Wear Simulation Testing and Comparison of Mass Produced Artificial Joints and Customized Joints

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Wear Simulator Testing

- Reproduce loads and motion
- Operates under
  - Force control
  - Displacement control
- ISO 14243
  - Parameters and regulations for testing machines
  - Methods of measurement
Anatomic Knee Simulator

• Intends to mimic realistic usage and orientation

• Motions
  • Anterior/posterior motion
  • Internal/external rotation
  • Flexion/extension rotation
  • Dynamic loading
Anatomic Knee Simulator

- Tests joint in anatomically correct apparatus
Main Reasons for Failure

• Aseptic loosening
• Polyethylene damage
• Wear phenomena
• Friction
• Osteolysis
Previous Studies

• Present a complete protocol for wear tests that include all daily activities\(^1\)
  • Stair climbing and sitting on a chair
• Joint was run through a normal gait cycle approx 12 million times after being aged in an oxidation chamber\(^2\)


Our Goal

• Create a realistic knee simulator that includes:
  • Feedback system to sensing technology
  • Forces that occur during normal gait as well as old normal daily activities
  • Follows ISO 14243 and expands on it
  • Cost effective

• Compare “off the shelf knees” and personalized artificial joints
Custom vs. “Off the Shelf”

iTotal TKA Implant by ConforMIS

A3 Primary Knee System by AK Medical
Custom vs. “Off the Shelf”

- Higher max flexion.
- Resembles natural motion.
Methods

- Use motion capture data to replicate natural movements in realistic simulator.
- Match motion data to customized implants.
- Compare with traditional implants.
Resources

• Joint Simulator(s)
• Motion Capture
• Imaging
• Implants
Why it matters

• Approximately 50% of Americans affected

• In 2015 719,000 TKAs performed

• More than 7 million Americans have one

• Costs roughly $57,000

• People are outliving their replacements
Conclusion

Combine natural motion with a realistic \textit{in vivo} simulation environment.

Compare wear over extended use between customized and traditional TKA implants.
References


Questions?