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Ligament Preserving Techniques in Total Knee Arthroplasty
10-15% have Fair to poor Results? Why?
The complication rate is 2.567%

If It happens To You

It’s 100%
Types of Total Knee Replacements

- Anterior Posterior Cruciate Retaining ACL/PCL
- Posterior Cruciate Retaining PCL
- Medial Pivot MP
- Posterior Cruciate Substituting PS
- Mobile Bearing MB
- Varus Valgus Constrained VVC
- Hinged
ACL/PCL Retaining Knee Replacement
(XP Knee)
ACL/PCL Retaining Knee Replacement (XP Knee)
PCL Retaining Knee

- Most Used
- ACL function replaced by polyethylene geometry
- Rollback often does not occur
- Paradoxical Motion Tibia Moves Forward
Medial Pivot Knee

• Allows lateral Roll-back
• PCL sacrificed to obtain Flexion
• Allows normal feel to Gait
• ? Tibial Resection
Posterior Substituting TKA {PS}

Posts of Various Designs
Post controls Roll Back
High Flexion can lead to Dislocation
“Jump Height”
Varus Valgus Constrained \{VVC\}

Varying types
Of Posts with
Varying levels of
Constraint
Varus Valgus Constrained {VVC}

Used in Primary with Major Bone Loss and Ligamentous Laxity or Revision Knee Surgery
Hinged Knee Replacement

Fully Constrained usually Rotating Hinge
Anterior Cruciate Deficient Knee

• Gait Adaptations
• 1/3 compensate to do recreational activities
• 1/3 compensate but have to discontinue many activities
• 1/3 have very poor function
Anterior Cruciate Deficient Knee

- Substantial differences from normal
- In level walking jogging
- Reduction in flexion moment
- Decreases Quadriceps contraction
- Quadriceps Avoidance 75%
- Patients alter gait to prevent anterior translation of proximal tibia
Cruciate Retaining Knee Replacement

- Why?
- Anterior Cruciate is Proprioceptive
- Normal roll back in Flexion occurs
- Prosthetic Movement not controlled by Polyethylene Geometry
- 10-15% Have Fair to Poor Results for Multiple Reasons Instability, Pain, Weakness and usually Unknown
Envelop of Functional Motion
Professor Andriacchi and Dr. Galante

A complex interaction between the primary movement (knee flexion/extension) and secondary movements (AP translation and IE rotation)

Articular Contact Motion → EFM
Envelop of Functional Motion (EFM)

- Envelop of Functional Motion (EFM)
  - Determined by AP Translation and IE Rotation

- EFM is Dependent on Activity
  - Dynamic EFM cannot be predicted from Passive motion

- Engages ACL and PCL Function
  - Determined from Activity

- Articular Design Permits EFM
  - Avoids UHMWPE Constraint Forces and Minimize Contact Stress
Envelope of Functional Motion

Why is EFM Important?

- Research demonstrates\(^1\) loss of the ACL causes loss of normal proprioception and function.
- Patients studied with bi-lateral total knee arthroplasties preferred retention of both cruciates with use of an ACL-PCL prosthesis\(^2\) when compared to a non ACL-PCL retained design.

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1 - BERCHUCK, M; ANDRIACCHI, TP; BACH, BR; et al. GAIT ADAPTATIONS BY PATIENTS WHO HAVE A DEFICIENT ANTERIOR CRUCIATE LIGAMENT, JOURNAL OF BONE AND JOINT SURGERY-AMERICAN VOLUME Volume: 72A Issue: 6 Pages: 871-877 Published: JUL 1990

Applying EFM to Design

• Preserving the ACL is Not Enough!

• Natural kinematics requires preservation of ligamentous structures (anterior and posterior cruciate ligaments) and properly designed articular surfaces.
Evidence

- Pritchett. J Arthroplasty 2011
- Comparison
- ACL PCL/MB/PCL/PS/MB
- Bilateral Staged
- 11% Excluded Fair or Poor Result
- All Types had no differences in Pain Score, ROM, Knee Score or Function Score
Evidence

• Pritchitt  J Arthroplasty 2011
  • ACL/PCL vs PCL 73% prefer ACL/PCL sig
  • ACL/PCL vs PS 89% prefer ACL/PCL sig
  • ACL/PCL vs MP Equal ns
  • MP vs PS 76% prefer MP sig
  • MP vs PCL 76% prefer MP ?
  • PCL vs PS Equal ns
Evidence

- Cloutier
- Hermes 2C 163 Bicruciate TKA wear
- 82% survival at 20yrs
- Poly Wear Major Revision Reason
Evidence

• Goutallier Comparative Study with PS
• At 1yr 37% painful ROM vs PS < 106 vs 113 degrees
• Function Good ACL/PCL>PS
• Conclusion Better Function Requires Lot more Precision
Bi unicompartmental Knee Arthroplasty

Italian Study

Comparison no PF Arthritis

No Differences in Pain, Knee Score or Function

Better Flexion Less Stiffness
ACL/PCL Retaining Knee Replacement

• Only Patients with retained cruciate ligaments have Normal Kinematics
• Only Patients with retained cruciate ligaments have normal rollback
• The new polyethylene different medial lateral geometry allows the ACL and PCL to drive motion
XP Cruciate Retaining TKA

Intercondylar Osteophytes predict absent or damaged ACL

Absent

Shredded
XP Cruciate Retaining TKA

75-80% of Knees that have Arthritis that go to Surgery For a TKA have an ACL
XP Cruciate Retaining TKA

Valgus Knees are more likely not to have an ACL

Severe Lateral Condyle Wear

Shredded ACL
XP Cruciate Retaining TKA

- Femur can done with Signature Technology
- Femoral Geometry is compatible with Anterior Cruciate Sacrificing Tibia
- ACL deficient or Bone Island Fx Easy Convert
- Tibia Cuts are Critical
- Signature Technology can be Adapted (still in development)
- More Anatomical Tibial Slope (7 degrees)
XP Cruciate Retaining TKA

- Femur can be done using Signature Technology
XP Cruciate Retaining TKA

- Femur can done with Signature Technology
- Personalized Blocks 3D Printer from MRI
XP Cruciate Retaining TKA

- Femur can done with Signature Technology
- 4 in 1 Cutting Block Protects ACL
XP Cruciate Retaining TKA

- Tibial Resection can be done with Signature Technology
- Tibial Slope 7 degrees More Anatomic
XP Cruciate Retaining TKA

- Tibial Rotation set by Medial 1/3 Tibial Tubercle
- Medial Vertical as Far Lateral as Possible without Damaging ACL
XP Cruciate Retaining TKA

- Medial Vertical Cut as Far Lateral as Possible without Damaging ACL
XP Cruciate Retaining TKA

- Tibial cut surfaces must be Flat (within 1mm)
- Tibial Slope 7 degrees More Anatomic Match the Native Slope
XP Cruciate Retaining TKA

• Flexion Gap (Distance Between Femoral Posterior Cut surface and Tibial Cut surface) 10mm or More
XP Cruciate Retaining TKA

- Flexion Gap (Distance Between Femoral Posteriorly Condyle Cut surface and Tibial Cut surface) 10mm or More at 90 Degrees
- Extension Gap Must be Identical
- This Ensures Ligament Balance
- Varus Knees need Medial Ligament Release
XP Cruciate Retaining TKA

- Tibia size must be sized to Allow Roll Back

Bone Island With ACL PCL
XP Cruciate Retaining TKA

• Medial and Lateral Bearing are designed Independently Sizes 9mm to 12mm
• At Trialing Knee Feels More Like a Normal Knee
• ⭐ Stable in Extension and Flexion Definite Medial Lateral Mid Range Give
XP Cruciate Retaining TKA

- At Trialing Knee Feels More Like a Normal Knee
- ★ Stable in Extension and Flexion Definite Medial Lateral Mid Range Give
XP Cruciate Retaining TKA

• With only 2 small Posts and 2 Narrow Keels cement Technique is Critical

• Use drill holes in Sclerotic Hard Bone
XP Cruciate Retaining TKA

- Trial Medial and Lateral Bearing
- Keep Bearings Symmetric
- Asymmetric Bearings 1mm. = 1 degree
XP Cruciate Retaining TKA

Normal XP X-Ray

Bone Island Good Fit Neutral Tracking Patella
XP Cruciate Retaining TKA

Results (Impressions)

- Selected Group!
- Early Flexion
- Less use of Ambulatory Aids
XP Cruciate Retaining TKA

Bone Island Cracked During Surgery Fixed With 4.0 Cancellous Screw Post-Op 3 Months Healed No Complications ROM 119 degrees
XP Cruciate Retaining TKA

Fall 5 weeks Post-Op Tear Medial Ligament
Braced 6 Weeks Bone Island Fracture
?? Result
Thank You

Northeast Nebraska Orthopaedics Staff
FRHS Surgical Staff and Anaesthesia
FRHS Pre-Op Staff and Joint Teaching Staff
FRHS Ortho/Surg Staff (Rachel /Ann)
FRHS PT/OT
NE Nebraska NH and PT Facilities
Thank you for your Attention

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