Client Needs

Client Need Statement
Our client is Dr. Corinne Henak, the principal investigator of a lab studying orthopedic biomechanics who nee the purpose of eventually delivering real-time knee tissue health information to orthopedic surgeons during a

List of client needs (in their words)
The manikin must be anatomicaly correct, spanning from mid-shaft femur to mid-shaft tibia/fibula, to allow for pr
The project should be split into divisions: oxygen control systems (PBS), joint system (shape, joint connection), a
Hard anatomical elements, like bone, should be 3D printed with a biocompatible material, and soft parts, such a
Cartilage from the femoral side should be included, however this is less preferred over including cartilage from t
The manikin is intended to be reusable, however reusability is slightly dependent on cost of manufacturing.
As patient variability impacts the anatomy of the knee which in turn creates variations in the cartliage properties,
Specifically, the proximal tibia and the distal femur will be inserted into the model, along with cartilage/meniscus
Mechanical loading of the cartilage is not part of the design, therefore there is no need to recapitulate in vivo joir
Inadverdent loading during handling of the cartilage is to be avoided as it can damage the samples

Engineering Specifications

Specification description	Target	Unit	Test method
			Enclosure
PBS/irrigating synovial fluid: Media contained within the knee model should remain inside and avoid leakage	-	-	Visual inspection
Knee model flexion: the enclosure should permit the knee to contract and expand according to the procedure	0-150	degrees	Protractor
Reusable			
			Pump
The pump system should maintain the oxygen concentration of the media in a healthy range for the chondrocytes	2-10	percent	Oxygen monitoring sensor
The pump should maintain a flow pressure similar to that which is used in arthroscopic knee procedures	40-80	mmHg	Flow meter/orifice plate
			Joint/Mounting
No mechanical stress should be applied to cartilage inserted to the model which would cause a difference in the health of the tissue	?	?	Comparison between health of mounted and non-mounted cartilage by measurement of autofluorescence
The knee joint should be anatomically correct to the rough dimensions of an average weighted 50 year old	-	-	Visual Inspection
Each joint model should be reproducible between fabrication attempts	?	?	Measurement using calipers, tape, etc.

	CRH comments
ds a model to measure cartilage health for arthroscopic procedures.	
	Arthroscopy would fit in here
oper positioning during arthroscopy.	How anatomically correct?
and housing of cartilage / insertion of	
s ligaments should be fabricated out of	Agreeing with Russ's feedback in the meeting - my material sug
he tibial side as femoral cartilage often	
, the model should be able to adapt to	Ideal case includes a range, but narrowing the range would be c
, requiring a placeholder that will serve to	Use anatomical terms to be more clear (proximal tibia, distal fer
nt loading	
	Two pieces here, suggest separating them out: (1) mehcanical l

Rank	Met	
Must		You could dye the fluid and quantify leaks as visual area of dyec
Should		Can you use optical methods to track this? Would be more qua
Nice		
		Any specs on weight or amount of material?
Must		How will you drop the O2? How will you measure? (We current
Should		
Must		I would check this using pressure-sensitive film (fuji film)
Must		You can quantify differences between surfaces.
Should		Suggest a 3D approach such as laser scanning the printed parts

loading of the cartilage is not a part of the design - i.e., there is no need to recapitulate in vivo joint loading; (2) in

ntitative than holding up a protractor. Also, any requirement for holding a position (not sure if that goes here or u

tly bubble N2 to drop O2, and use a dissolved O2 sensor to measure. Note that dissolved O2 is not the same as

advertent loading during handling is to be avoided as that can damage the samples