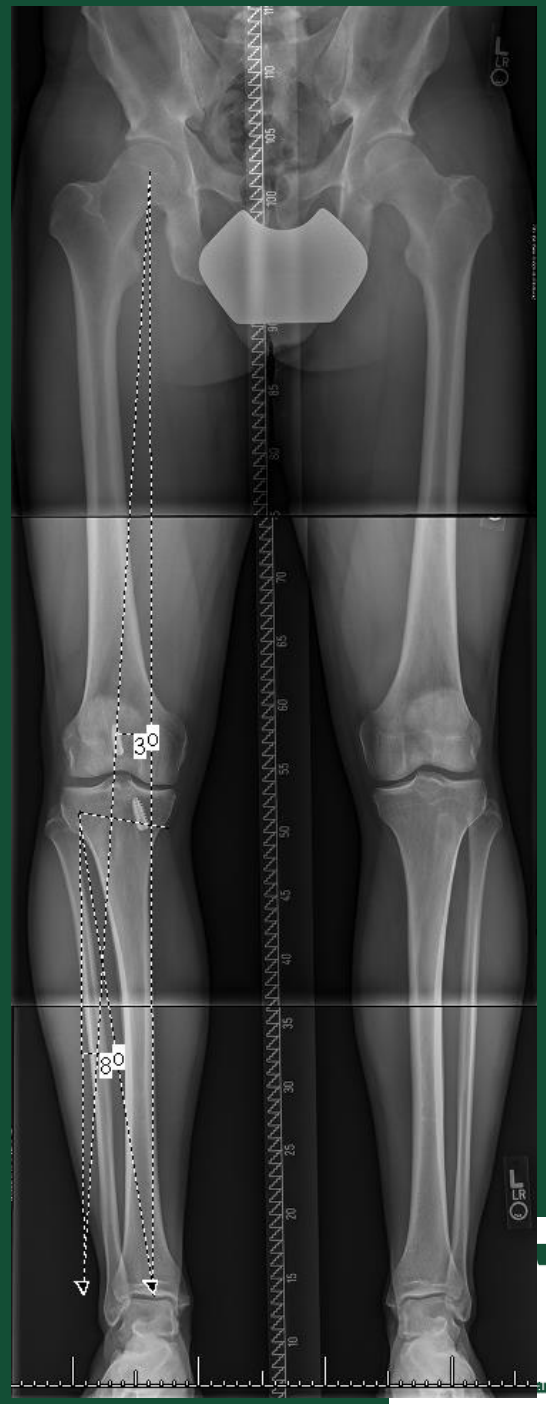
DeBerardino, Uconn Lab Data, 2012, publication pending

SINCE 1947 TSAOG ORTHOPAEDICS Experience. Innovation. Expertise.

BRIO Burkhart Research Institute for Orthopaedics

Complex Case

- DIAGNOSIS
  - Failed prior ACLR,
  - Subtotal MMT resection
  - Patella Gr 4 lesion
  - Varus alignment
- PLAN
  - iBalance HTO + Quickset
  - Allograft rACLR, GraftLink
  - Medial MAT
  - Patella OCA, trochlear BioCart



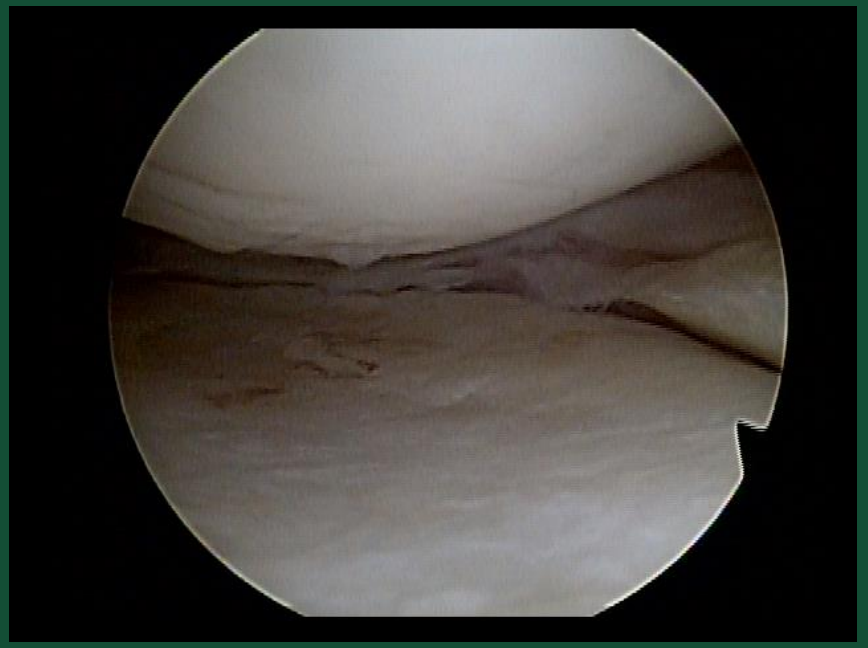
Stepwise Plan

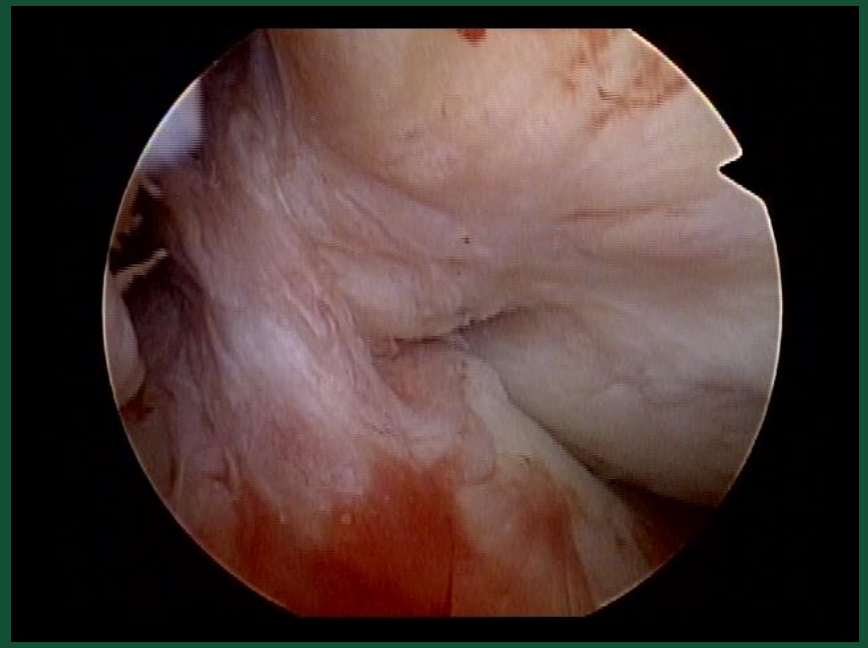
1. iBalance HTO – 40m
2. Prep for MAT, ACLR- 30m
3. Place medial MAT- 30m
4. Place rACLR- 20m
5. Fresh patella OCA- 30m

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Absent Medial Meniscus, Nonfunctioning ACL



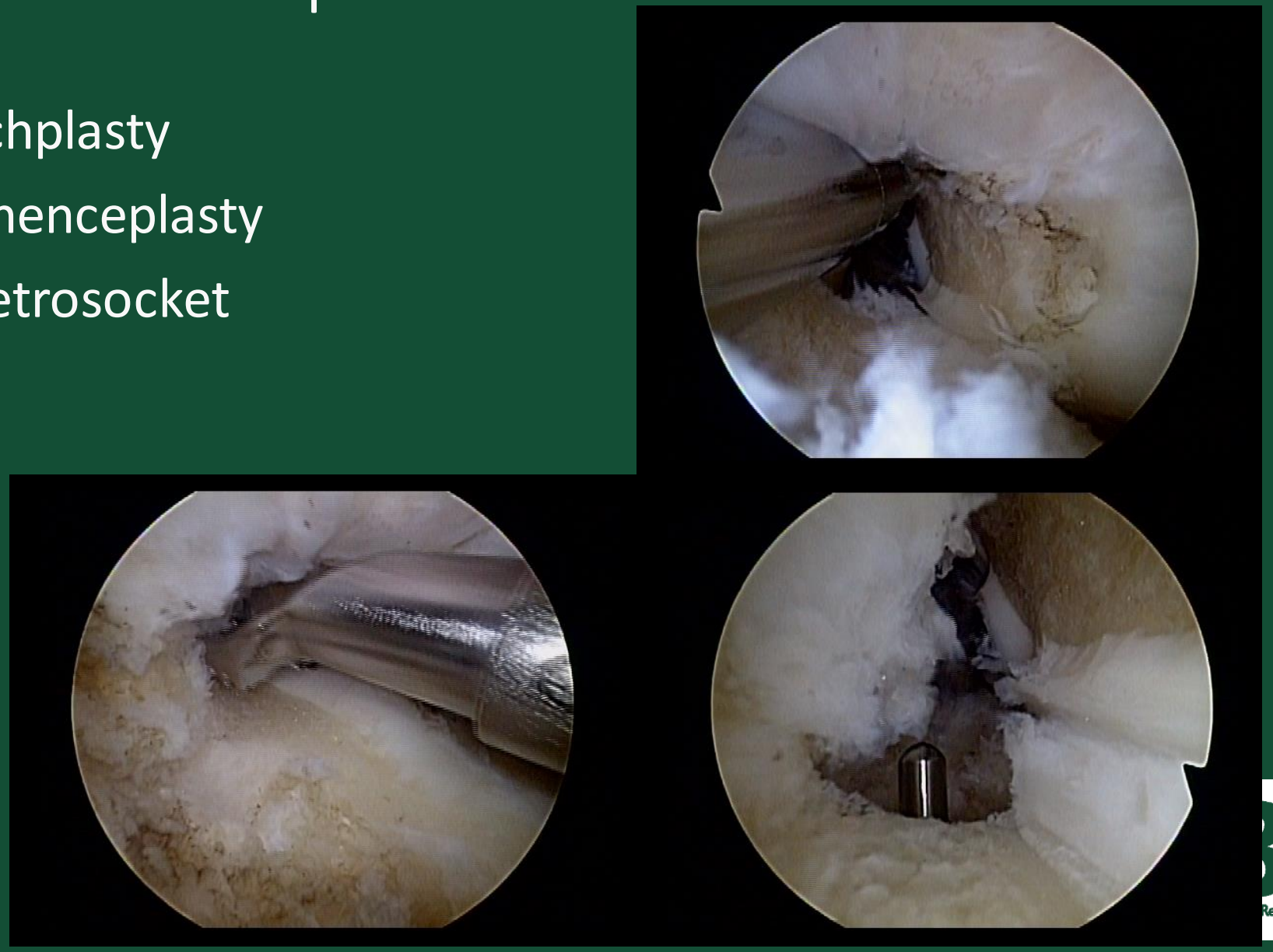


SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

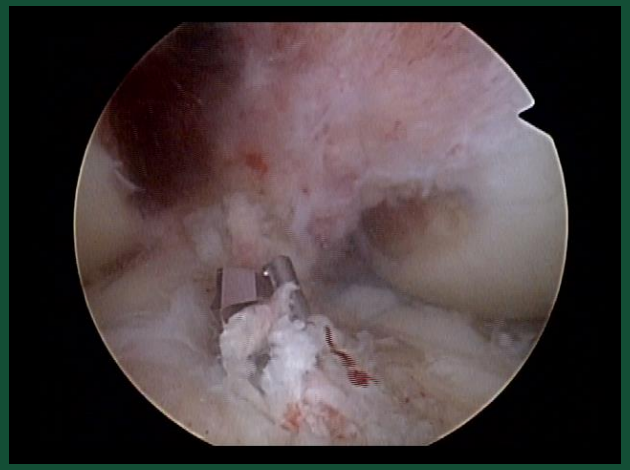
BRIO
Burkhart Research Institute for Orthopaedics

Prep For Medial MAT

- Medial notchplasty
- Medial eminenceplasty
- Post horn retrosocket



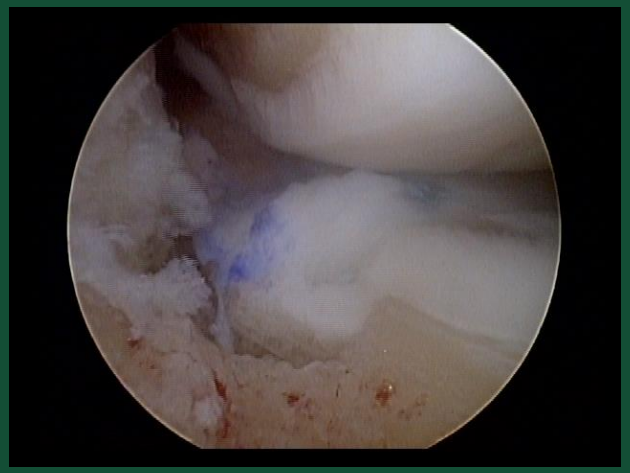
Prep For Rev ACLR

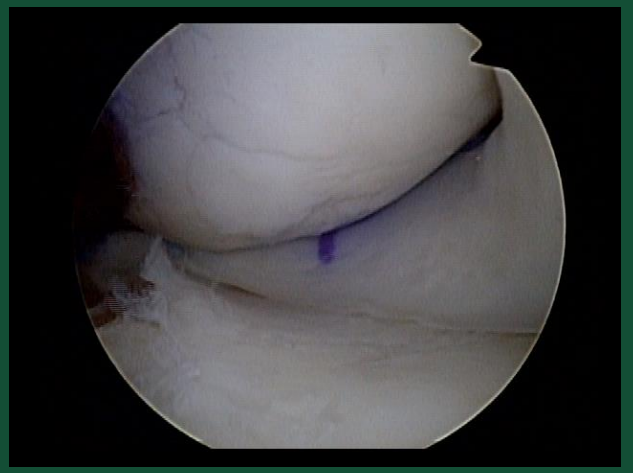


SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Medial MAT





SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

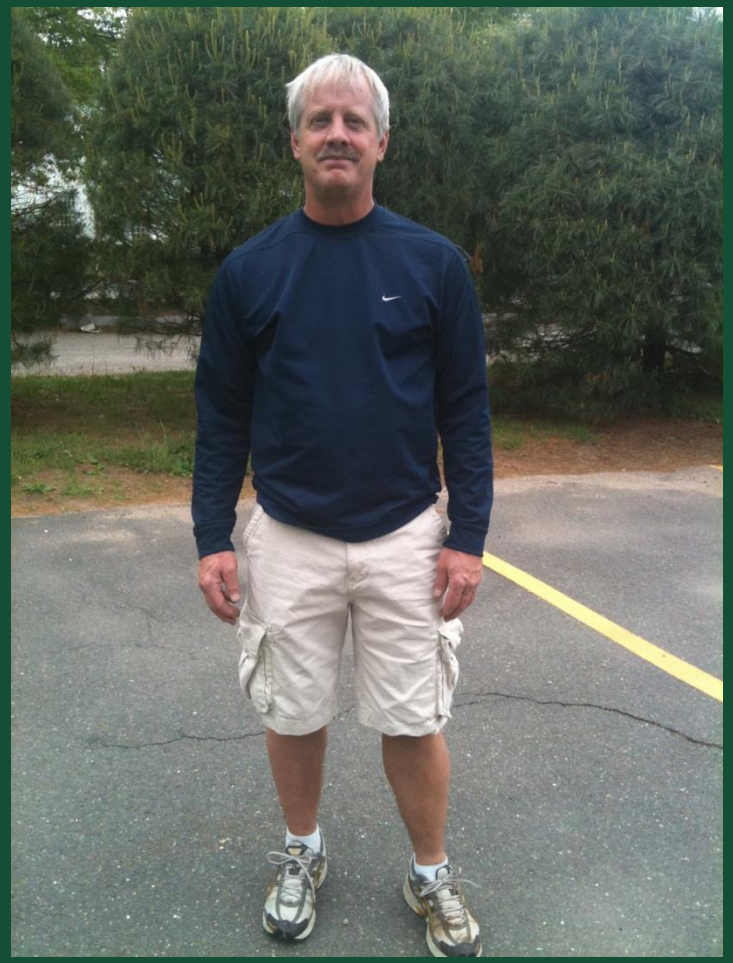
Final Thoughts - HTO

- Fluoroscan (no lead/C-Arm)
- Concomitant procedures
  - rACLR, MAT, OCA
- Same-day surgery ready
- Early weightbearing proving safe, robust healing
- Low morbidity, low pain

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Typical Patient

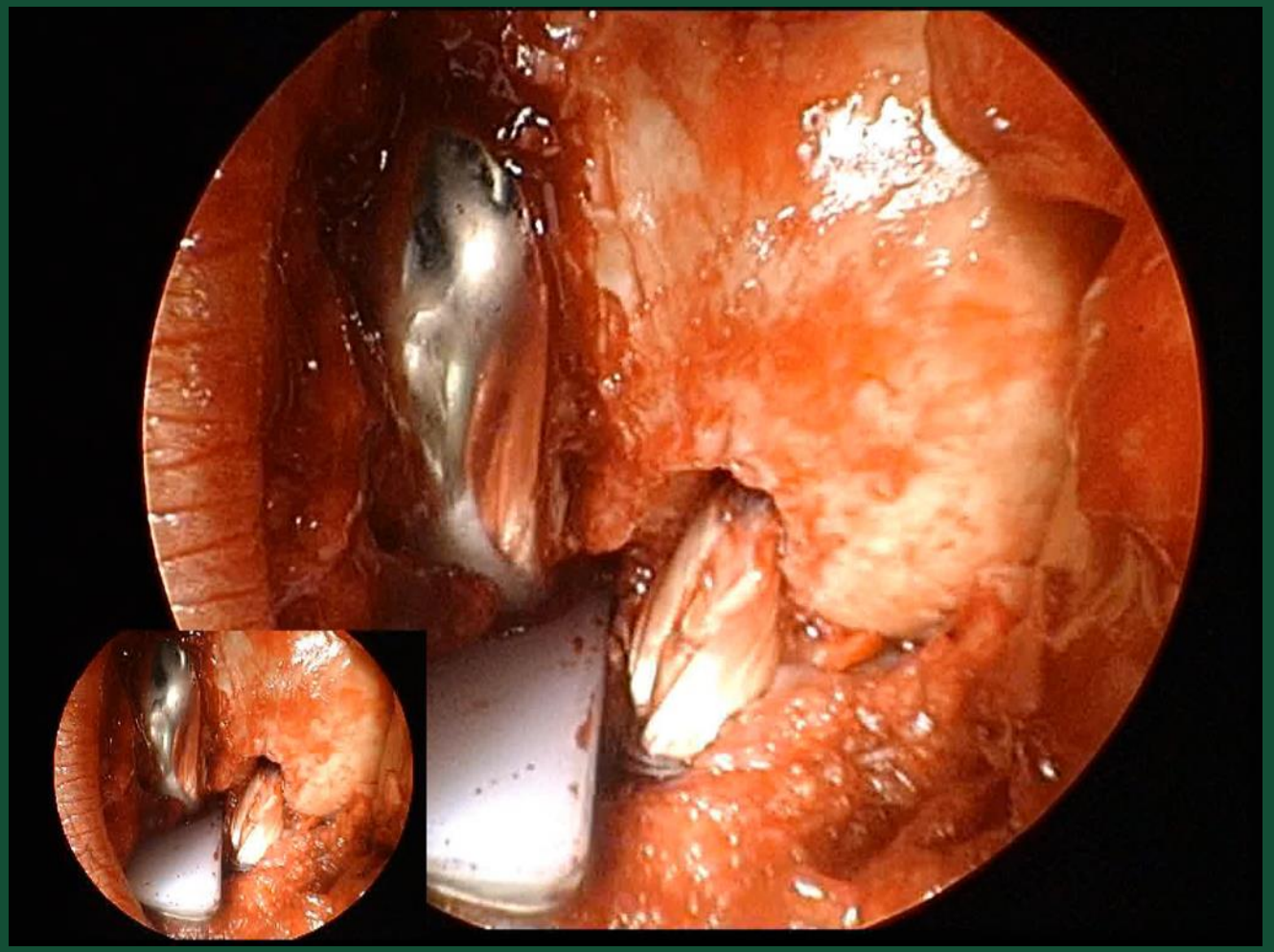


6m s/p HTO R Knee Ready for N.H. Triathlon

Summary: Key Highlights

- Growing need for knee realignment and joint preservation procedures
- HTO evolved from “freehand procedure” to guided, predictable/reproducible procedure
- Addresses high impact patient (vs. Uni “low impact”)

Arthrex iBalance Uni Knee



SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Benefits

- Preservation of kinematics and improved gait
- Preservation of uninvolved tissue and bone
- Lower perioperative morbitidy
- Less blood loss
- Accelerated patient rehabilitation and recovery

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Indications

Patient selection!

- Classic indication
  - Several algorithms proposed
- Kozinn and Scott 1989
- Indications
  - Isolated compartmental arthritis/osteonecrosis
  - Age >60
  - Weight <82 kg
  - ROM arc >90 degrees, <5 degree flexion contracture
  - <15 degrees angular deformity, passively correctable

Indications

- Ritter 2004
  - Analyzed 4021 knee arthroplasties
  - 6.1% met anatomic qualification
  - 4.3% met clinical standards

Contraindications

- Multicompartment disease
- Inflammatory arthropathy
- Sepsis
- Significant flexion contracture
  - >10 to 15
- Significant varus/valgus deformity
  - >15, not passively correctable
- Flexion <110
- ?Chondrocalcinosis, Crystalline arthropathy

Contraindications

- Patellofemoral Joint
  - Berend 2011
    - preoperative radiographic changes in the patellofemoral joint can be safely ignored when considering patients for medial UKA without compromising survivorship.
  - Controversial
  - Many consider p-f disease a contraindication
  - Swedish registry
    - No revisions due to p-f joint
  - Oxford group
    - Postop pain independent of state of p-f
    - No revisions secondary to p-f problems
    - Improvement of mechanical axis
      - More normal kinematics and tracking
  - My criteria
    - No anterior knee pain. “Reasonable amount” of radiographic wear

Preoperative Assessment

- History
  - Localized pain
  - Activity related
  - Beware night pain
- Exam
  - Malalignment of the limb should be passively correctable to neutral and not beyond
  - Flexion contracture less than 15°
  - Flexion to 110°
  - One finger test vs. the knee grab

Preoperative assessment

- Radiographs
  - Radiographs
    - WB AP, Flexion WB PA, Lateral, Sunrise / patellar view
    - Evaluate other compartments
    - Tibiofemoral subluxation
  - MRI
    - not routinely needed
    - Ligamentous integrity
    - Osteonecrosis

Final decision made in OR

Results

- Berger 2005 96% 10 year
- Price 2005 93% 15 year

Results

- Compared to HTO
  - Broughton 1986
    - Improved results, rom, recovery time, peri-operatve morbidity
  - Weale and Newman 1994
    - Better long term function and survival in Uni group
  - Stukenborg 2001
    - P/R study: increased survivorship, decreased intra and peri-op complications with Uni

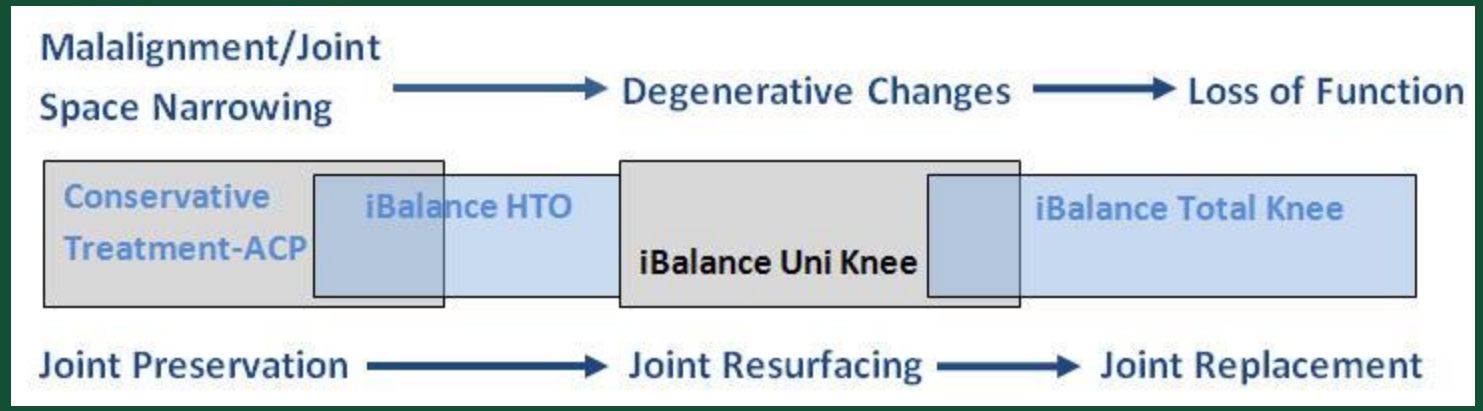
Results

- Compared to TKA
  - Laurencin 1991
    - More preffered UKA, felt more normal, better function
  - Dalury 2009
    - No difference in outcome, none preferred the TKA
  - Newman 1998
    - More excellent outcomes, quicker recovery, less periop morbidity
  - Patil 2005
    - Kinematic study
    - Tibial axial rotation, femoral rollback more closely resembles normal knee than does a TKA

Results

- Revision to TKA
  - Barrett 1987
    - Good results in only 45%
    - Results worse with augmentation, increase constraint, stems
  - Levine 1996
    - Improved UKA designs: clinical results similar to primary TKA
  - McAuley 2001
    - All tibial defects managed without allograft or structural support

Where does the iBalance Uni fit in the treatment ladder?



iBalance UKA System

- Complete, minimally invasive instrument and implant platform for the treatment of localized unicondylar cartilage degeneration as a result of osteoarthritis or post-traumatic arthrosis
- Incorporates highly anatomic femoral and tibial resurfacing implants and a novel and innovative instrument platform that facilitates a highly accurate, efficient and reproducible surgical technique

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

iBalance UKA System

- Femoral implants have coronal and sagittal geometries that match the curvature of the normal knee with a tapered anterior aspect that helps to reduce the incidence of patellar abutment
- Instrumentation is minimalistic and elegantly designed to be intuitive for the surgeon and OR staff, helping to reduce the learning curve
- iBalance UKA provides a predictable, balanced result that ensures near-natural kinematics

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Incision and Approach

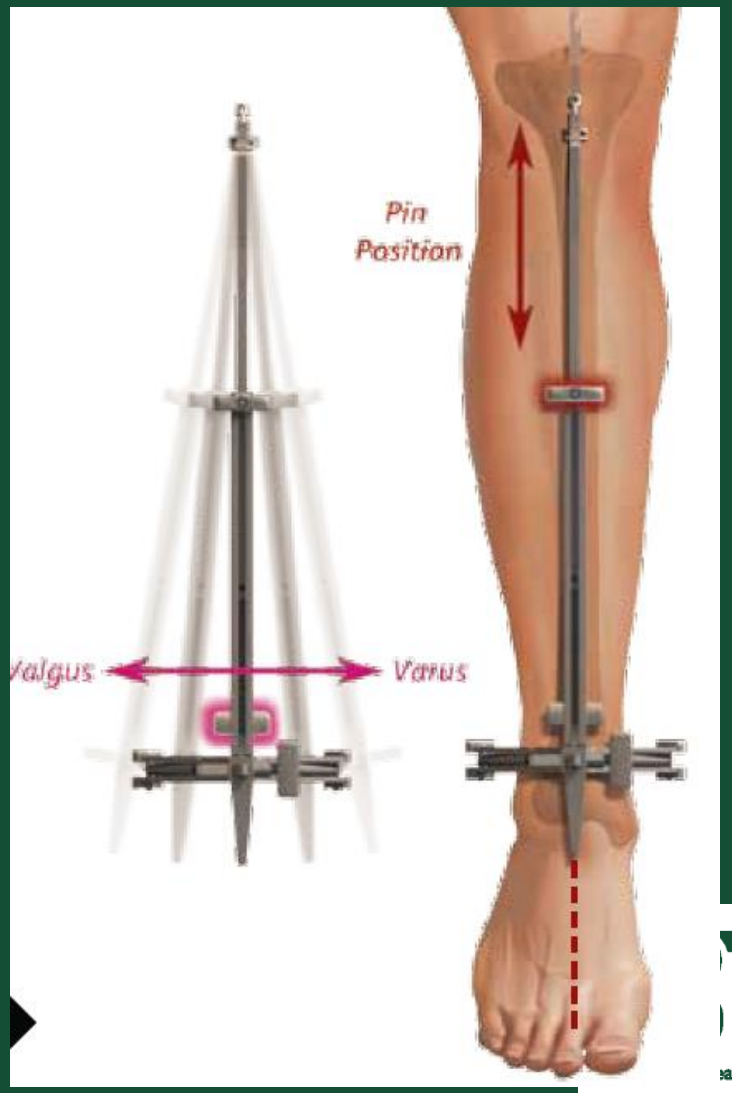
- Incision
- Exposure
- Osteophyte removal

Step 1

- Assemble the tibial alignment guide and place it on the operative limb

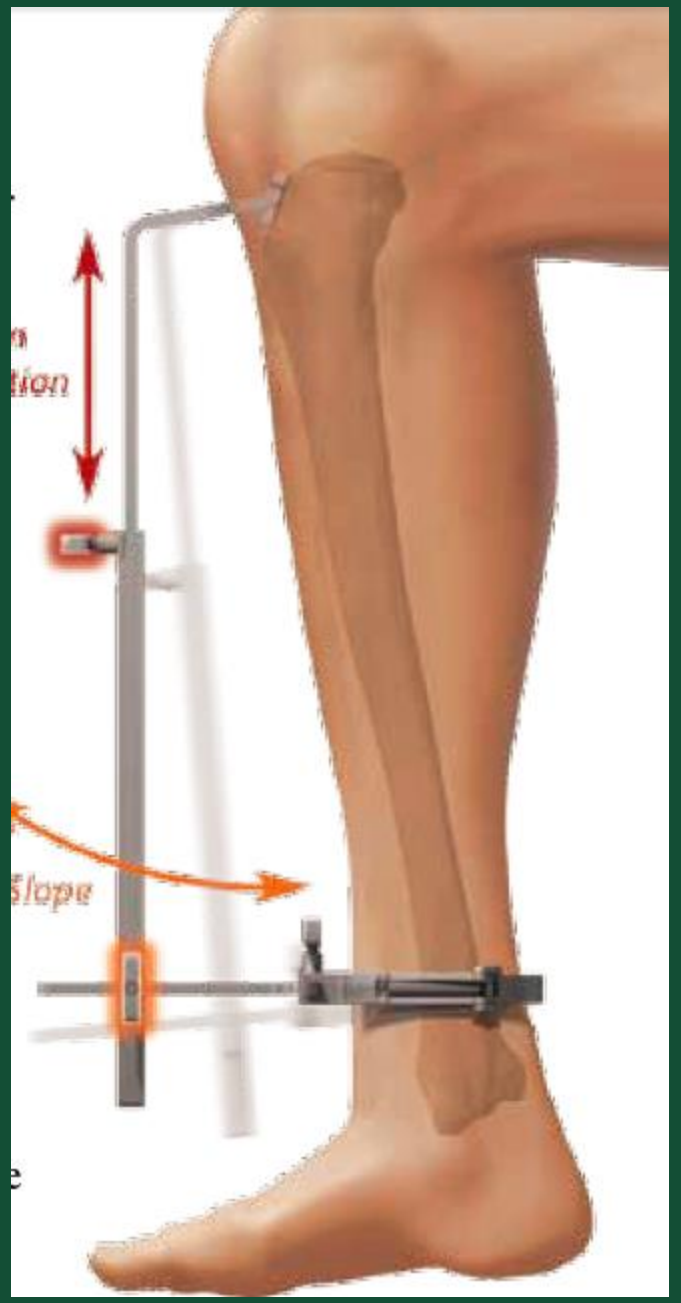
Step 2

- Adjust length of tibial alignment guide to allow proximal portion of guide to reach area between tibial tubercle and tibial plateau and pin guide with a single pin
- Varus/valgus alignment is accomplished by aligning long axis of tibial guide between 2nd and 3rd metatarsals and parallel to long axis of tibia



Tibial Resection Guide

- Attach appropriate (left-medial or right-medial) tibial resection guide to tibial alignment guide



Match Slope

- Tibial resection should match tibial slope
- Loosen screw that allows anterior/posterior motion of tibial alignment guide relative to ankle clamp
- Adjust alignment guide so that proximal surface is parallel to slope of tibia
- Tighten the screw to secure tibial slope alignment

Tibial Resection Depth

- 2 tibial stylus options available
- “0” stylus places tip of stylus at level saw will cut through, representing zero resection depth
- “5” stylus places tip of stylus 5 mm proximal to level saw will cut through, representing a 5 mm resection depth

Tibial Resection Depth

- Loosen tibial resection guide thumbscrew so that resection guide slides proximal/distal on tibial alignment guide
- Slide tibial stylus over tibial resection guide and place stylus pointer on tibial plateau at lowest point of the chondral defect
- Once the stylus is in appropriate position and depth of cut determined, lock tibial resection guide in place on tibial alignment guide

Vertical Tibial Cut

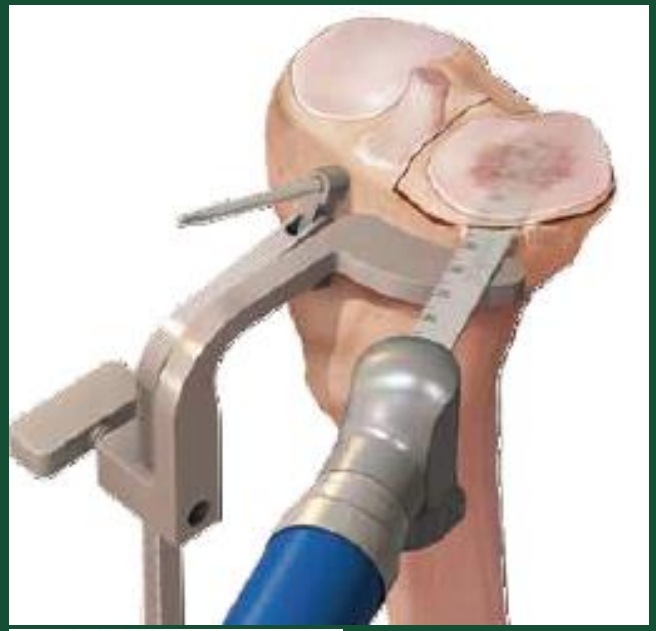
- Reciprocating saw makes vertical tibial cut
- Make cut parallel to and located at edge of tibial eminence from plateau to level of tibial cutting guide
- Use caution to avoid cutting into ACL attachment
- Electrocautery device is helpful to mark proper orientation line

SINCE 1947 TSAOG ORTHOPAEDICS Experience. Innovation. Expertise.

BRIO Burkhart Research Institute for Orthopaedics

Horizontal Tibial Cut

- Use a 1.27 mm x 13 mm sagittal saw to make the horizontal cut
- Hold saw blade flat against surface of tibial resection guide and take care not to allow saw to undermine tibial eminence
- Do not flex blade
- Remove resected tibial plateau with rongeur or osteotome



Balancing Flexion Extension Gaps

- Prior to assessing gaps using spacer blocks remove all retractors from joint to ensure proper tensioning of joint space
- Measure/record flexion/extension spaces using spacer block handle and modular spacer blocks
- Magnetically attached

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Flexion & Extension Gaps

- Goal: balance prepared flexion and extension gaps to achieve optimal stability through full range of motion
- Once tibial cut made, flexion/extension gaps assessed using 6 mm - 10 mm Spacer Blocks
- iBalance Unicondylar Knee has overall minimum implant material thickness of 15 mm so goal is to create flexion/extension spaces of at least 16 mm to prevent overstuffing of compartment

Extension Gap

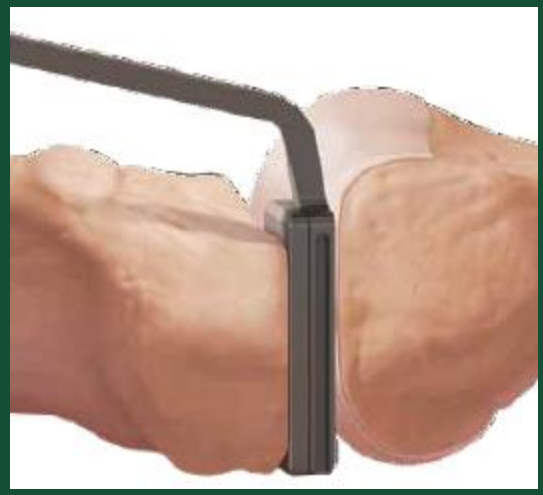
- Assessed using appropriately sized spacer block in extension
- Example: If goal id to achieve 16 mm extension gap and extension space after making tibial cut measures 10 mm, a 6 mm distal femoral cutting block should be used
- This would allow the appropriate amount of bone to be removed in extension to result in a 16 mm gap

Flexion Gap

- If flexion gap is tighter than extension gap, more posterior than distal bone resected
- Example: if extension gap = 10 mm, but flexion gap = 8 mm
- In this case, with a target overall gap of 16 mm, posterior femoral cut is made with 8 mm Posterior Cutting Block
- Lead to matching flexion/extension gaps of 16 mm

Measure Extension Space

- Insert appropriately sized spacer block into compartment with leg in full extension and leg in proper varus/valgus alignment

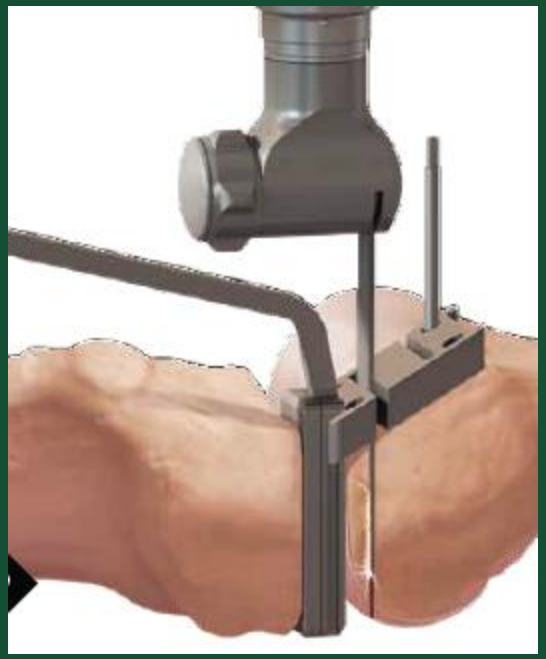


Measure Flexion Space

- Insert appropriate sized spacer block into compartment with leg in 90° of flexion with leg in proper varus/valgus alignment

Distal Femoral Cut

- Cutting block determined to be correct and flush against anterior femoral condyle, pin in place
- Check varus/valgus alignment before distal resection is made using the alignment rods
- Use 1.27 mm x 13 mm wide sagittal saw



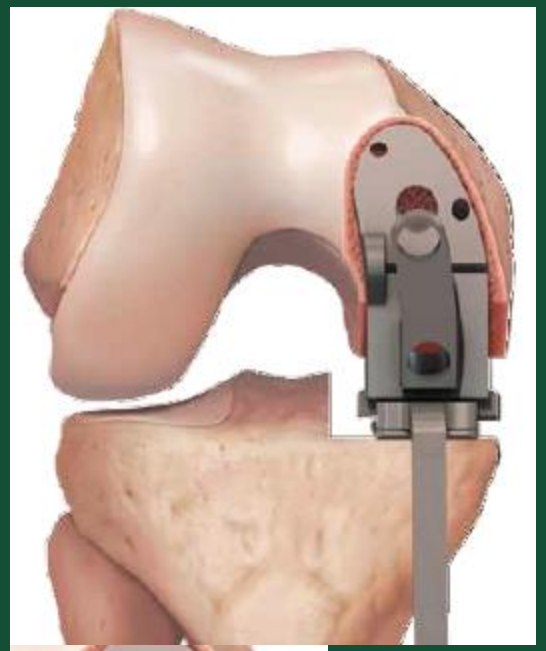
Posterior Femoral Cut

- With cutting block flush against previously made distal resection to provide correct angle between posterior and distal cuts, pin block in place
- Check varus/valgus alignment before resection
- Use 1.27 mm x 13 mm sagittal saw

16 mm Composite Block Gap Check

- Composite block of 16 mm placed in flexion and extension spaces to ensure gaps are indeed square and flexion and extension spaces are balanced

Femoral Sizing, Chamfer Cut, and Peg Hole Preparation



Rim of 2-3 mm of exposed bone above anterior flange of guide (no medial overhang)

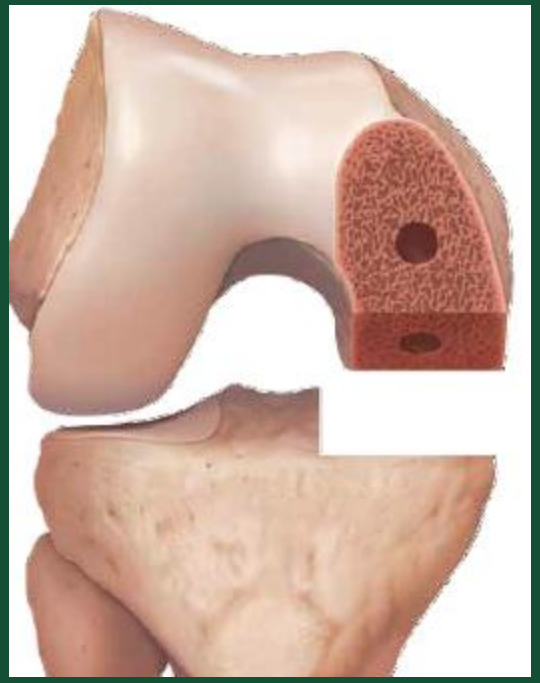
Pin guide in place
Make chamfer cut using 1.27 x 13 mm sagittal saw

Create anterior and posterior lug holes using Femoral Step Drill

SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

BRIO
Burkhart Research Institute for Orthopaedics

Tibial Reduction



D-ring tibial trials, tibial bearing trials and femoral component trials to assess fit and position of implants and proper tensioning of compartment

Tibial Sizing

Use tibial peg step drill to drill two tibial peg holes
Drill bit can be left in medial hole to add support during punching keel

Insert Keel Punch into slot on Tibial Guide
Mallet Keel Punch down into tibial plateau Keel Punch should be impacted until tip is flush with guide

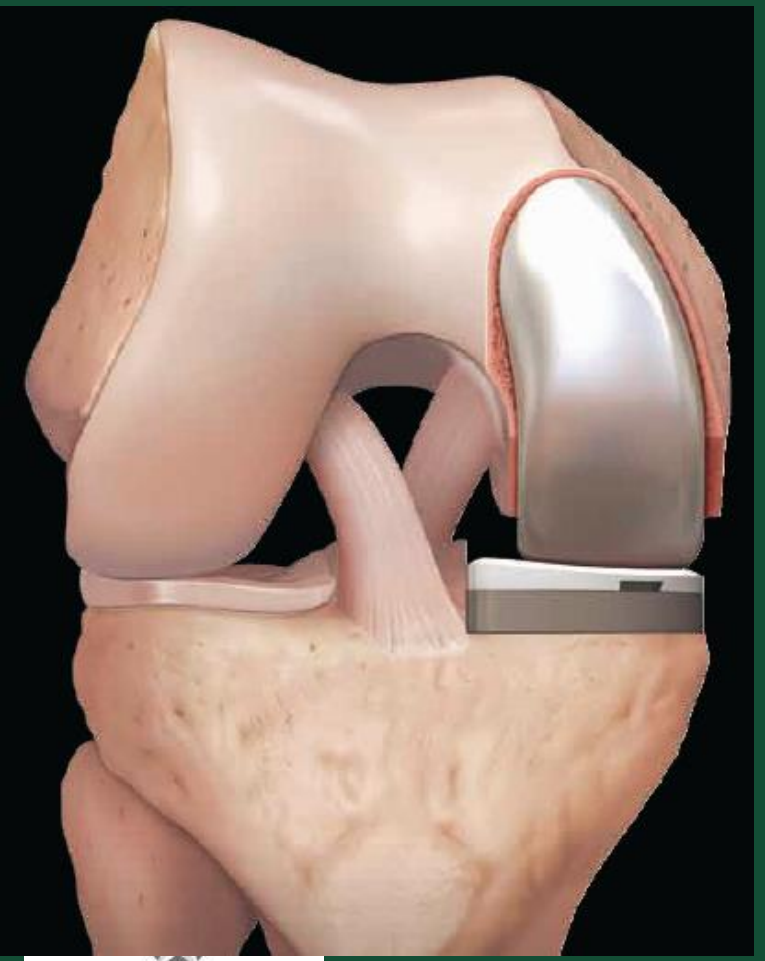
SINCE 1947
TSAOG
ORTHOPAEDICS
Experience. Innovation. Expertise.

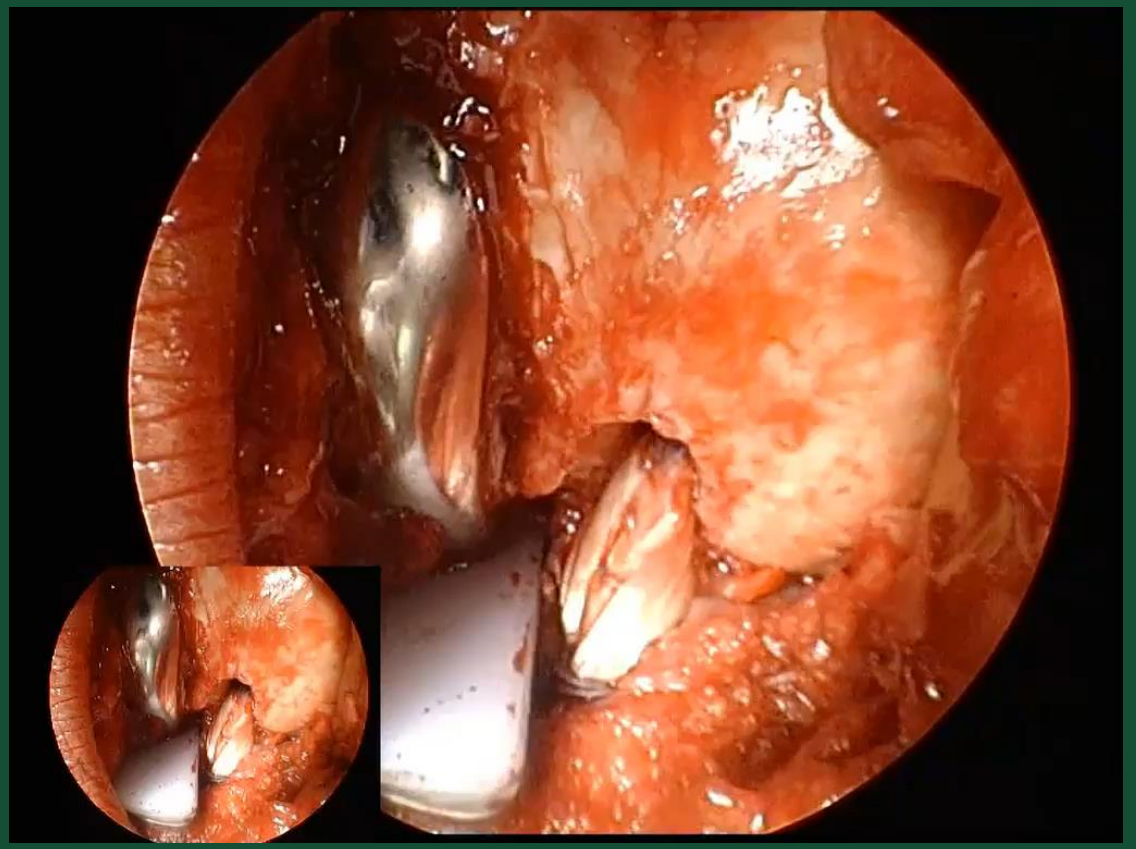
BRIO
Burkhart Research Institute for Orthopaedics

Implantation

- Tibial component is implanted first
- Femoral component is implanted with leg flexed as much as possible
- Determine final thickness of tibial bearing component by using tibial bearing trial placed in definitive tibial tray component
- Push anterior edge of final tibial bearing down into tibial tray component using thumb pressure until snaps into place

Final iBalance UKA





Initial Rehab

- WBAT
- AROM 0-90
- Quads, SLRs, calf pumps
- Keep knee generally straight
- RTC, 1-3 days, 6-10 days, then 6 & 12 weeks