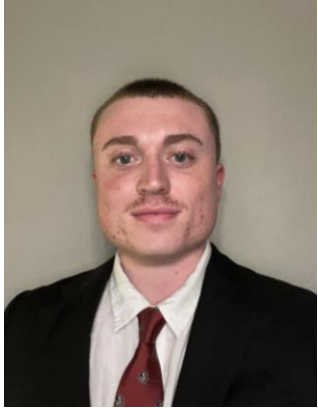


A 3D rendering of a human arm, showing the hand, forearm, and upper arm. The arm is colored in a gradient from blue to white. A red, glowing, cylindrical indenter is positioned against the forearm, with a white, glowing, cylindrical indenter positioned against the upper arm. The text "Human Bone Density Indenter" is overlaid on the arm in a white, bold, sans-serif font.

Human Bone Density Indenter

Team Introductions



Grant Giorgi
*Orthopedic
Bioengineer*



Erin Perkus
*Biomaterials and
Biopolymers
Engineer*



Timothy Surface
*Manufacturing
Engineer*



Abrea Green
*Clinical
Engineer*



Tessany Schou
*Materials
Engineer*



Nicholas Vastano
*Bioinstrumentation
Engineer*

Sponsor and Advisor



Project Sponsor

Tom Vanasse

Director of Engineering, Exactech



Academic Advisor

Stephen Arce, Ph.D.

Professor, FAMU-FSU Engineering

Tessany Schou

Objective

The objective of this project is to create a functional prototype and complete feasibility testing of a device that can quantitatively measure human bone density.

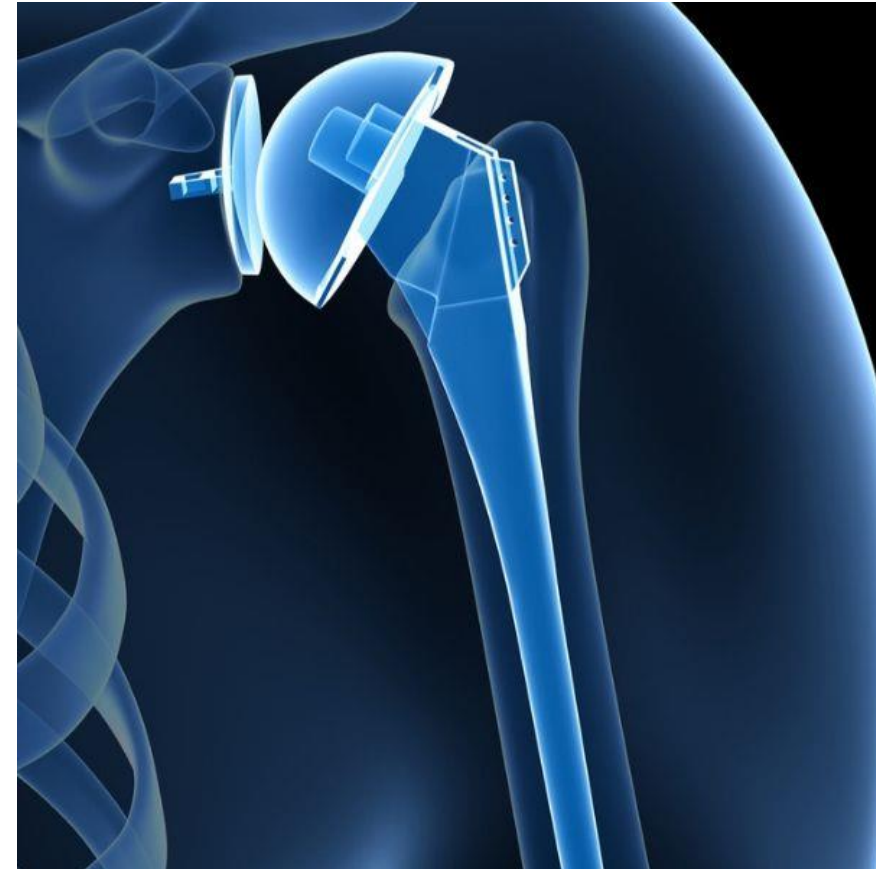
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Total Shoulder Arthroplasty

Purpose

Eliminate source of pain and dysfunction by replacing shoulder joint with artificial components



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Types of Implants

Stemmed Implant

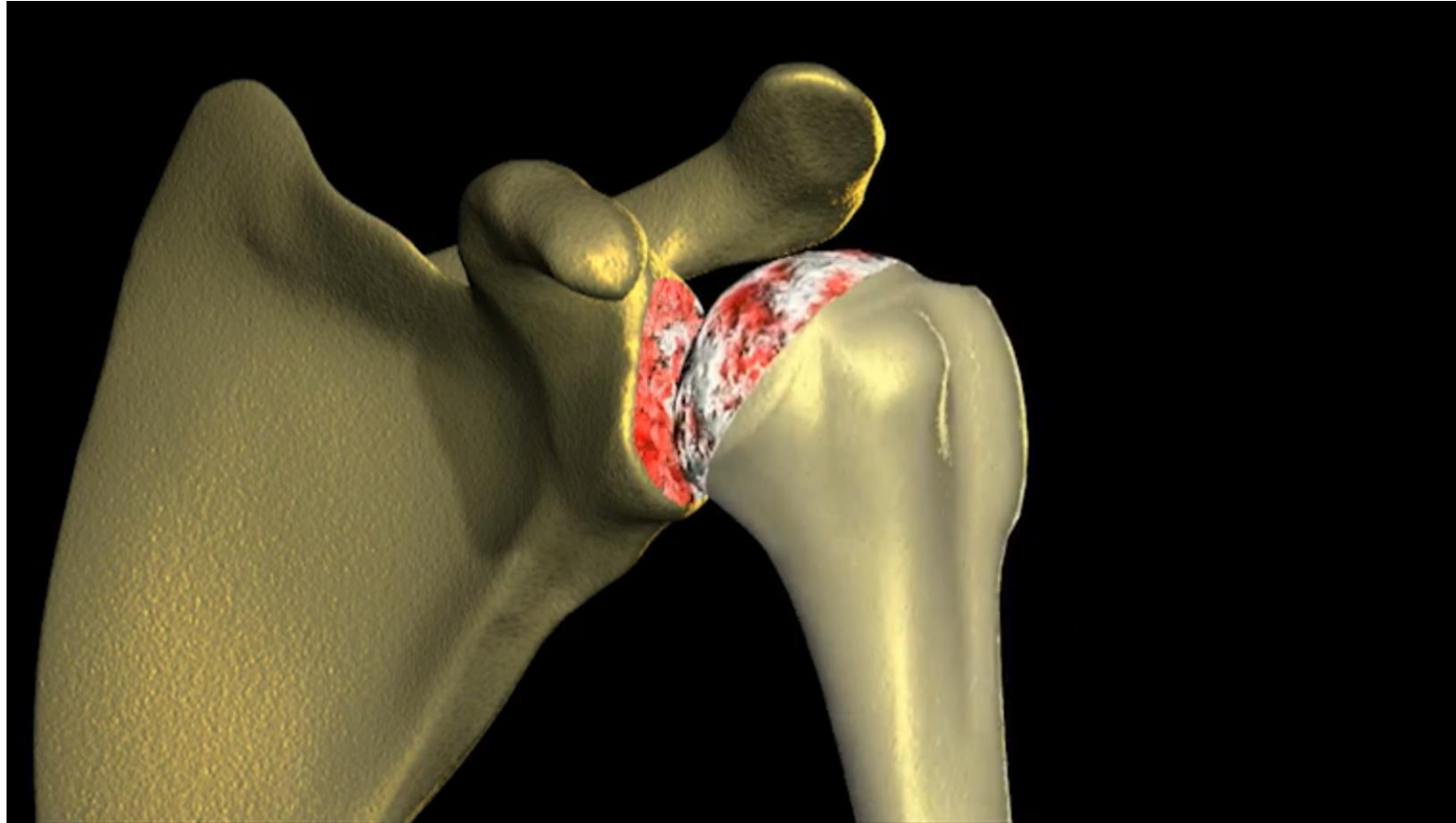


Stemless Implant



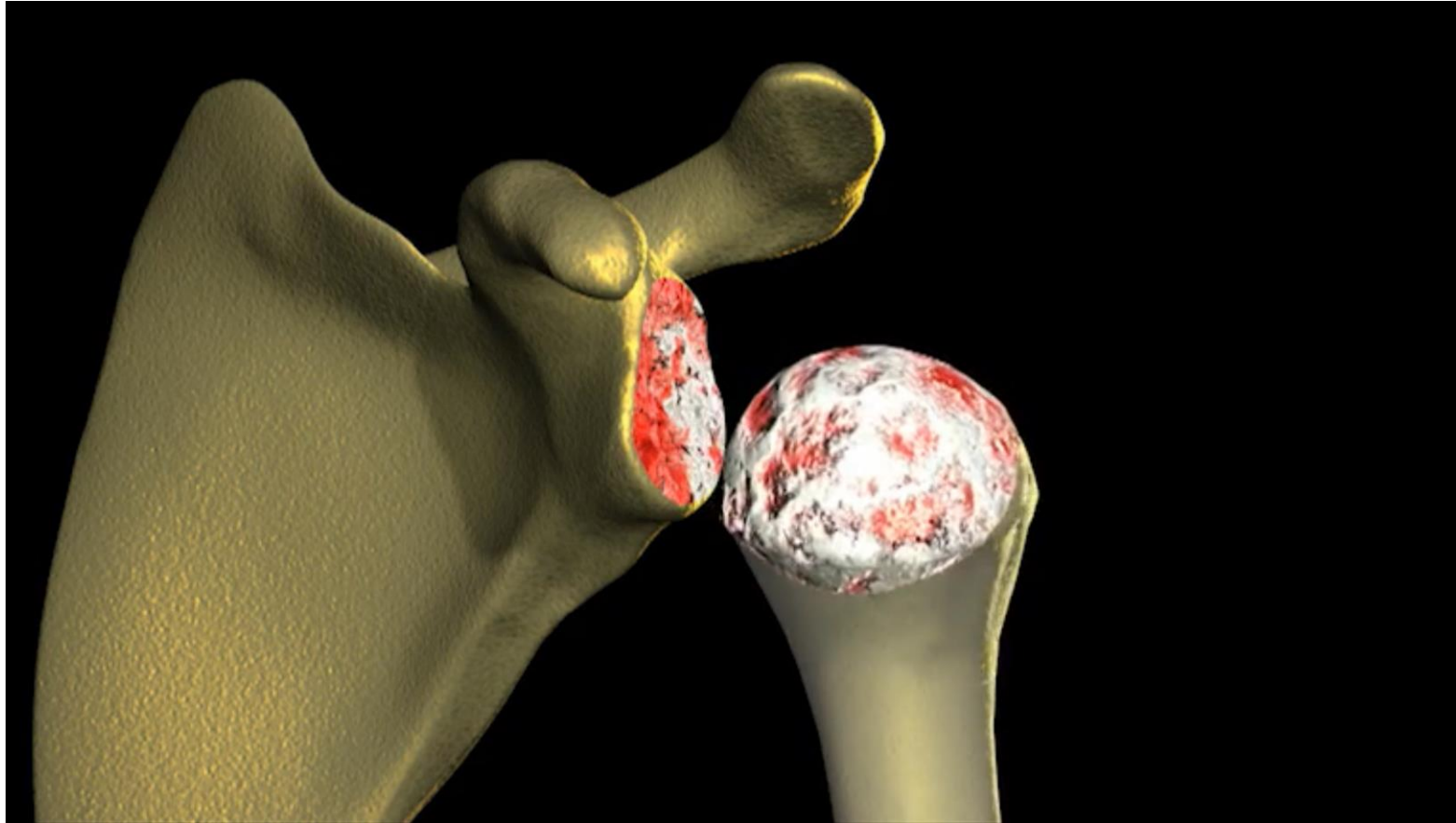
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The “Thumb Test”



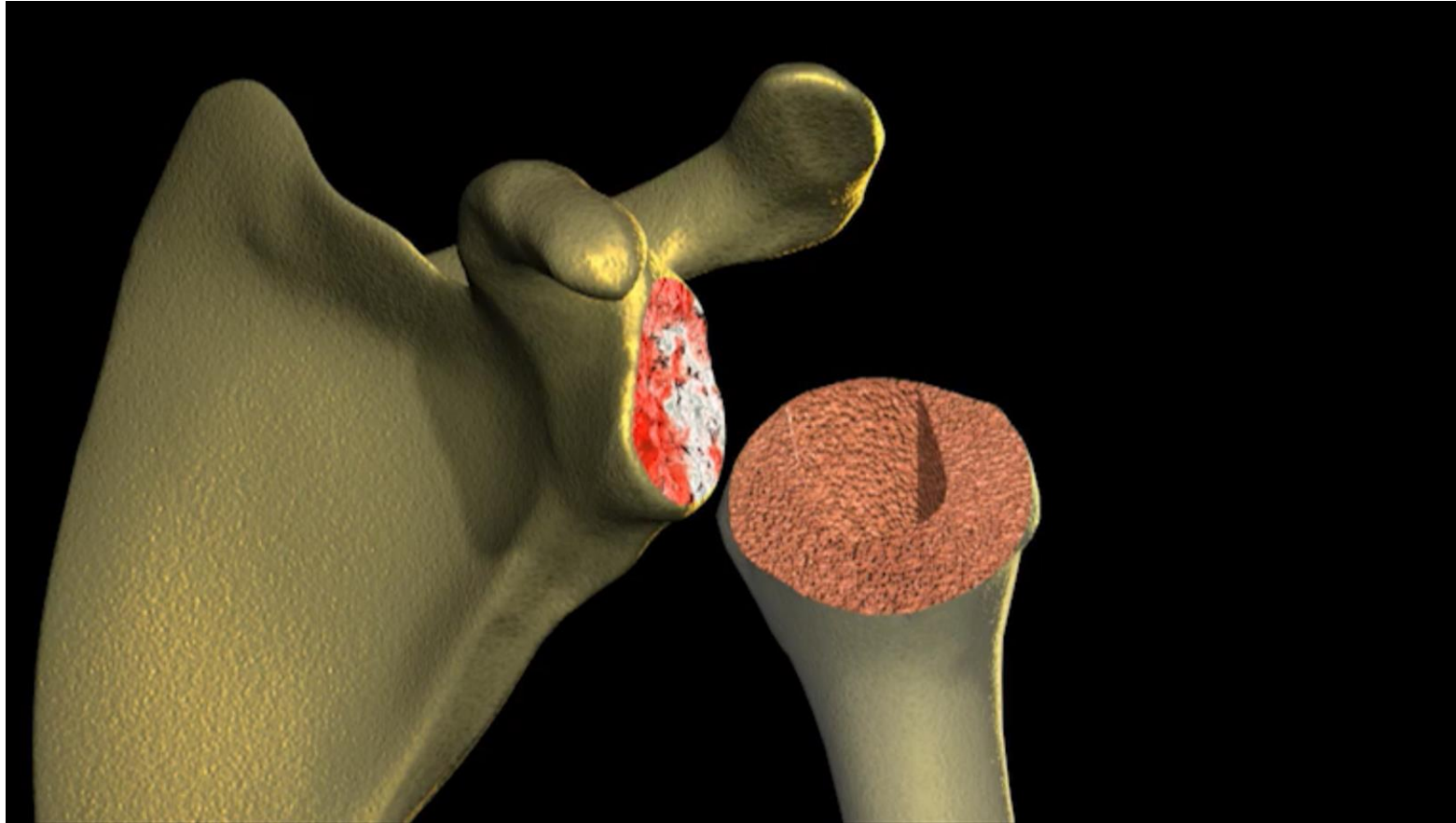
Tessany Schou

The “Thumb Test”



Tessany Schou

The “Thumb Test”



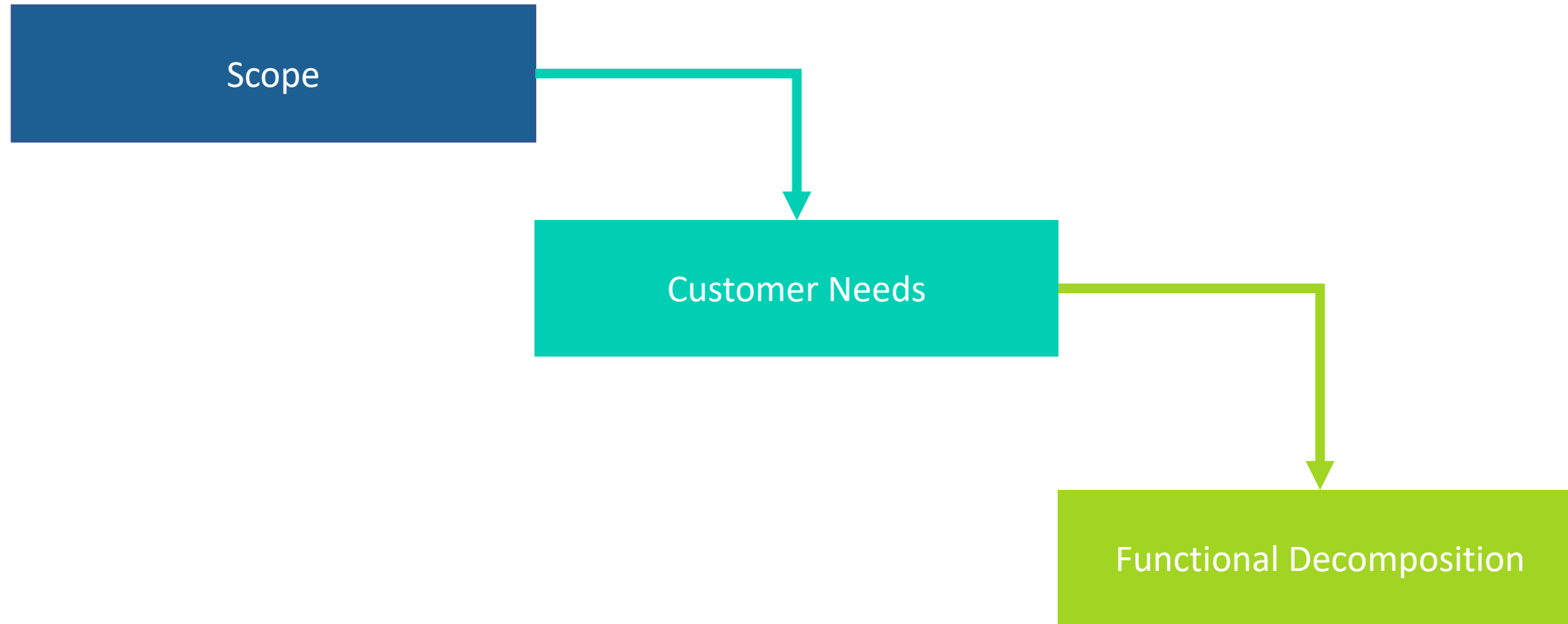
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Levels of Bone Density/Quality



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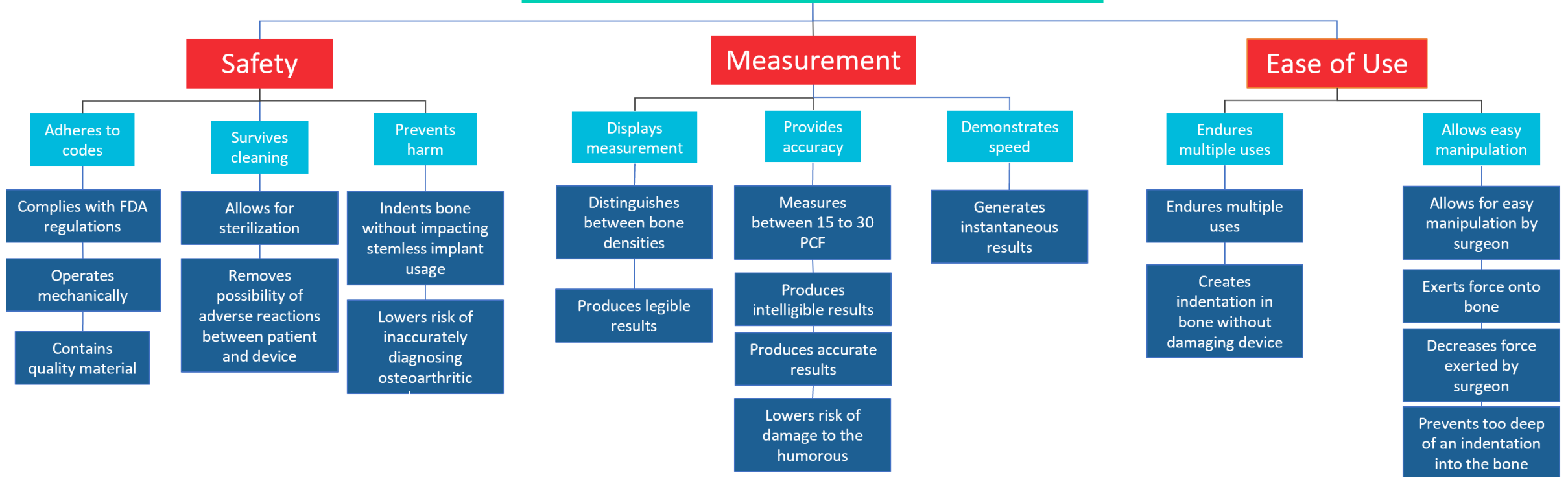
VDR1



Tessany Schou

Functional Decomposition

Device for Use in Surgery that will Easily and Safely Provide Measurement



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Research Update

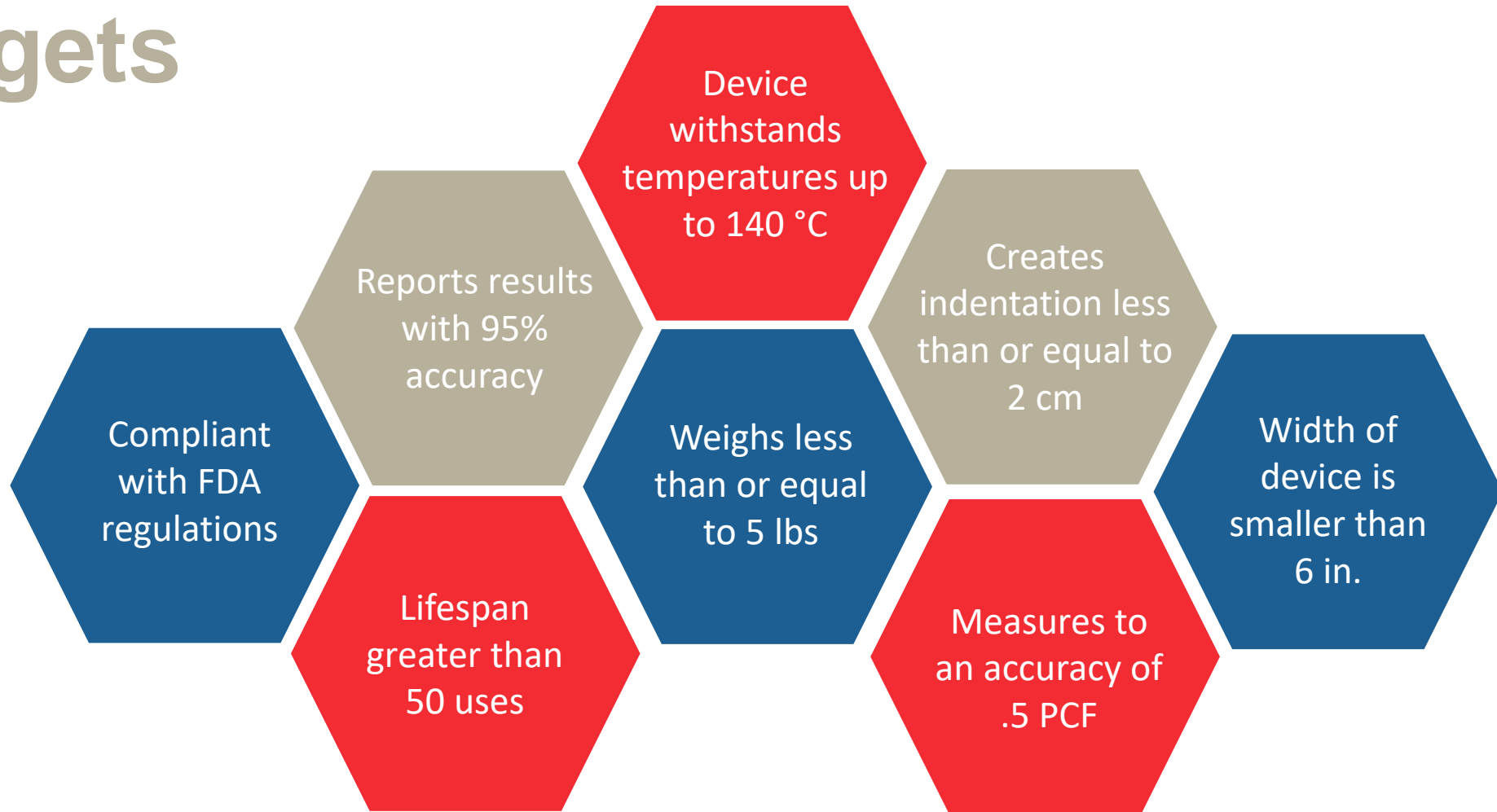
Interview with
Dr. Andrew Hayden

PCF
Verification

Interview with
Dr. Shay Koch

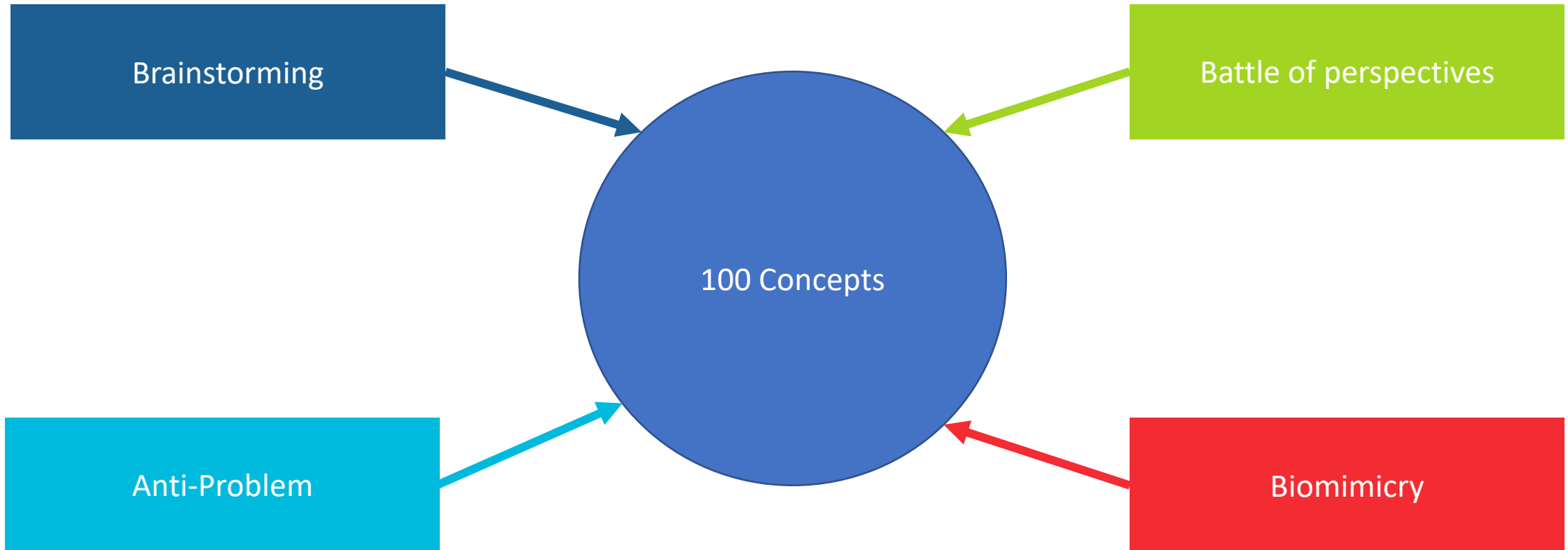
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Targets



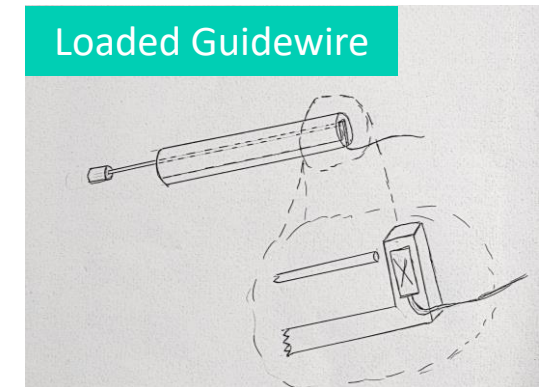
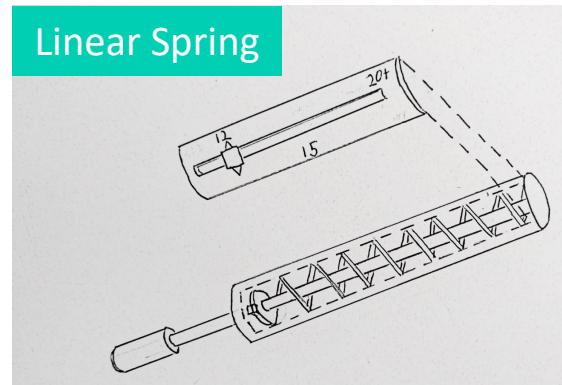
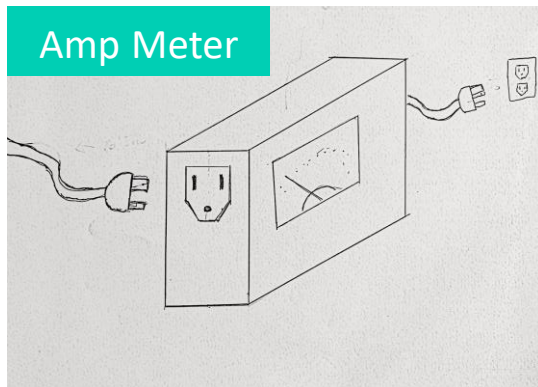
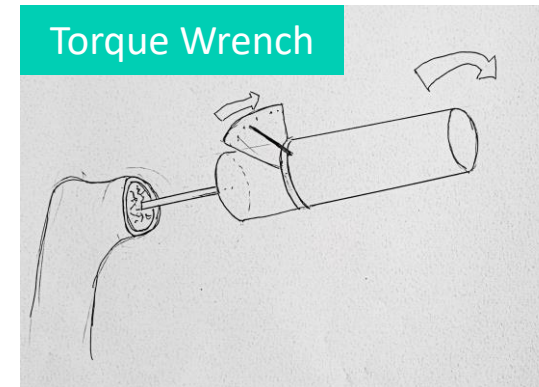
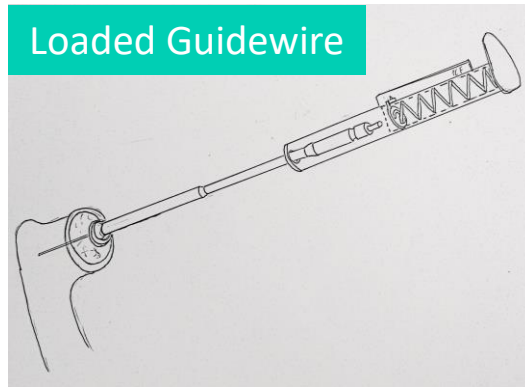
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Concept Generation



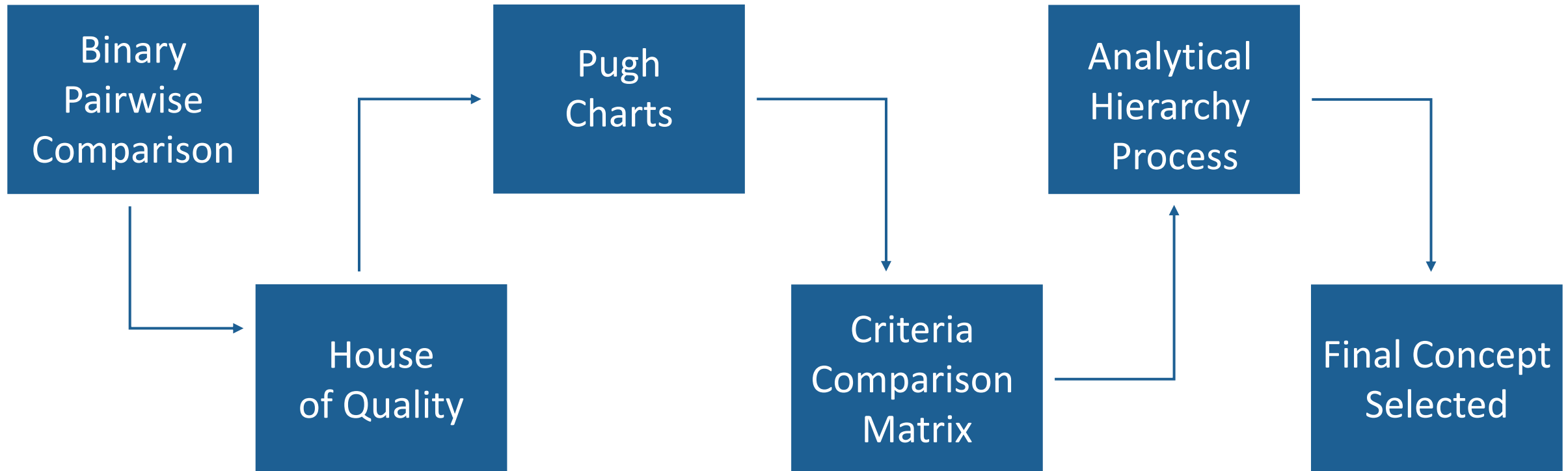
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Concepts



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Concept Selection



Timothy Surface

Binay Pairwise Comparison

Importance	Customer Requirements
1	FDA Compliant
2	Sterilizable
3	Non-toxic
4	Measures Bone PCF
5	Handheld
6	Reusable
7	Class 1
Last	Mechanically Operated

Timothy Surface

House of Quality

Rank	Engineering Characteristic
1	Result Repeatability
2	Indentation Depth
3	Measurement Accuracy
4	Withstands High Temperatures
5	Readability Distance
6	Reusability
7	Device Width
8	Device Weight
Last	Quick Results

Timothy Surface

Pugh Chart

	Concepts						
Selection Criteria	Thumb test	Torque Wrench	Sensor	Linear Spring	Loaded Guidewire	Amp Meter	
Result Repeatability	Datum	+	+	+	+	+	
Device Weight		-	-	-	-	-	
Indentation Depth		-	S	S	-	S	
Reusability		S	S	S	S	S	
Measurement Accuracy		+	+	+	+	+	
Withstands High Temperatures		+	-	+	+	-	
Device Width		S	S	S	S	S	
Readability Distance		S	S	S	S	S	
# of Pluses			3	2	3	3	2
# of Minuses			2	2	1	2	3

Timothy Surface

Pugh Chart

	Concepts						
Selection Criteria	Thumb test	Torque Wrench	Sensor	Linear Spring	Loaded Guidewire	Amp Meter	
Result Repeatability	Datum	+	+	+	+	+	
Device Weight		-	-	-	-	-	
Indentation Depth		-	S	S	-	S	
Reusability		S	S	S	S	S	
Measurement Accuracy		+	+	+	+	+	
Withstands High Temperatures		+	-	+	+	-	
Device Width		S	S	S	S	S	
Readability Distance		S	S	S	S	S	
# of Pluses			3	2	3	3	2
# of Minuses			2	2	1	2	3

Timothy Surface

Pugh Chart

	Concepts						
Selection Criteria	Thumb test	Torque Wrench	Sensor	Linear Spring	Loaded Guidewire	Amp Meter	
Result Repeatability	Datum	+	+	+	+	+	
Device Weight		-	-	-	-	-	
Indentation Depth		-	S	S	-	S	
Reusability		S	S	S	S	S	
Measurement Accuracy		+	+	+	+	+	
Withstands High Temperatures		+	-	+	+	-	
Device Width		S	S	S	S	S	
Readability Distance		S	S	S	S	S	
# of Pluses			3	2	3	3	2
# of Minuses			2	2	1	2	3

Timothy Surface

Pugh Chart

	Concepts						
Selection Criteria	Thumb test	Torque Wrench	Sensor	Linear Spring	Loaded Guidewire	Amp Meter	
Result Repeatability	Datum	+	+	+	+	+	
Device Weight		-	-	-	-	-	
Indentation Depth		-	S	S	-	S	
Reusability		S	S	S	S	S	
Measurement Accuracy		+	+	+	+	+	
Withstands High Temperatures		+	-	+	+	-	
Device Width		S	S	S	S	S	
Readability Distance		S	S	S	S	S	
# of Pluses			3	2	3	3	2
# of Minuses			2	2	1	2	3

Timothy Surface

Pugh Chart 3

	Concepts				
Selection Criteria	Loaded Guidewire	Torque Wrench	Sensor	Linear Spring	
Result Repeatability	Datum	+	+	+	
Device Weight		-	-	+	
Indentation Depth		+	+	+	
Reusability		-	+	+	
Measurement Accuracy		S	+	+	
Withstands High Temperatures		S	-	S	
Device Width		-	-	S	
Readability Distance		+	+	+	
# of Pluses			3	5	6
# of Minuses			3	3	0

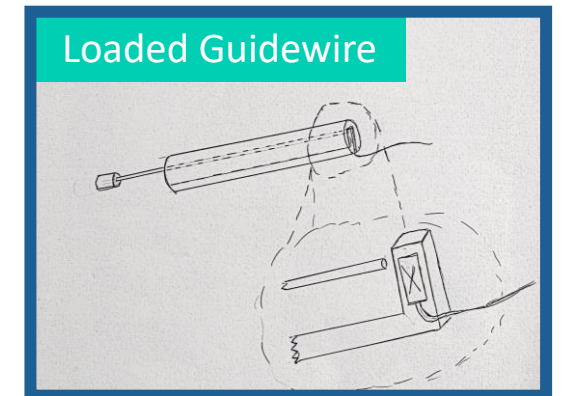
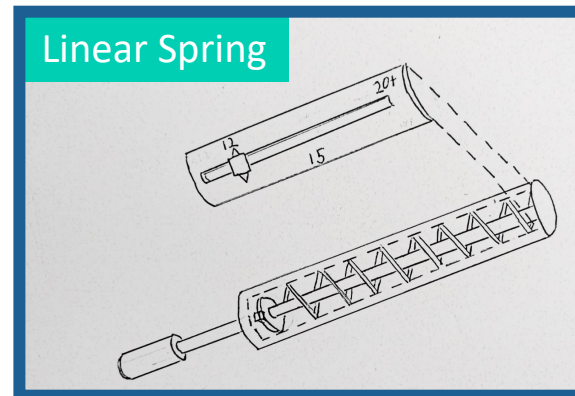
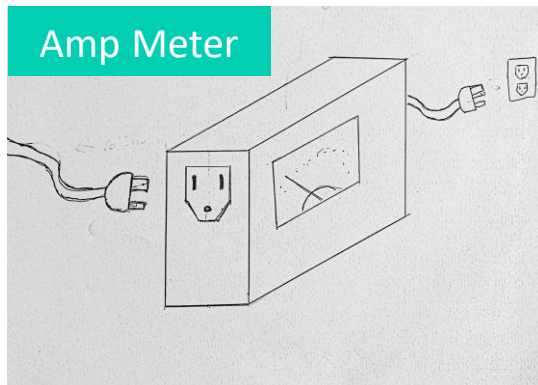
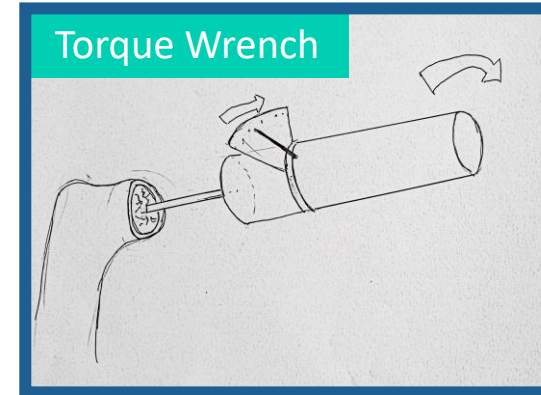
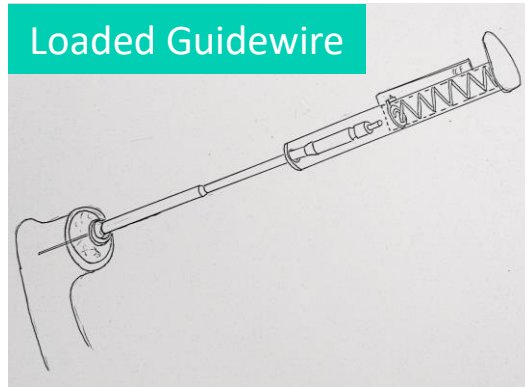
Timothy Surface

Pugh Chart 3

	Concepts				
Selection Criteria	Loaded Guidewire	Torque Wrench	Sensor	Linear Spring	
Result Repeatability	Datum	+	+	+	
Device Weight		-	-	+	
Indentation Depth		+	+	+	
Reusability		-	+	+	
Measurement Accuracy		S	+	+	
Withstands High Temperatures		S	-	S	
Device Width		-	-	S	
Readability Distance		+	+	+	
# of Pluses			3	5	6
# of Minuses			3	3	0

Timothy Surface

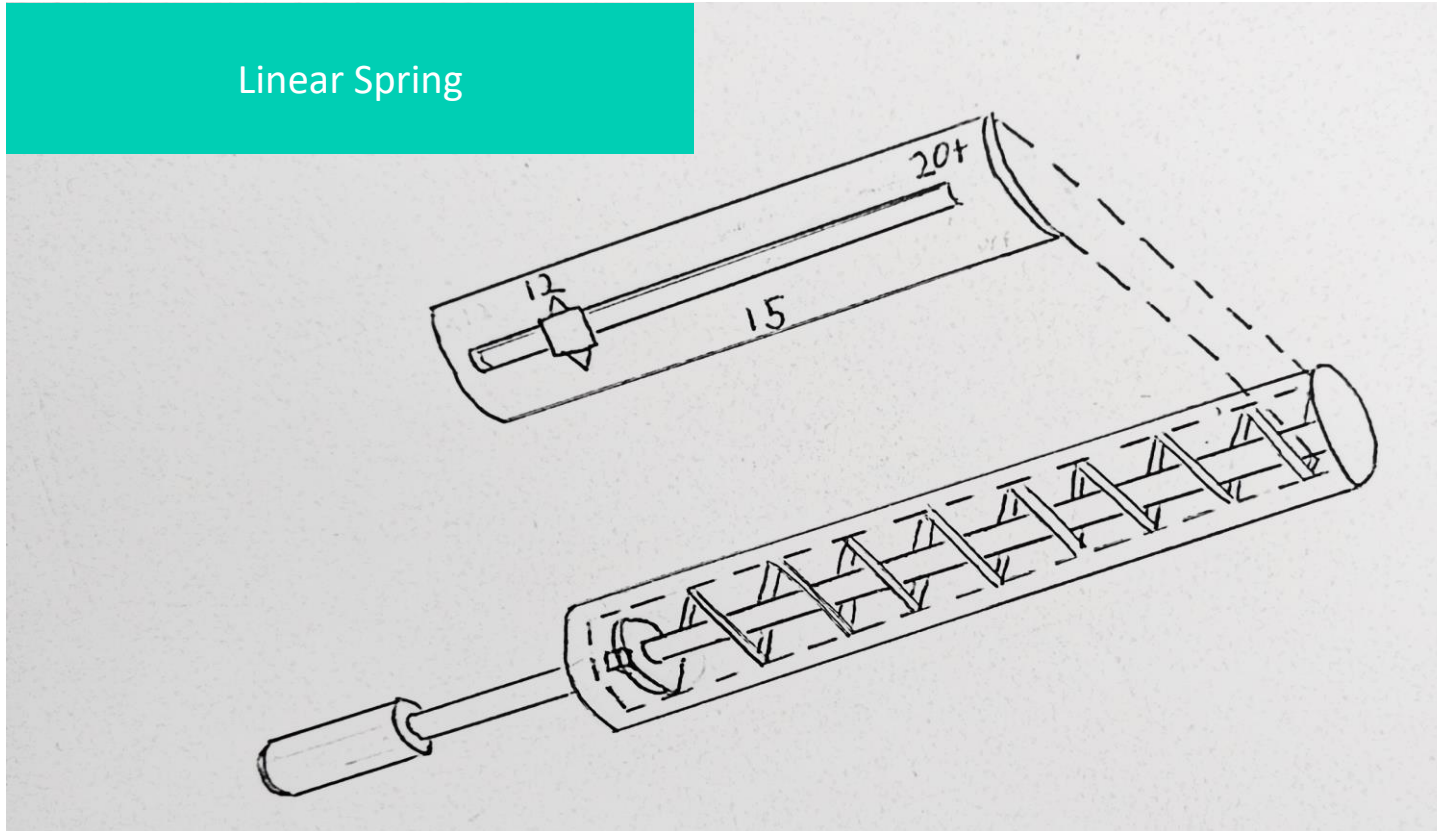
Concept Selection



Timothy Surface

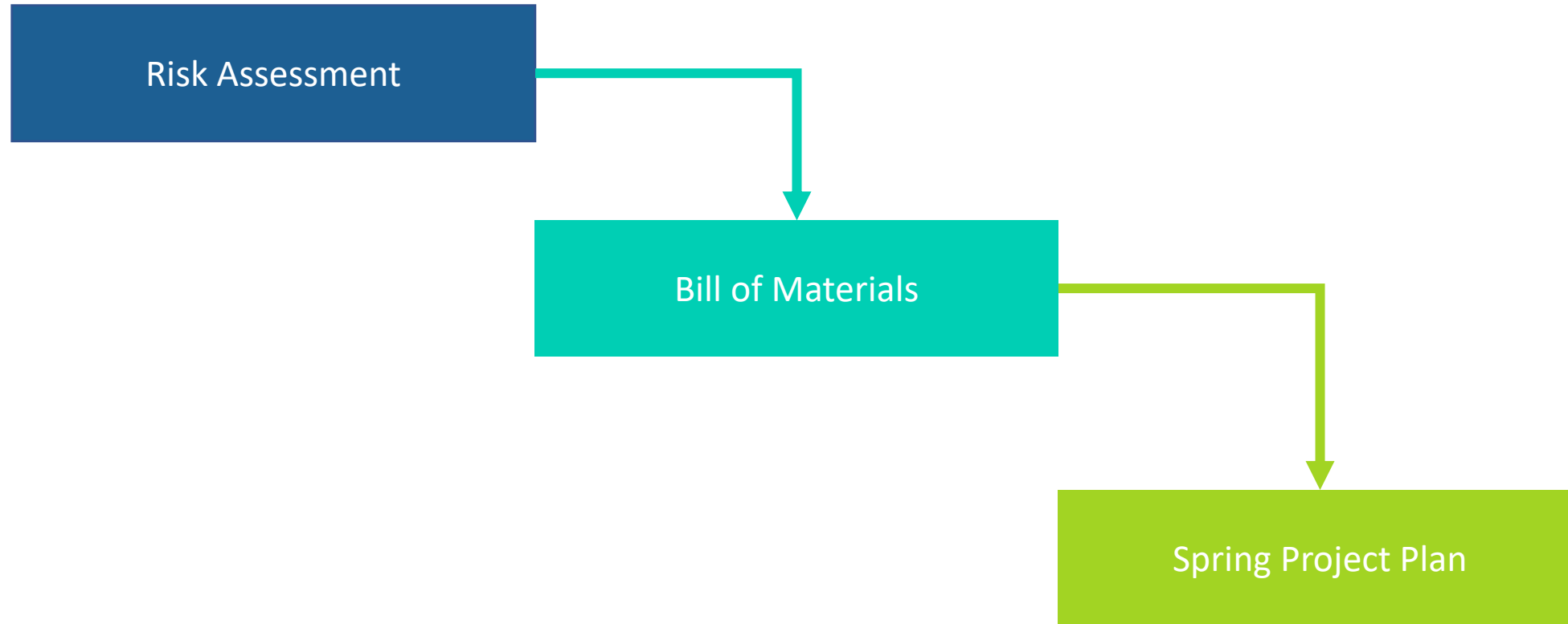
Concept Selection

Linear Spring



Timothy Surface

Looking Ahead



Timothy Surface

4 Most Important Points

1. Project is to develop a device to measure bone density.
2. Project focused on customer needs.
3. Concept selected based on customer needs.
4. Moving forward will begin risk assessment and manufacturing plan.

Timothy Surface



Reference

Jordan D. Walters, S. F. B. (n.d.). *Anatomic total shoulder arthroplasty with a stemless humeral component - Jordan D. Walters, Stephen F. Brockmeier, 2021*. SAGE Journals. Retrieved October 15, 2021, from <https://journals.sagepub.com/doi/10.1177/2635025421997126>.

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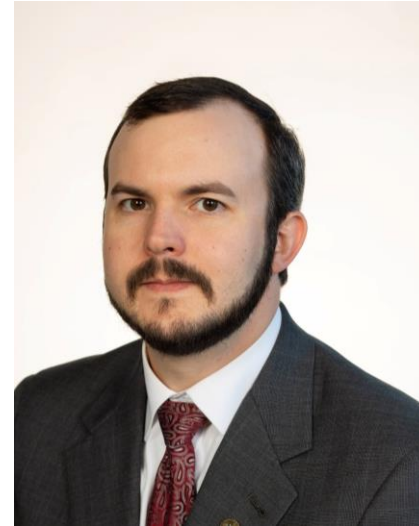
Reeves, J. M., Vanasse, T., Roche, C., Athwal, G. S., Johnson, J. A., Faber, K., & Langohr, D. G. (2017). *Proximal Humeral Density Correlations: Are We "Thumb Testing" in the Right Spot?* ORS.

Timothy Surface

Contact the Team



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Timothy Surface