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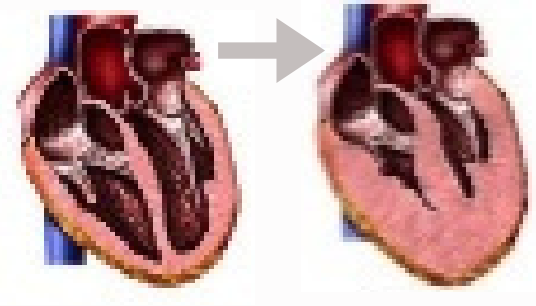
THESIS (Identification of Mechanical Properties in Patient-Specific Left Ventricles from Cardiac MRI)

Introduction

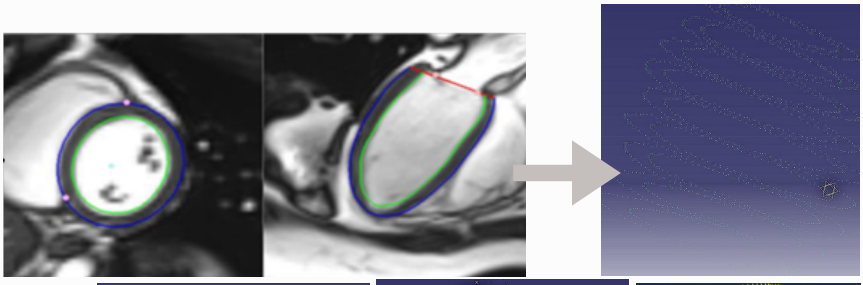
- **Leukemia** is the most common form of **Childhood Cancer**.
- **Chemotherapy** treatments for leukemia include **doxorubicine**.
- **Problem:** Doxorubicine-induced **cardiotoxicity** causes **geometric remolding** and cardiac dysfunction.
- **Objective**: Early **diagnosis** of cardiac dysfunction by characterization of **mechanical properties** as **clinical indices** and compare patients.



Methodology

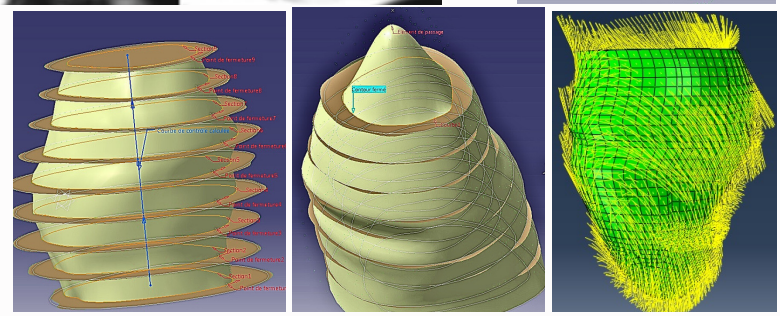
Development of the **multidisciplinary** computational package:

- **Geometry** modeling of left ventricle (LV) from image data
- Finite element analysis (**FEA**)
- Soft tissue biomecancis and material modeling



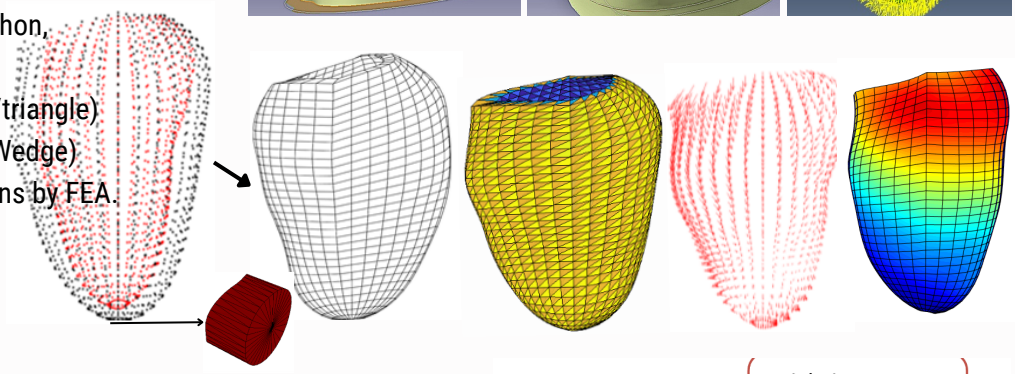
First, 3d modeling in Catia

- Image segmentation (Matlab Segment)
  - Reconstructed personalized LV shape:
    - produced cloud points,
    - Generated 3d Curve, volume
    - Imported into ABAQUS: meshing, loading,



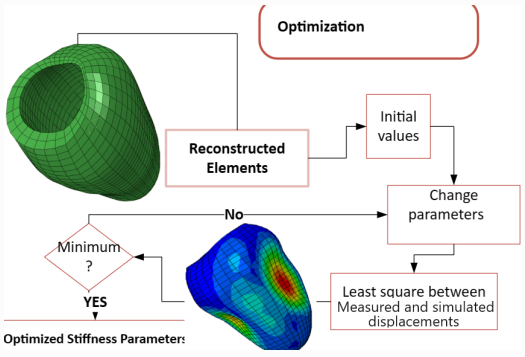
Second, meshing creation and calculation in Matlab

- Generated LV from guide-point modeling (Python, Matlab)
  - Fitted finite element surfaces (Rectangle/triangle)
  - Created body (Hex/Tet), apex elements (Wedge)
  - Measured actual displacements and strains by FEA.



Third, Optimization

- Combined two models for the optimization purpose.
  - Implemented **inverse algorithm** using **FEA** (Matlab into Abaqus)
  - Minimized the difference between displacements obtained from the measurements and simulation.
  - Identified the LV's material properties.



Results

- The identified mechanical shear stiffness as clinical indices could evaluate changes in cardiac dysfunction.
- We successfully compared 3 patients' groups who received different doses of doxorubicine.