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3DKNEE™: RATIONALE FOR AN ACL SUBSTITUTING DESIGN & A GAP BALANCING MODEL

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TKA and LIGAMENT BALANCE

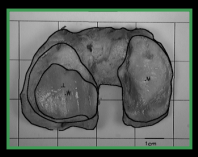
- If ACL & PCL preserved: simple resurfacing if no deformation ; more complex in other cases
- If ACL & PCL sacrificed : how to fill trapezoidal gap
- If ACL only sacrificed : convexity laxity
  - => fill gap without release: let medial laxity (varus)
  - => fill gap with release: PCL is too tense and vertical
  - => fill gap with medial & PCL release: spaced height too high (=> low patella)
- In all cases question is to determine sot tissue envelope tense

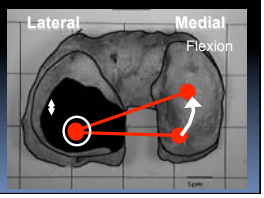
Consider:

- The ACL is resected in majority of TKA
- Removing the ACL changes the kinematics of the knee
- Total knee patients are effectively ACL deficient knees
- What can we learn from the study of ACL deficient knees?

Research Behind the Design

- **Analysis of extracted tibial plateaus of knees without the ACL** showed **a central point of pivot about the lateral condyle**
- **After ACL rupture evolution is medial arthritis of the knee**

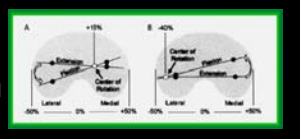


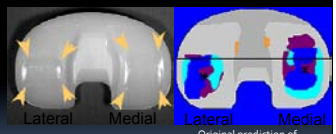


Research Behind the Design

Tracking the contact points of many different implant designs available today has shown lateral pivot patterns regardless of design type.

Accuracy
+ 1° rotation
+ 0.5 mm translation





5 yr post-op Retrieval Series 7000 insert (Stryker)

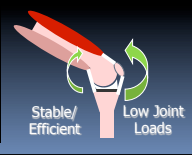
Original prediction of wear pattern from Fluoroscopic Analysis

Provide Intrinsic Stability/Strength

- Joint Stability
  - Sports Medicine Perspective – ACL Deficient Knees: 'Copers' vs. 'Non-Copers'
    Alkjaer T, Eur J Appl Physiol. 2003

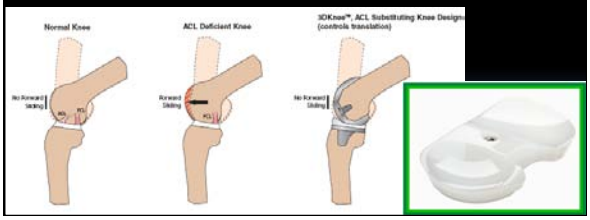
- Ideal TKA would provide definite AP stability so that hamstrings activation is not required to stabilize the joint
- Increase available quadriceps strength AND reduce joint compressive forces

'Ideal TKA'



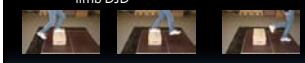
Provide
Intrinsic Stability/Strength

- The 3DKnee was engineered to provide inherent anterior/posterior stability to enhance strength and range of motion
- The 3DKnee acts as an **ACL Substituting Knee**



Provide
Intrinsic Stability/Strength

- Mitchell, Banks, Rawlins, Wood, Hodge, Orthopaedic Research Lab Study 2004
  - 8 patients with unilateral 3DKnees
  - Selection criteria: > 6 months post-op, climb stairs, no other significant lower limb DJD



No statistically significant difference in weight-bearing maximum flexion comparing operated 3DKnees and healthy knees

Comparing this study to others:

Implanted knee as % of normal:

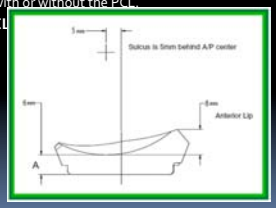
TKA[1]	68% (sig. diff.)
IBII[2]	70% (sig. diff.)
Maxim[2]	84% (n.s.d.)
Trac PS[2]	81% (n.s.d.)
3DKnee[3]	85% (n.s.d.)

- **Intrinsically Stable Knees are Stronger!**

1. Sivan et al., J Arthrop 28(8) 2013
2. Dejour et al., J Arthrop, 2012
3. Banks et al

Other Features - Inserts

- **Posterior Positioned Sulcus**
  - Sulcus is 5mm behind A/P center, encouraging increased femoral rollback for greater flexion
- **8mm Anterior Lip**
  - The anterior lip of the 3DKnee insert resists tibial subluxation in the absence of the PCL, therefore it can be used with or without the PCL.
- **Same insert with or without the PCL**



Conclusions:

- 3DKnee provides intrinsic AP stability to enhance strength and ROM (ACL Substituting Knee)
- Very positive early clinical and functional (ROM, strength) results
- Enhanced contact areas and reduced co-contraction should reduce wear and enhance implant longevity

- But how to balance correctly in front plane ?

GAP BALANCE: eLIBRA System

- To achieve stability through ligament balancing
- To achieve optimal flexion gap
- With good patellar tracking
- When anatomic landmarks (like transepiconylar axis, Whiteside's line) are difficult to precise

GAP BALANCE: eLIBRA System

- Dynamic system used after proximal tibial and distal femoral resections
- Force sensor in flexion (same thickness than TKA)
- After reducing patella
- Set pressure on each plate to balance them by rotating the dial until the medial and lateral forces are equal
- If rotating isn't suffisant, soft tissues release (3D Knee) or bone cuts change

GAP BALANCE: eLIBRA System

- External rotation isn't pre-determined
- Avoid mistake in case of deficiencies of posterior lateral femoral condyle
- Patellar tracking could be checked before final trials
- Allows soft tissue toi dictate optimal femroal component position
- Allows choice of « stiff or not knee » according to surgeon choice with pressure : 3 to 8 pounds

CONCLUSION

- Ligament balance is fundamental
- In sagittal plane : ACL/PCL preserving with coherent plate design
- In frontal plane according to surgeon's choices :
  - Orthogonal or not spaced gap
  - Soft tissue balance or assymetric resections
  - In all cases to enhance flexion and patellar track
- Various tools exist. E-Libra is one of them, simple to use, repetitive and reliable