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Characterising 3D Soft Tissue Features on Joint Surfaces

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Characterising 3D Soft Tissue Features on Joint Surfaces

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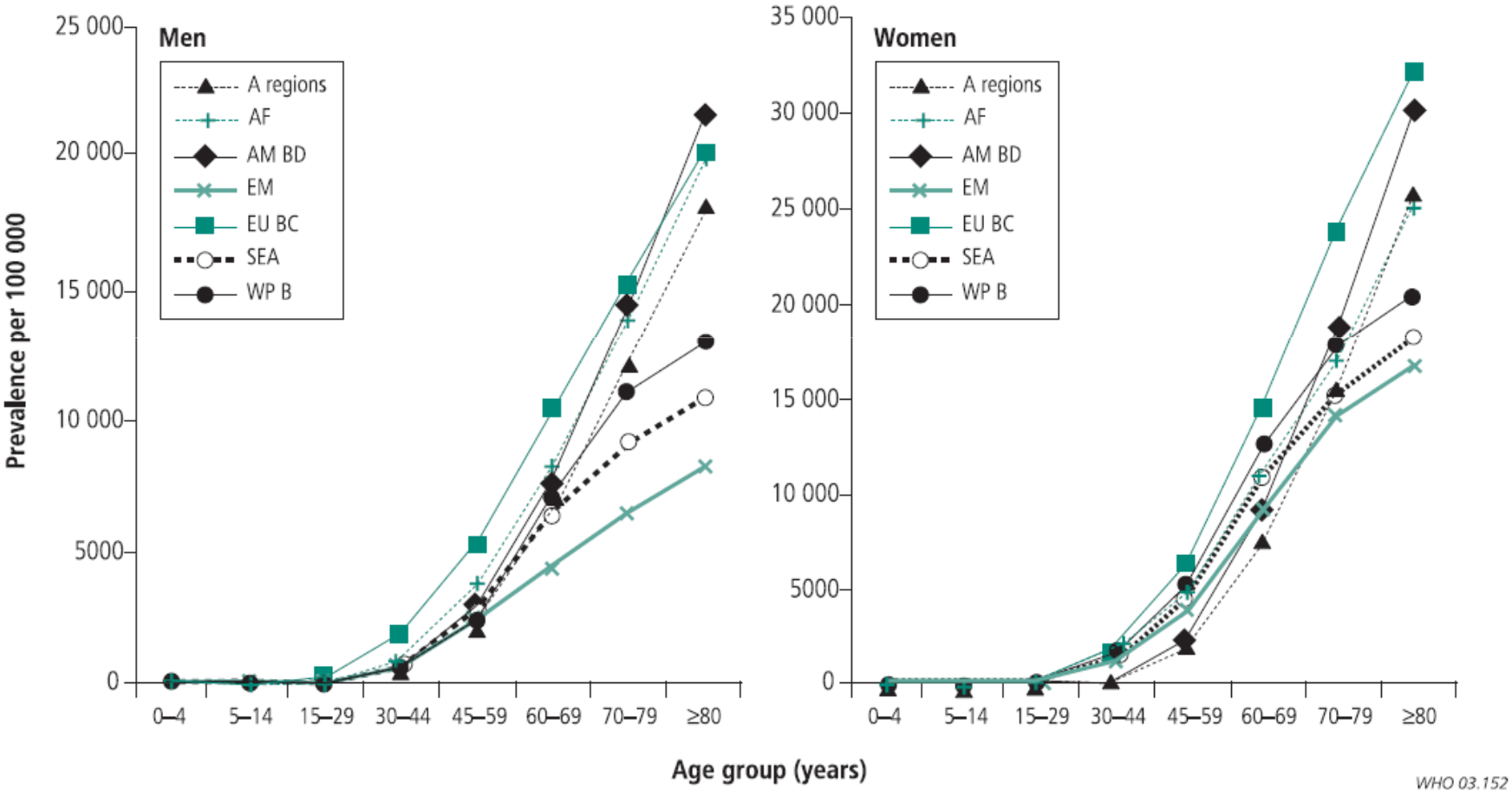
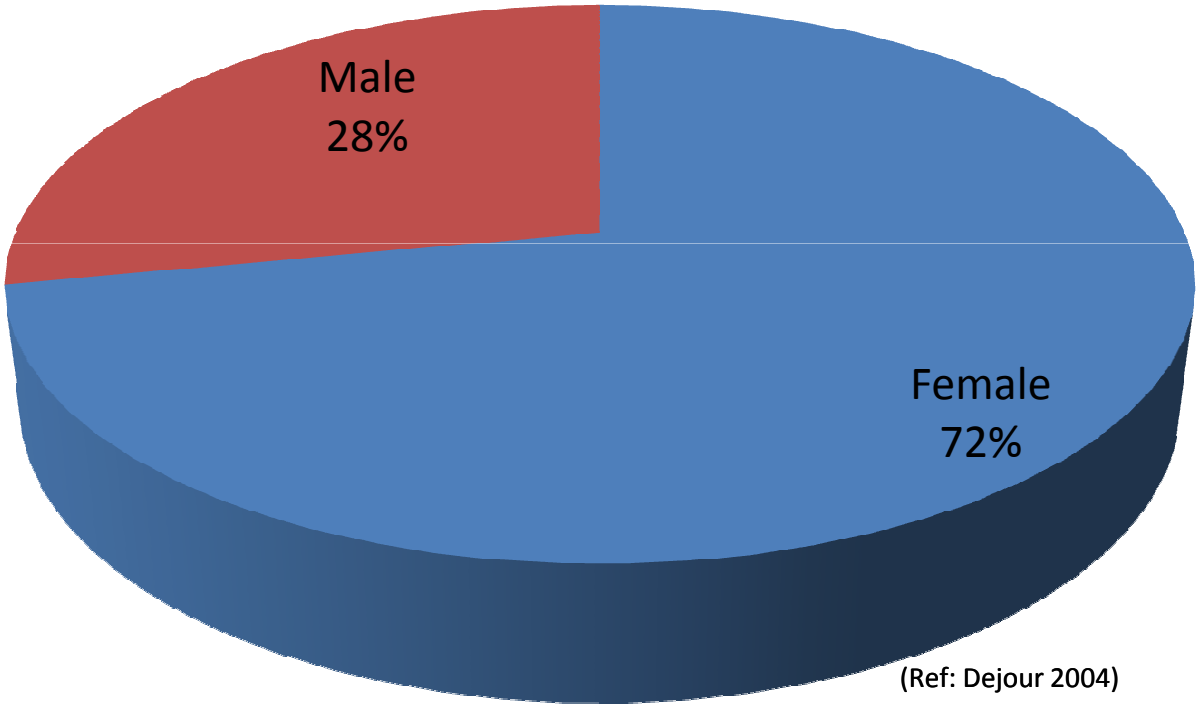
Prevalence of Knee Arthritis - Subgroups



(Ref: Woolf & Pfleger, 2003)

Prevalence of Knee Arthritis - Subgroups

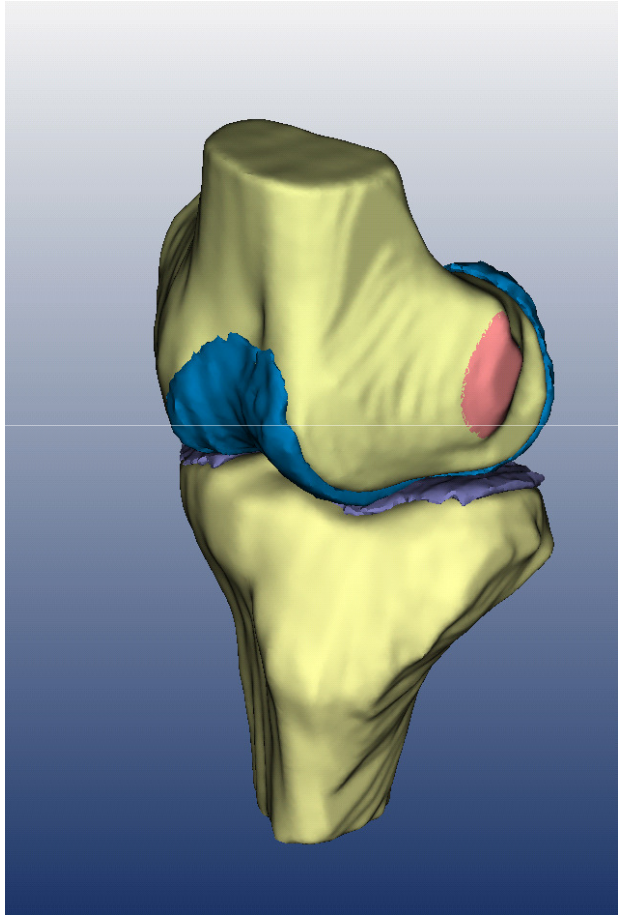
Gender breakdown, >500 patients with isolated patellofemoral arthritis



(Ref: Dejour 2004)

Knee Anatomy and Kinematics

- Hypothesis: That soft tissue geometry is a key driver of both kinematics and disease development in the knee joint



- Objectives
  - Investigate Shape – Gender, Ethnicity Effects
  - Investigate links between Anatomy & Kinematics

  ➢ Modeling soft tissue anatomy crucial.

- Issues:
  - Multi-modality
  - Absence of landmarks
  - Complex surfaces

Tools

Visualization Toolkit

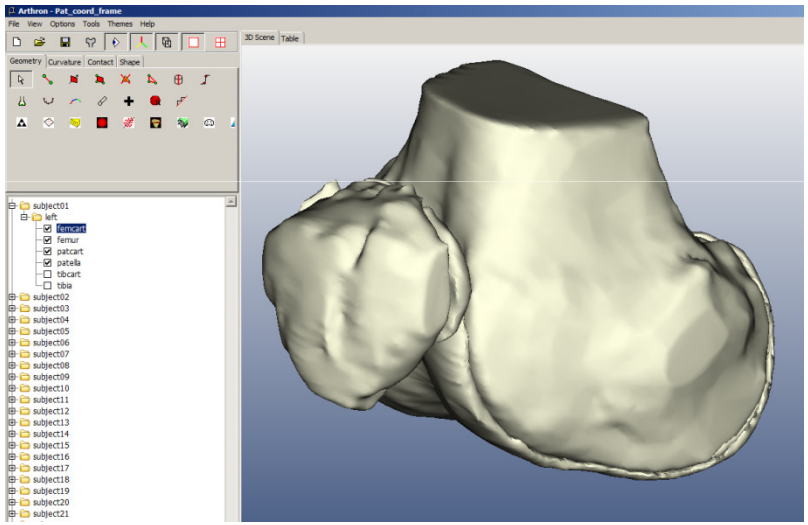
Tcl/Tk

VTk

vtkBioeng

C++ vtk

Arthron



- Mesh smoothing, cutting, simplifying, etc.
- 3D shape/size analysis tools
- Extendable Plug-ins
- Command line interface

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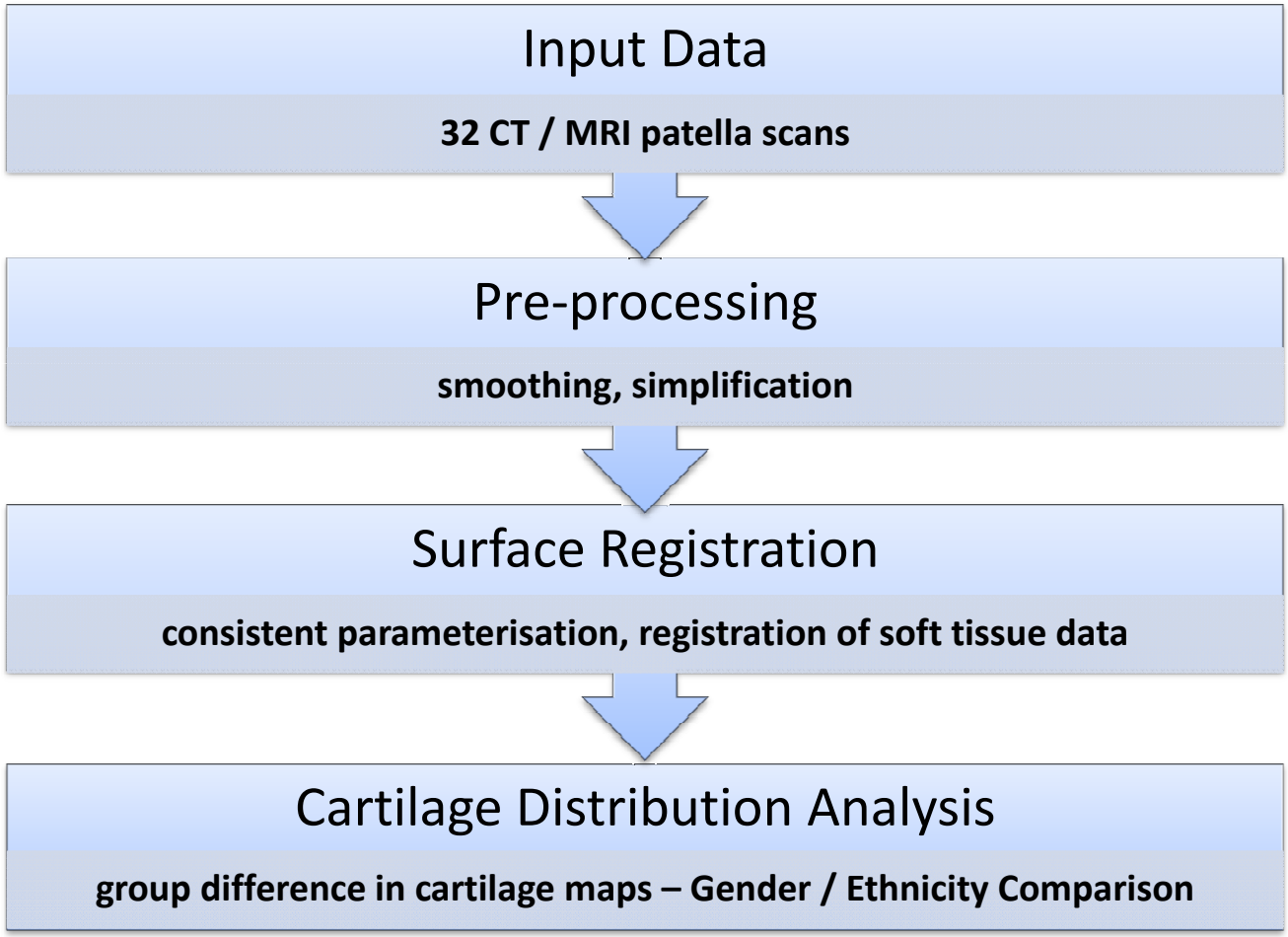
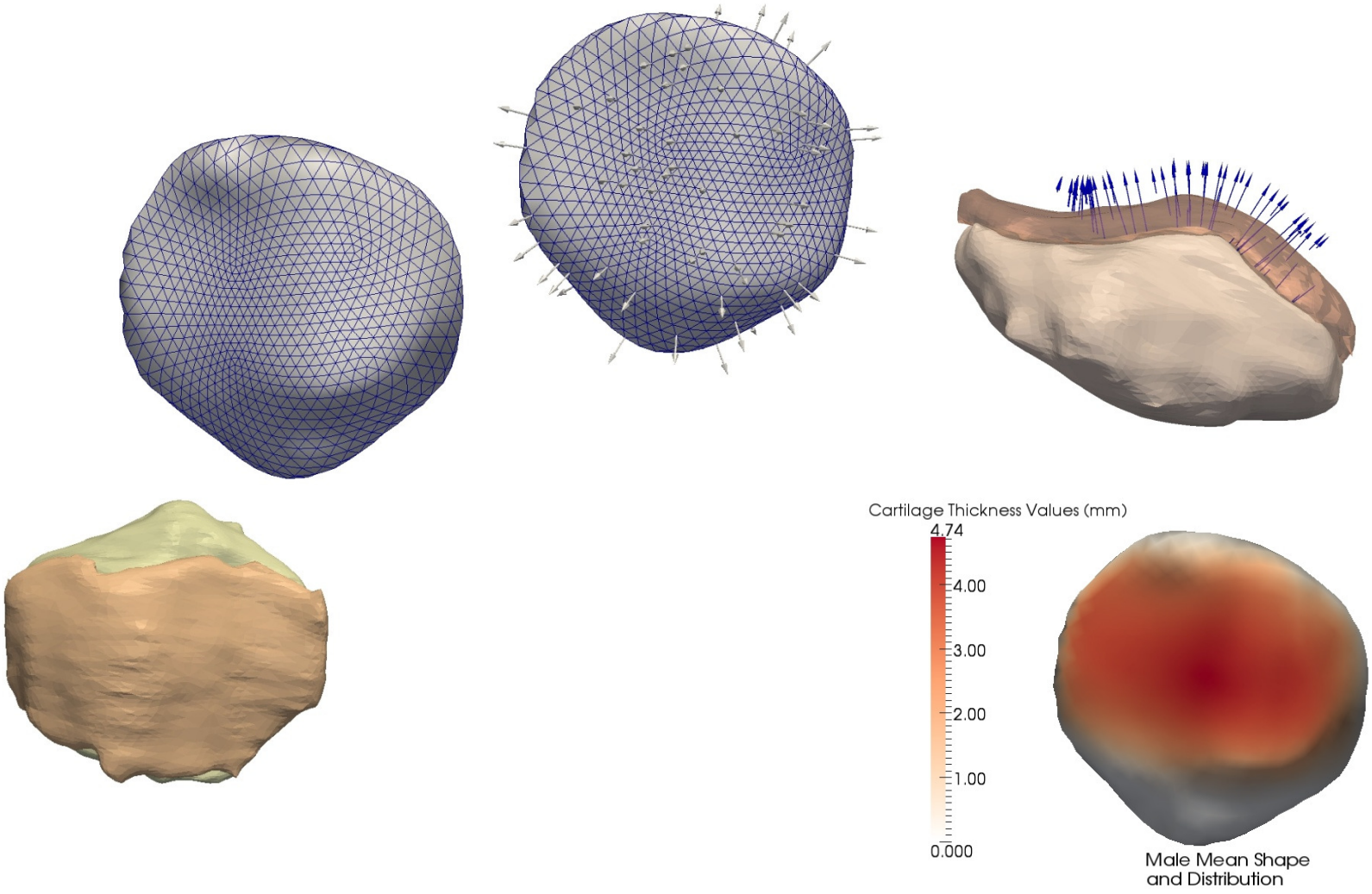
Patellar Cartilage Thickness Study



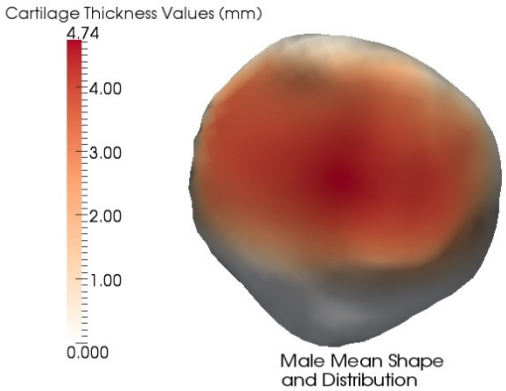
Patellar Cartilage Thickness Study

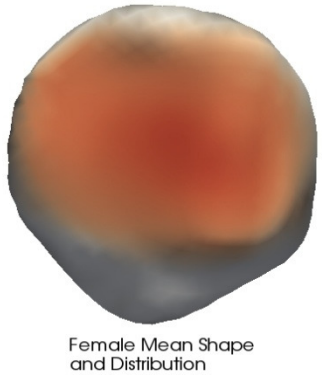
Data Groupings		
	Male	Female
Caucasian	12	7
Asian	6	7

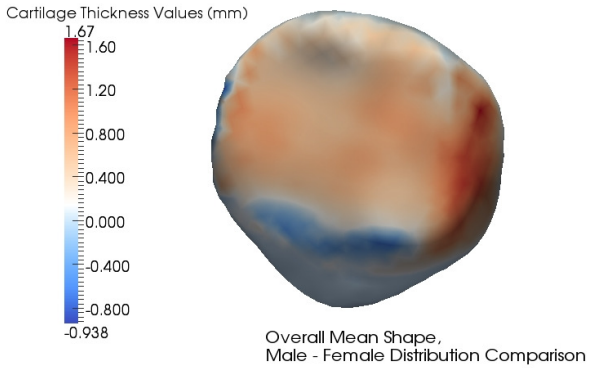
Methodology: Registration of Soft Tissue Data to Bone Models



Gender Difference Results: Raw Data

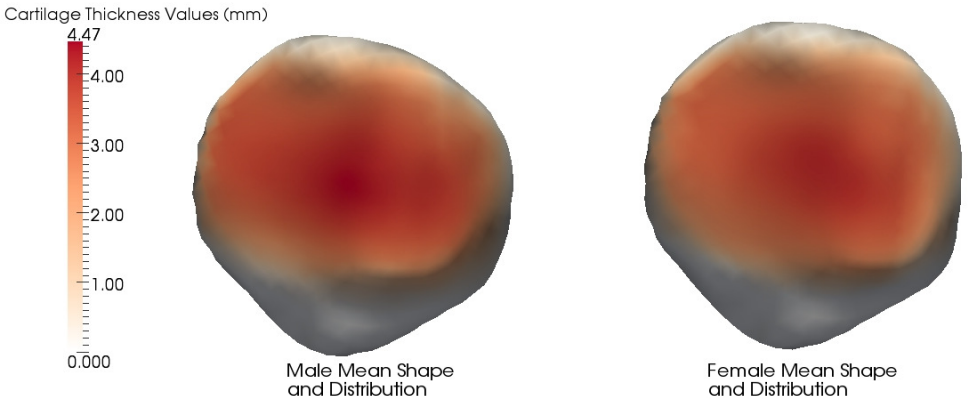


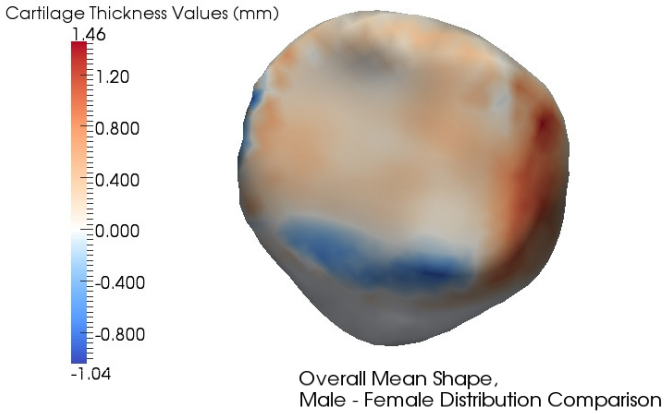


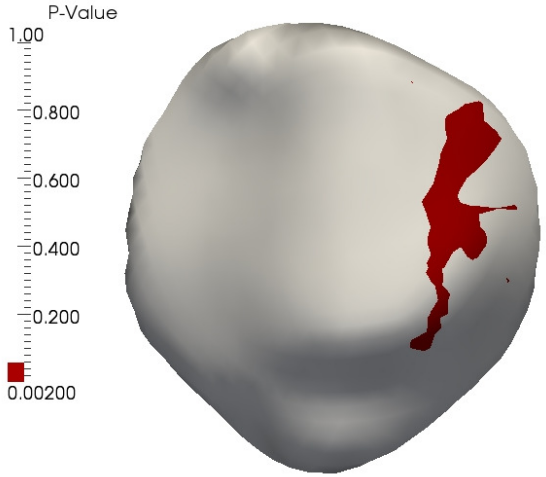


Male and Female Mean Model Data			
	Male	Female	% Difference
Mean Cartilage Thickness (mm)	1.3	1.06	23
S.D. of Cartilage Thickness (mm)	1.74	1.45	

Gender Difference Results: Size-Corrected Data

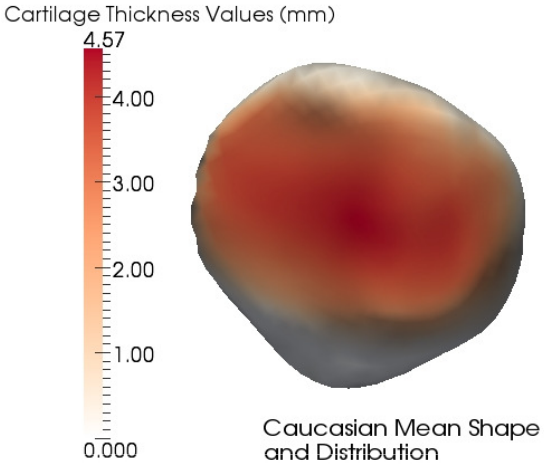






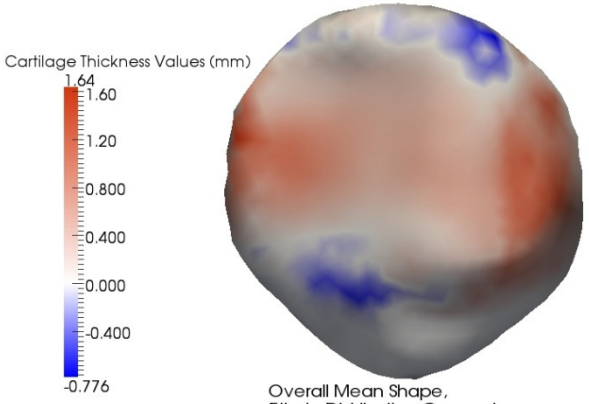
Male and Female Mean Model Data			
	M	F	%
Mean Cartilage Thickness (mm)	1.22	1.12	8.9
S.D of Cartilage Thickness (mm)	1.64	1.53	

Ethnicity Difference Results: Size-Corrected Data



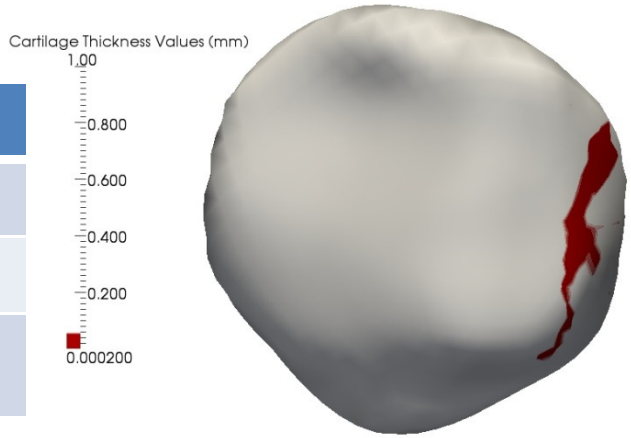
Caucasian Mean Shape and Distribution

Asian Mean Shape and Distribution



Overall Mean Shape, Ethnic Distribution Comparison

White and Asian Mean Model Data			
	W	A	%
Mean Cartilage Thickness (mm)	1.25	1.07	17
Variance in Cartilage Thickness (mm)	1.3	1.2	

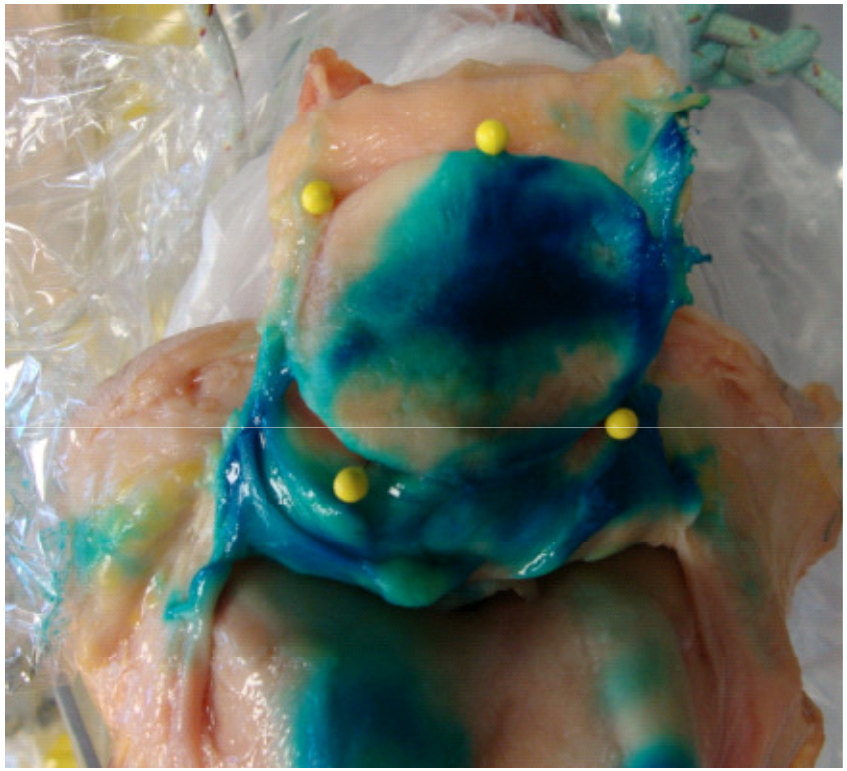


Conclusions and Future Work

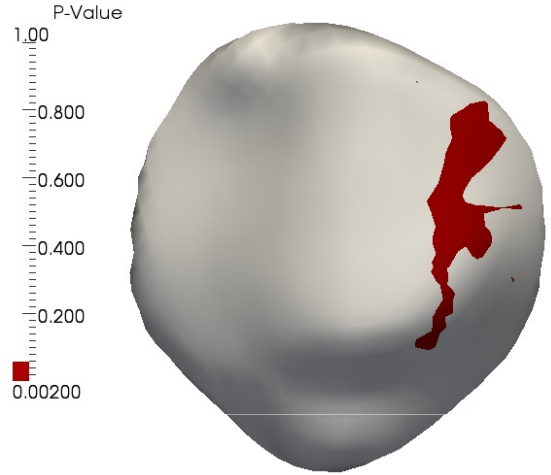
- Ethnic cartilage thickness variations more significant than gender variations (17% vs. 9%)

- Developed tool with potential to predict soft tissue shape from bony geometry , and correlate with contact patterns to link with kinematic models

Conclusions and Future Work



(McWalter, UBC, 2009)

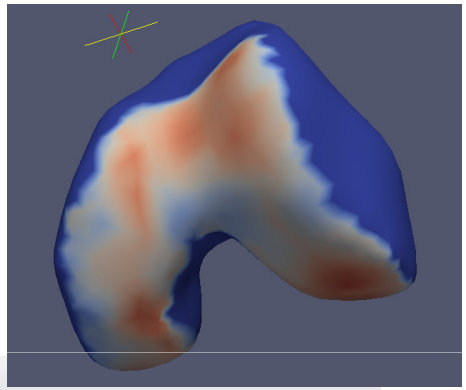


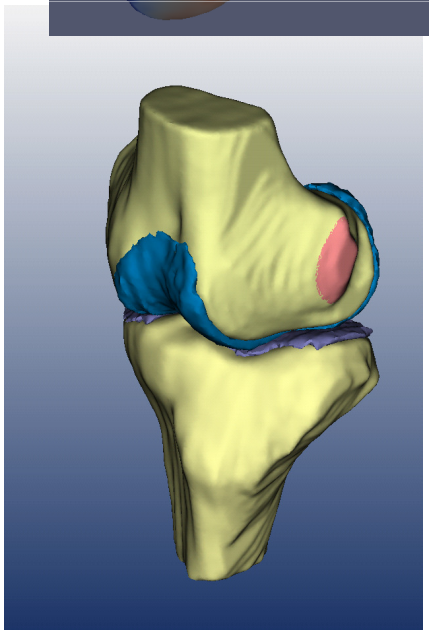
Conclusions and Future Work

- Ethnic cartilage thickness variations more significant than gender variations

- Developed tool with potential to predict soft tissue shape from bony geometry , and correlate with contact patterns to link with kinematic models

- Need to:
  - Increase sample size
  - Apply registration technique to femur, tibia, ligament attachments
  - Examine standard deviations of thickness values at each node





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