

Introduction

- Jackie Chiles, a 65-year-old man, has experienced debilitating hip pain since the age of 10. This discomfort has become more intense overtime, impeding his ability to walk more than a few minutes.



Figure 1- Frontal View Radiograph of Hip

Previous Treatments

- Physiotherapy
- Tramadol, 100mg daily (ineffective)
- Oxycodone, 2.5mg daily

Diagnosis

Legg-Calves-Perthes Disease (LCPD)

- Condition involving the osteonecrosis of the femoral head
- Causes the femoral head to “flatten” and lose its round shape
- Initially caused by lack of blood flow to the femoral head [1]
- Even if only temporarily can cause irreversible damage
- Normally occurs in childhood and can lead to hip arthritis as the patient grows up [2]



Figure 2- CT of femur and acetabulum

Need Statement

Design a hip replacement for Mr. Chiles, an individual with LCPD, which will reduce hip pain and improve his ability to walk without resting.

Evidence-based Solution

Multiple bearings: [3]

- Absorbs the compressive stress and allows uni-directional articulations

Hydrodynamic lubrication: [3]

- Synovial fluid from cartilage acts as interstitial fluid to sustain the loads in between the distanced bearings.
- Reduce wear and compression stress



Figure 4- CAD model of evidence-based solution

Uni-directional articulations: [3]

- The design constrains the motion of each articulation to move in one direction.

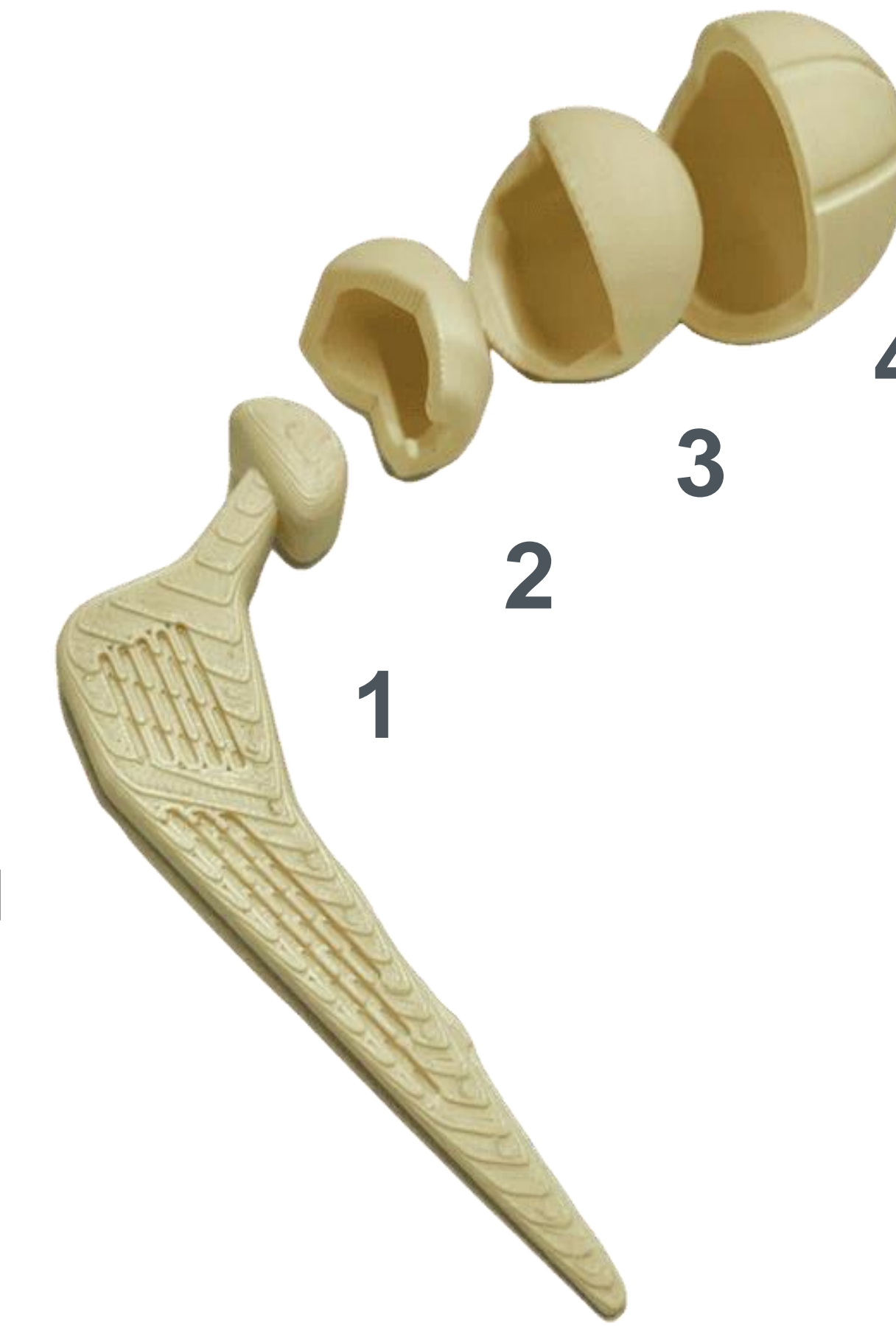


Figure 3- 3D printed model of evidence-based solution

Angular and cylindrical bearings: [3]

- Increase contact area to reduce contact stress as $pressure = force/area$

Stem's engraving: [3]

- Better adhesion between cemented bone and stem surfaces, resulting in a quick and permanent fixation.

Part List:

- Stem
- Rotator
- Flexor
- Abductor

Fixation

- Acrylic bone cement functions as grout to acetabular component
- Cement is squeezed in socket, then acetabular is pressed on cement [4]
- After ten minutes, implanted socket is fixated on bone
- Cement fixates quickly and efficiently, better for patient [5]

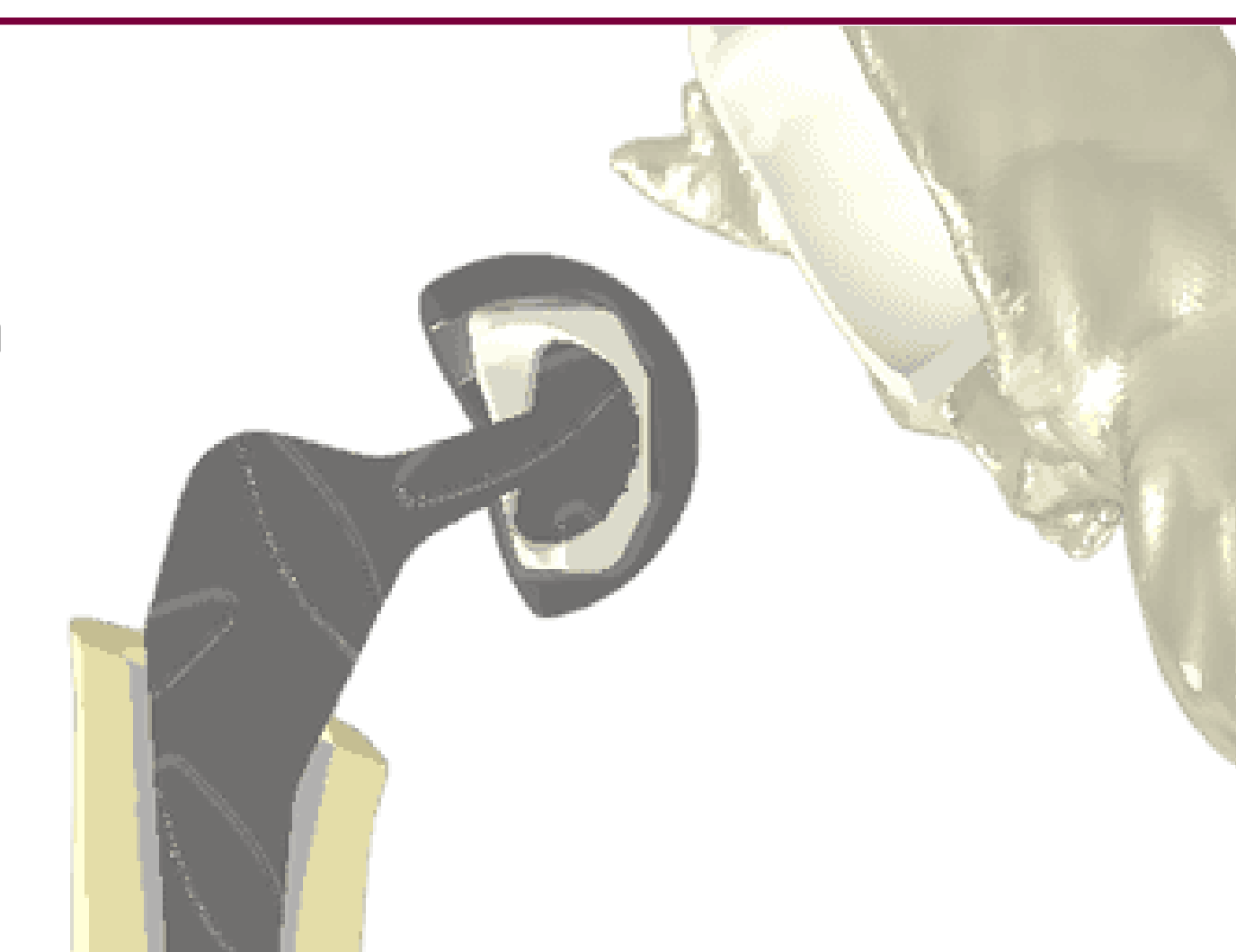


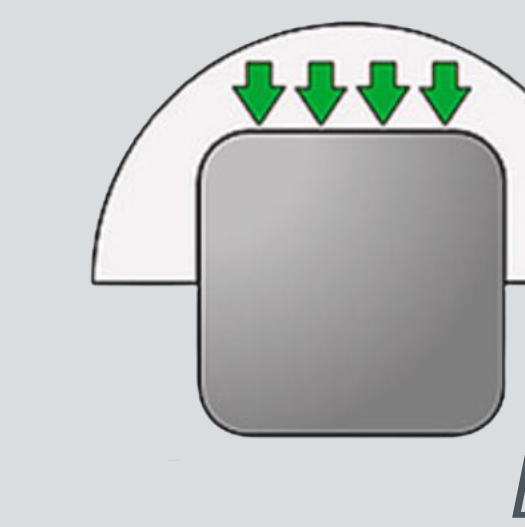
Figure 5 – CAD fixation model of evidence-based solution

Trusted Materials

Ultra-High Molecular Weight Polyethylene [6]	Diamond coating [7]	ASTM F799 Cobalt-Chromium-Molybdenum [7] [8]
<ul style="list-style-type: none"> Molecular reorientation mechanism- maintains form through wear [3] Economical Strongest load-bearing PE Corrosion resistant Biocompatibility confirmed in vitro & in vivo Low degradation 	<ul style="list-style-type: none"> Resistant to wear with low coefficient of friction Debris from wear are not toxic Prevent contact between Cobalt-Chromium-Molybdenum and bone cell, reducing risk of bone necrosis 	<ul style="list-style-type: none"> Excellent corrosion resistance Has some risk, but overall, less toxic than pure metals Excellent wear Counters motion of dislocation Highest Ultimate Tensile Strength, as compared to other alloys

The HIPocratic Difference.

Uni-Directional Technology



- Full range of motion
- Advanced load bearing
- Wear adverse
- Lowers risks of dislocation

Rethink the Ball-and-Socket

- Reinventing the biomechanical model of the hip to accommodate higher load-bearing needs
- Meeting the physical needs of patients
- Relieving compressive stress on the hip, in order to alleviate pain

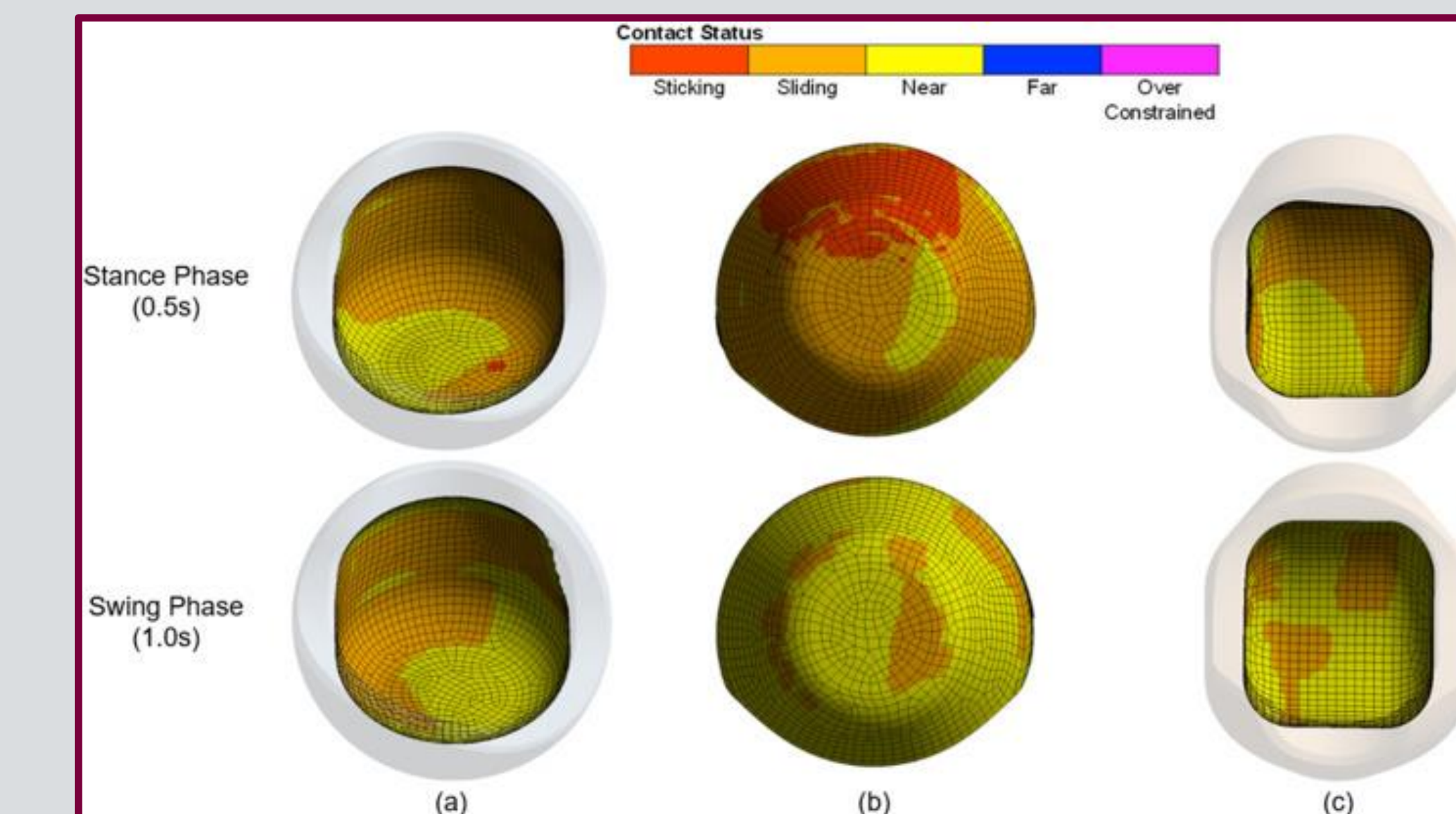


Figure 6 – Sticking and Sliding between cup surfaces [3]

Rounded, large surface area reduces sticking, leading to minimal stress and greater motion

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