ATTUNE® Knee System GLIDERIGHT™ Articulation– Designing for PF Tracking & Quad Function: The In-Vitro & In-Vivo Science

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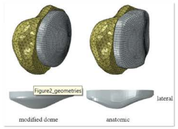
A summary of work previously published by U. Denver & U. Kansas

1. Introduction

- Patellar complications across various knee designs has been described as “fairly common”(1)
- Associated factors include poor patellar tracking, impingement between patellar bone and femoral implant, and reduced extensor strength(1)(2)
- ATTUNE® Knee System patellofemoral articulation (GLIDERIGHT™ Articulation) has been designed with the goal of reducing the potential for these factors.
- The ATTUNE Knee System includes two patella designs (Medialized Dome and the Medialized Anatomic), with a gradual capture femoral trochlea as observed in native knees(3)
- The apex of the PF articulation is medialized to help improve tracking without leaving the lateral patella bone uncovered(4)(5)
- The Anatomic patella utilizes concave articulation in the sagittal plane - to reduce patellar tilt & provide patellar mechanics more similar to native(6)(7)



2. Methods

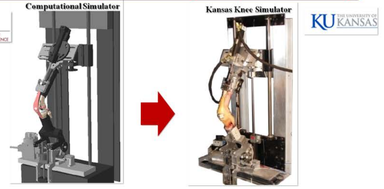
Pre-clinical In-vitro Kinematics(5)

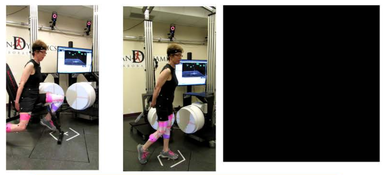
- Combined computational (U. Denver) and experimental (U. Kansas) lower limb kinematics analysis simulating activities of daily living (ADL)

In-vivo Fluoroscopy Kinematics(6)(7)

- IRB approved in-vivo study – 27 ATTUNE Knee Sytem PS RP pts, 32 knees, 16 Medialized Dome, 16 Medialized Anatomic
- Biplanar fluoroscope combined with registration of 3D implant model to 2D images
- 3D patellofemoral kinematics combined with biomechanical analysis

Pre-clinical Computational Design & Experimental Testing



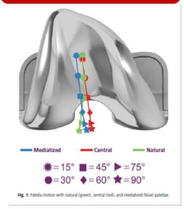


In-vivo Fluoroscopic Kinematics

3. Results: Pre-Clinical Studies

- Medialization of the patellar apex, combined with the GlideRight trochlear design, resulted in:
  - Patellar M-L tracking more similar to natural when compared to a traditional central apex design(5)
  - Reduced strains in the lateral peri-patellar issues (lateral patellofemoral ligament)(5)

Patella Tracking: Experimental Verification



Reduced Tensions in Lateral Peri-Patellar Tissues

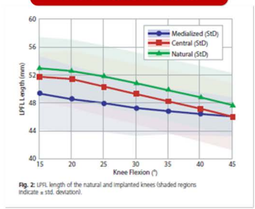
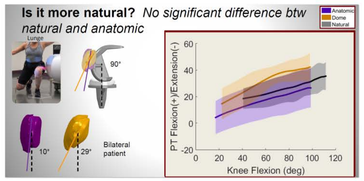
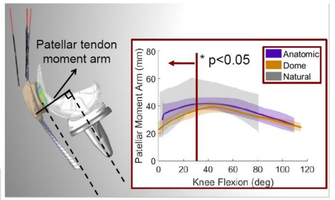


Fig. 2. LPFL length of the natural and implanted knees (shaded regions indicate ± SID, deviation).

3. Results – In-Vivo Fluoroscopy

- n = 32 knees - 16 Dome, 16 Anatomic
- Anatomic patella demonstrated:
  - Reduced sagittal plane tilting, more similar to the natural knee(6)(7)
  - Increase in patellar tendon moment arm, more similar to the natural knee(6)(7)
  - A trend towards improved knee isometric strength during extension(6)





Knee Isometric Strength(6)

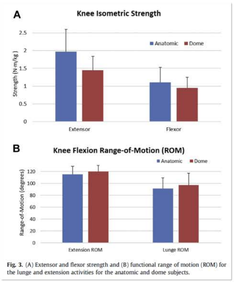


Fig. 3. (A) Extensor and flexor strength and (B) functional range of motion (ROM) for the lunge and extension activities for the anatomic and dome subjects.

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4. Discussion

- Extensive pre-clinical computational and cadaveric weight bearing biomechanics studies were utilized to understand impact of design upon patellofemoral kinematics, patella tracking, and forces in the lateral peripatellar soft tissues(5)
- Medialization of the patellar articulation surface, combined with gradual capture of the patella by the GLIDERIGHT Articulation femoral trochlea, resulted in improved patellar tracking and reduced strains in the lateral peripatellar tissues(5)
- Subsequent weight bearing in-vivo fluoroscopy confirmed that, when compared to a Dome patella, the Anatomic patella:
  - Reduced sagittal plane tilting, being more similar to the natural knee(6)(7)
  - Increased patellar tendon moment arm, being more similar to the natural knee(6)(7)
  - Trended towards improved knee isometric strength during extension(6)

5. Conclusion

- **Clinical Significance**:
  - Design features related to design of the patellar implant and the femoral trochlea were demonstrated in-vitro and in-vivo to result in more natural patellofemoral biomechanics/tracking and reduced tension in the lateral peripatellar tissues(5)(6)(7)
  - Use of the ATTUNE Knee System Anatomic patella was shown to trend towards improved isometric strength during leg extension(6)

- **References**:

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