Team 114

SHOULDER JOINT
PROSTHESIS

Team Members

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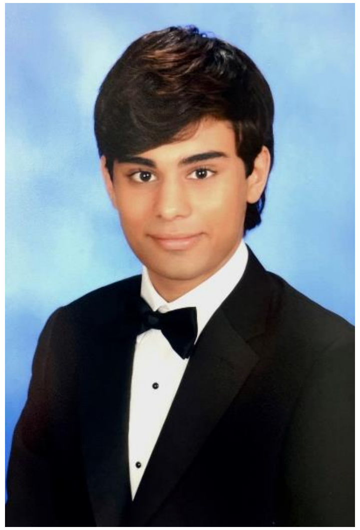

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Exactech®
Surgeon focused. Patient driven.™

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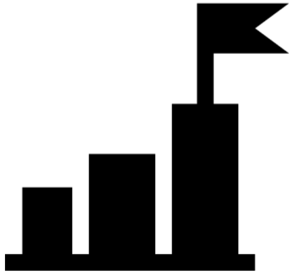
Project Objective



The objective of this project is to design a stemless reverse shoulder implant to prevent levering out and develop a series of tests to appropriately evaluate the design.

Total Shoulder Replacement

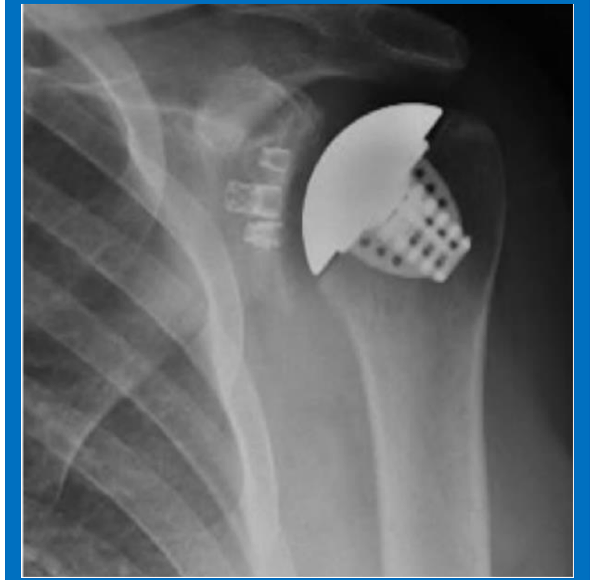
Purpose:

To provide ample fixation, restore range of motion, and ease surgical revisions by replacing portions of the shoulder joint with an artificial implant.

Types of Implants

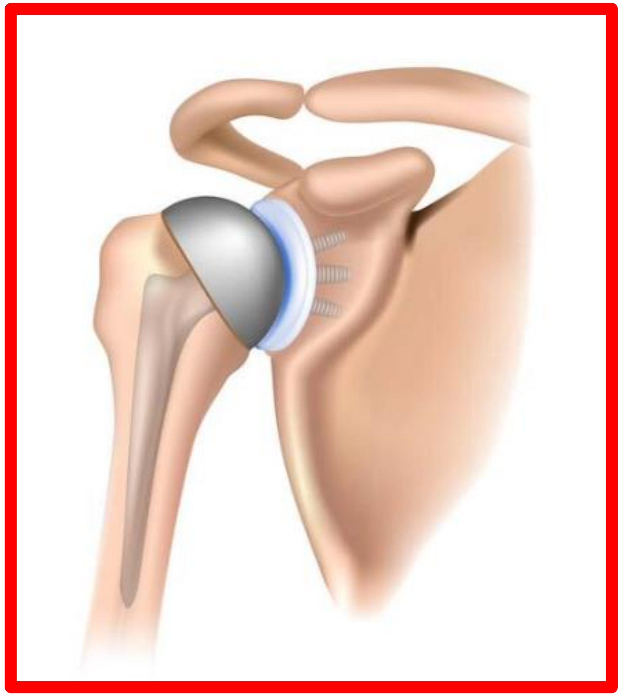
Stemmed Implant

Stemless Implant

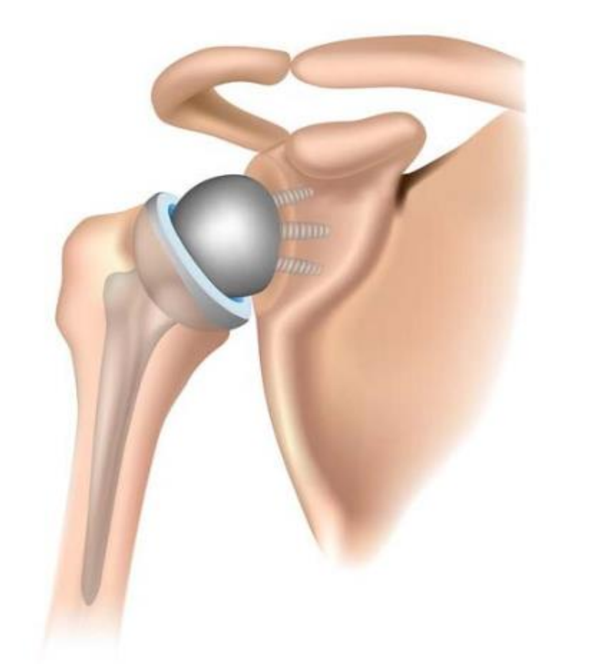


Anatomical vs. Reverse

Anatomical (aTSA)



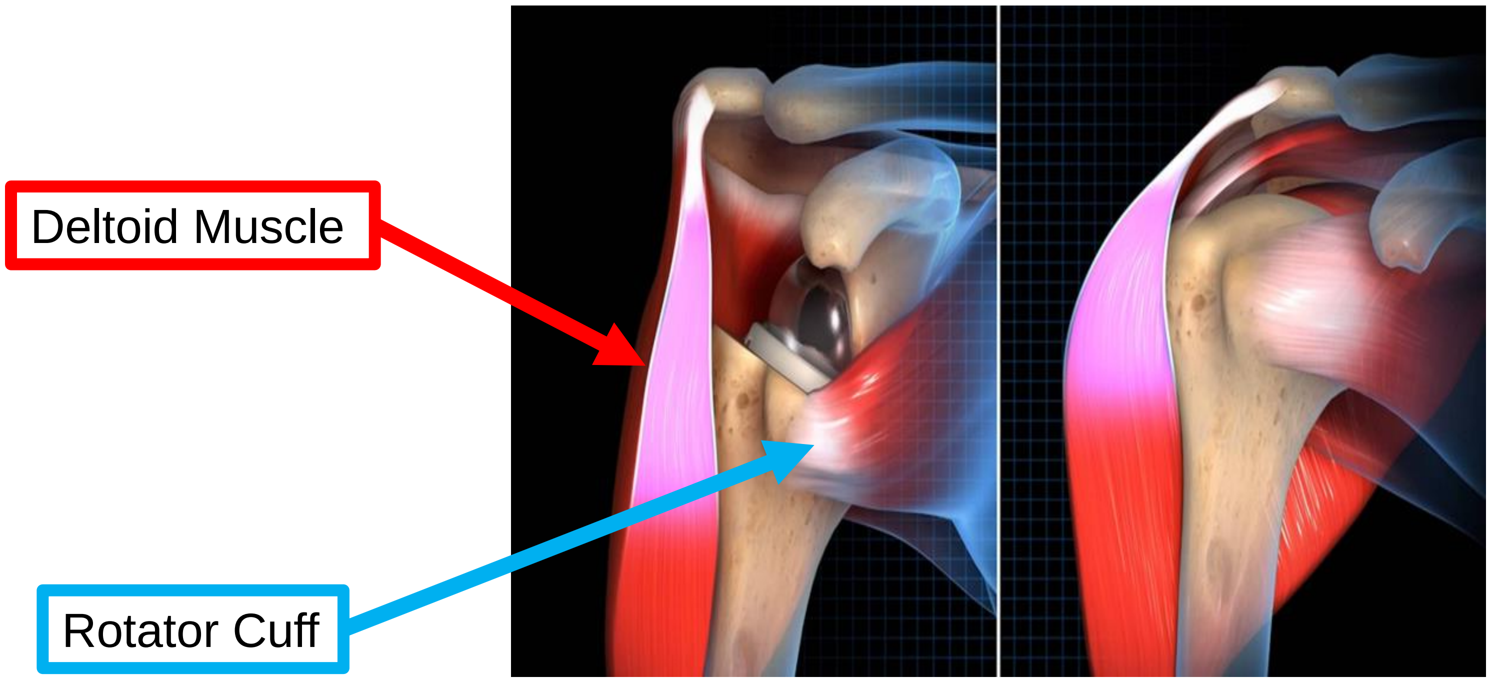
Reverse (rTSA)



Reverse Stemless Shoulder Implant

➢ <u>Potential Benefits:</u>

- Prevents rotator cuff damage.
- Better joint stabilization.
- Easier revisions.
- Decrease of fractures.
- Preservation of bone.
- Shifts emphasis to deltoid muscle.



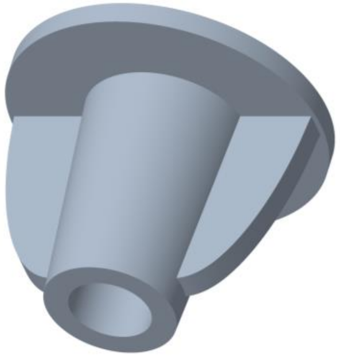
Current Exactech Design

Our focus will be
Modifying these **fins.**

Concept Selection

Generated Concepts → House of Quality → Pugh Chart → Revise Concepts

Primary Concept Group


2 Fin

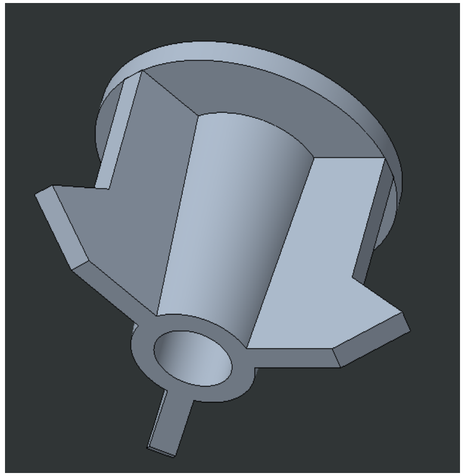

4 Fin

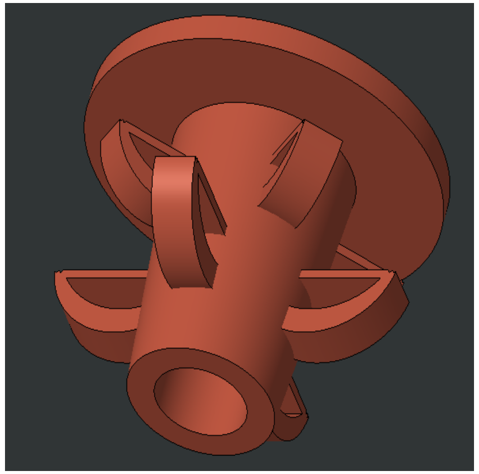

3 Fin Scaled: 1.05x


3 Fin Scaled: 1.1x


3 Fin Scaled: 1.15x

Secondary Concept Group





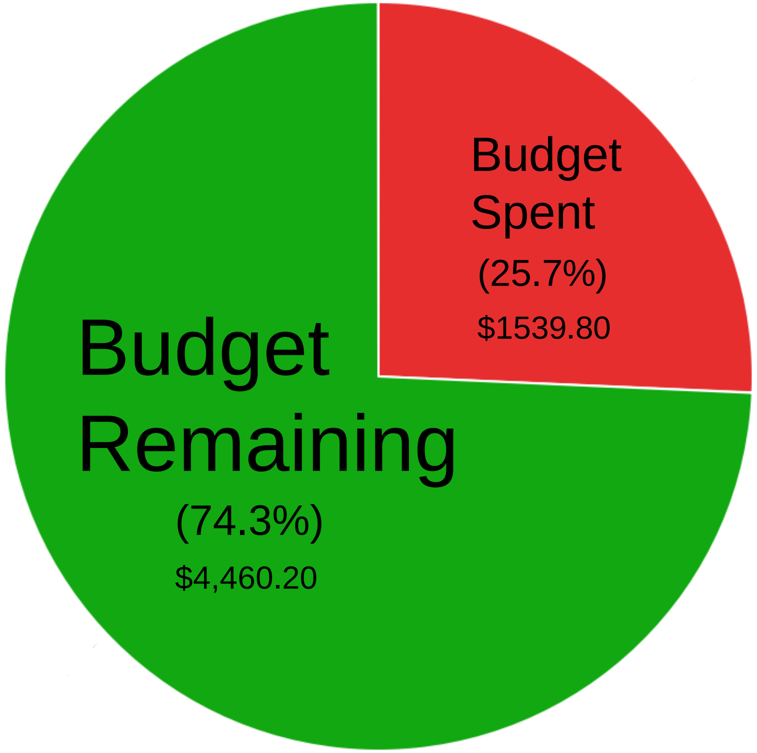
Concept 1 **Concept 2** **Concept 3** **Concept 4** **Concept 5**

Customer Needs

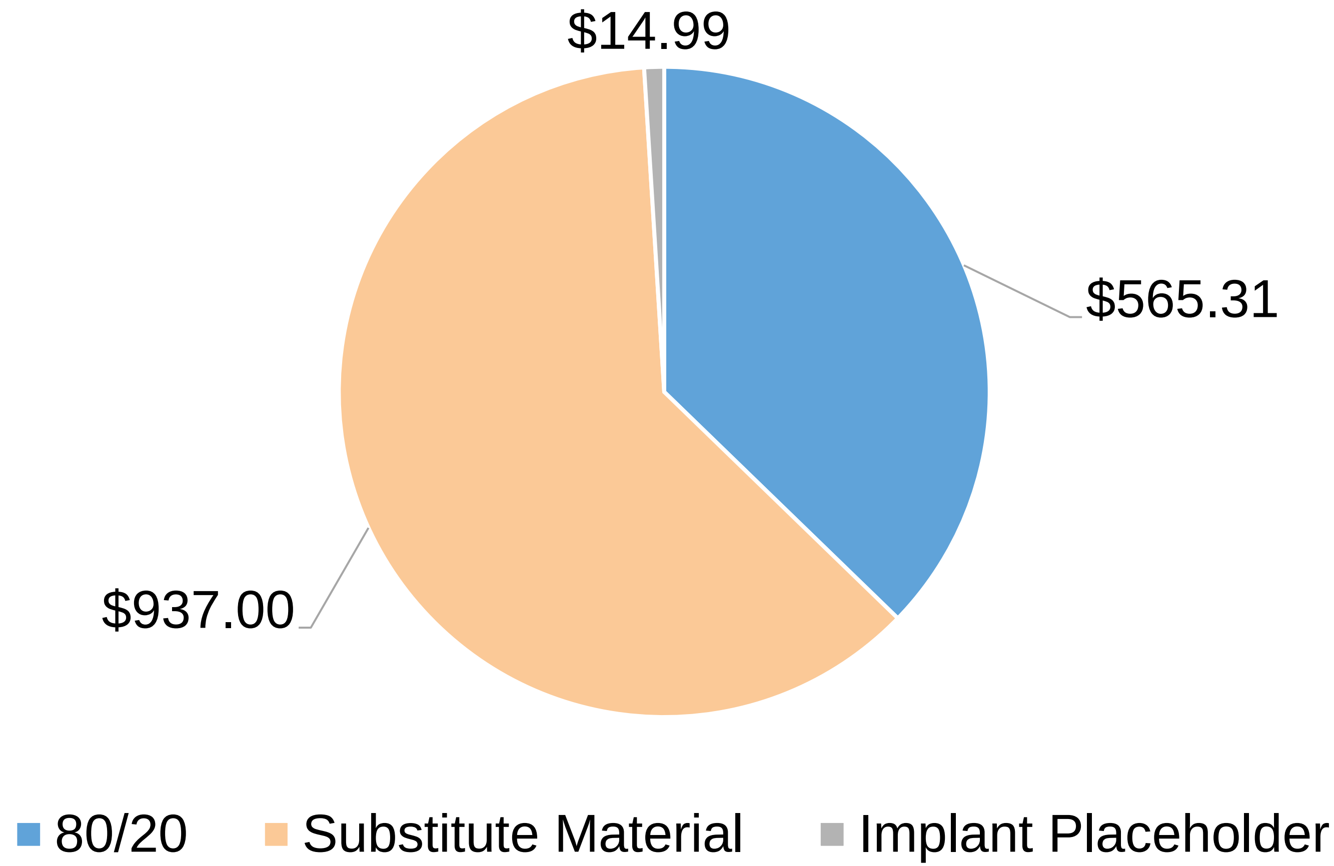
- Resists lever out
- No device failure
- No bone fracture
- Easy revision
- Immune response
- Ease of implantation
- Biologic fixation over time (6-8 weeks post-op)

Budget Update

Total Budget:
<u>$6,000</u>



Divided Budget

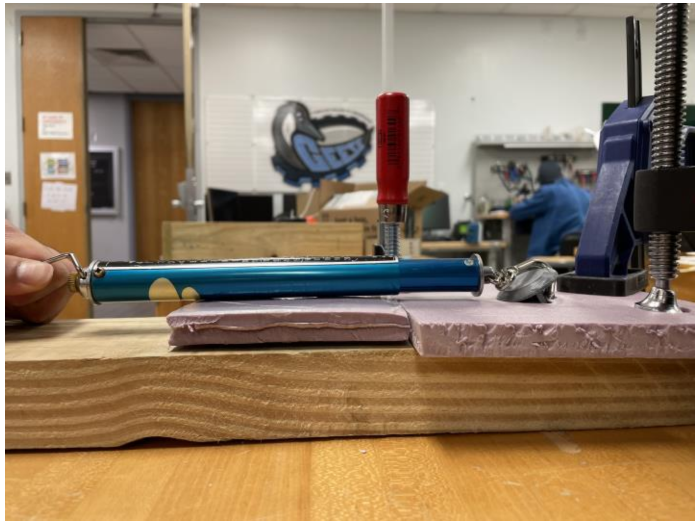


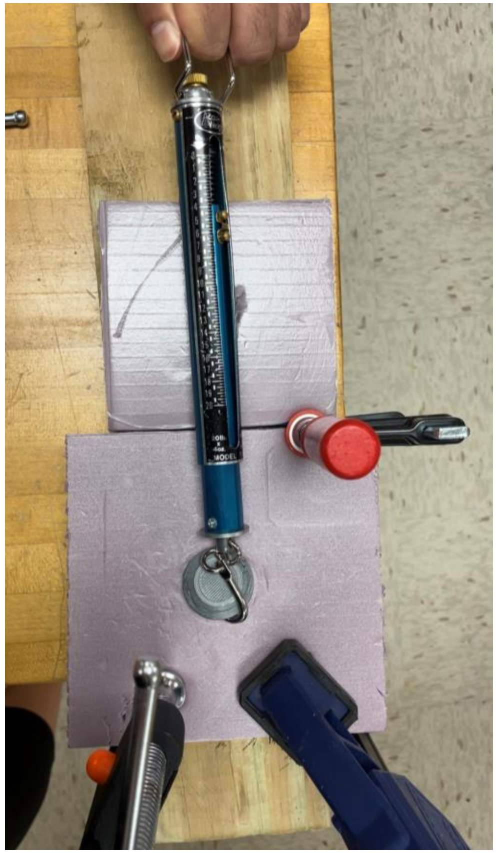
Costs

Money Spent	Items Bought
$22.50	10PCs T Slot Aluminum Profile Carbon Steel L-Shape Brackets 90 Degree Interior Corner Connector Bracket
$213.88	80/20 Linear Bearing
$33.18	80/20 Butt Hinge: 2 Holes per Leaf, 2 in Door Leaf Ht, 1 in Door Leaf Wd, 160° Range of Motion
$68.84	80/20 Deadbolt Latch: 1 1/2 in x 1 1/2 in x 2 1/2 in, 10 Series/15 Series, Silver, Anodized
$7.41	80/20 Handle: 10 Series, Inch, Textured, Pull, Glass-Filled Nylon, Black, Drop-In, 4 13/32 in x 5/8 in
$242.00	80/20 Inside-Corner Bracket: Inside-Corner Bracket, 1 in x 7/8 in x 1 in, For 17/64 in Slot Wd, 10 Series
$145.00	FOAMULAR 150 1 in. x 4 ft. x 8 ft. R-5 Scored Square Edge Rigid Foam Board Insulation Sheathing
$264.00	ORTHObones Biomechanical Test Blocks 20 PCF - CP1
$264.00	ORTHObones Biomechanical Test Blocks 15 PCF - CP1
$264.00	ORTHObones Biomechanical Test Blocks 10 PCF - CP1
$14.99	Ruisita 12 Pieces Stainless Steel Shot Cups Stainless Steel Shot Glass Drinking Tumbler
$1,539.80	**Total Cost**

Stage 1 Testing

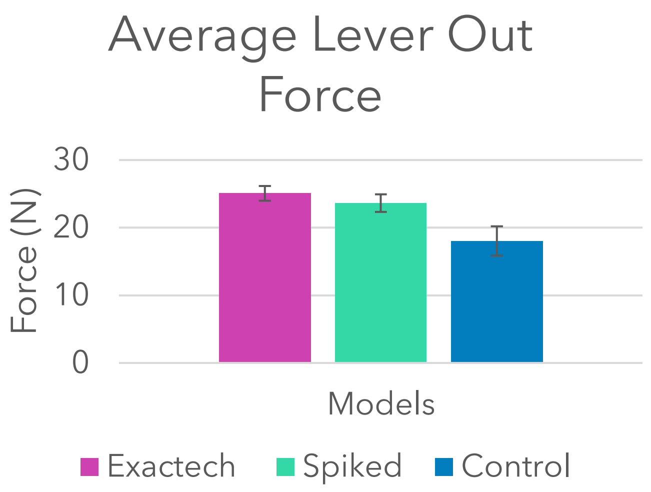
- This stage of testing was done by placing the PLA implants in sections of insulated foam sheets
- To simulate leveling out, we placed the hook of a spring scale right below the liner tray of the implant and pulled the scale along a wooden block to calculate the force it took to lever out the implant while keeping the scale horizontal





Stage 1 Testing Data

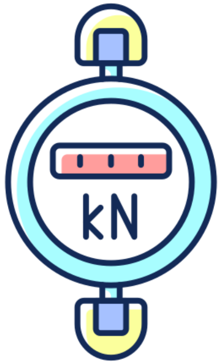
	Force lever out (N)								
Models	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average	Standard Deviation	SQRT (N)	Standard Error of the mean
Exactech	27.2718	27.468	24.525	21.582	24.525	25.07436	2.416527788	2.236067977	1.08
Spiked	19.62	26.487	25.9965	21.582	24.525	23.6421	2.951163677	2.236067977	1.32
Control	14.715	11.772	18.639	22.563	22.563	18.0504	4.785832404	2.236067977	2.14

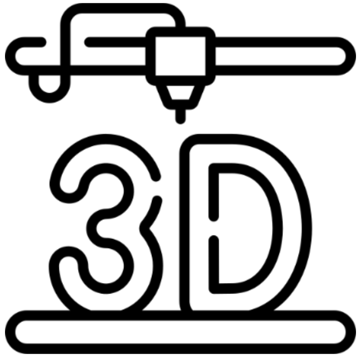


Stage 2 Testing

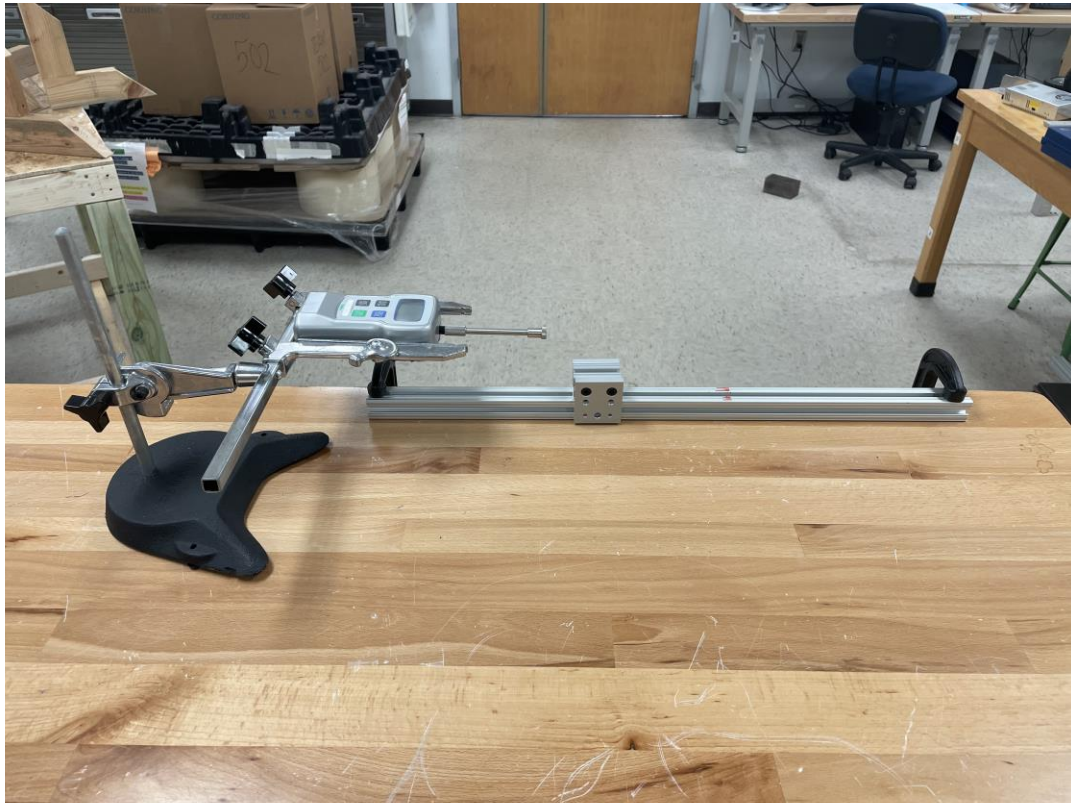
- The second stage of testing will consist of using an 80/20 bar along with a sliding mount that has a 3D printed tray attached to hold the cup that contains the foam insulated implant
- As the mount slides the humeral tray will make contact with a fixed strain gauge that will push against the tray till it levers out
- During this procedure there will be 2 cameras that will record the test both vertically and horizontally

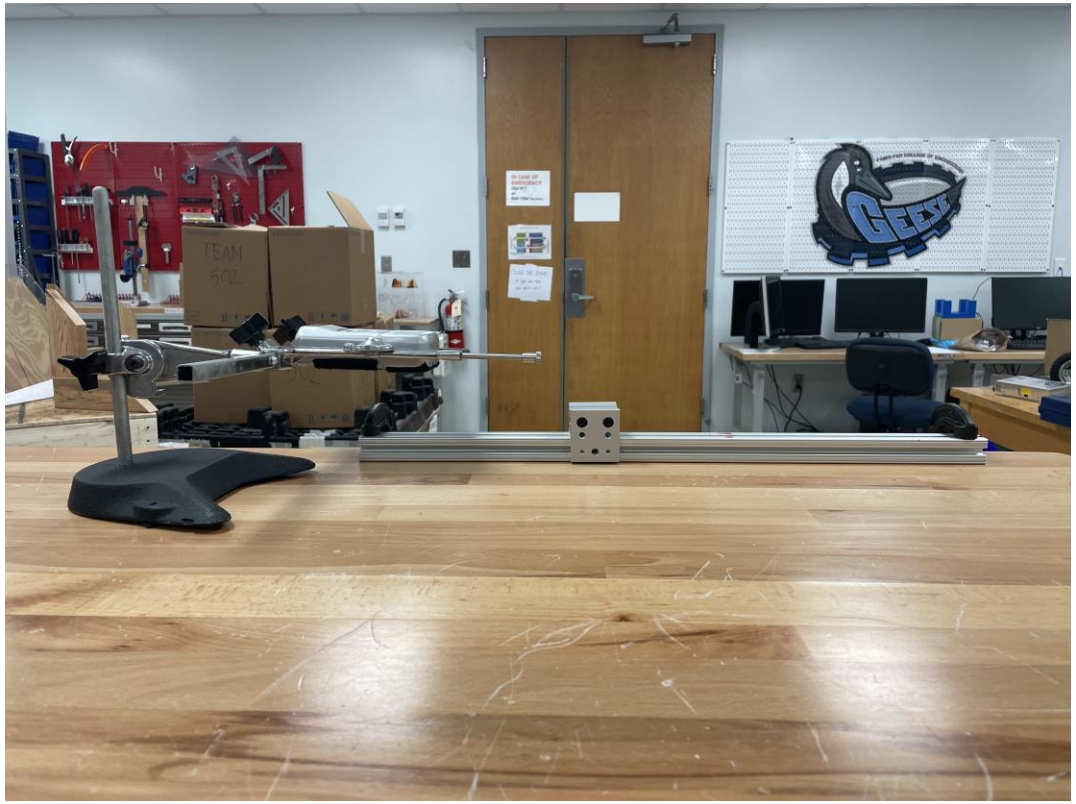
Stage 2 Testing - Assembly



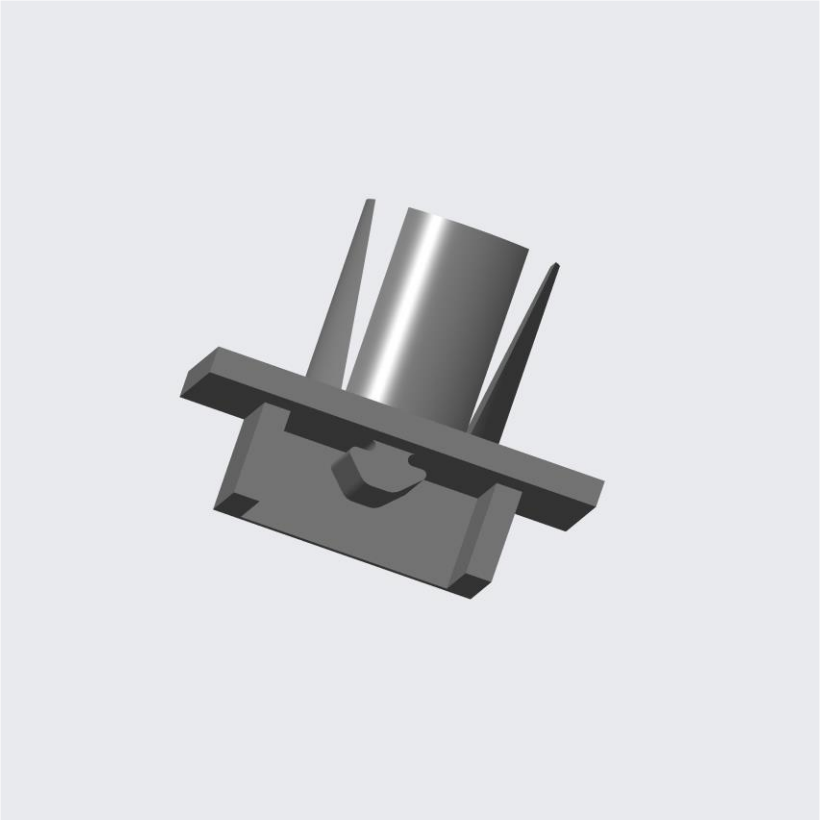


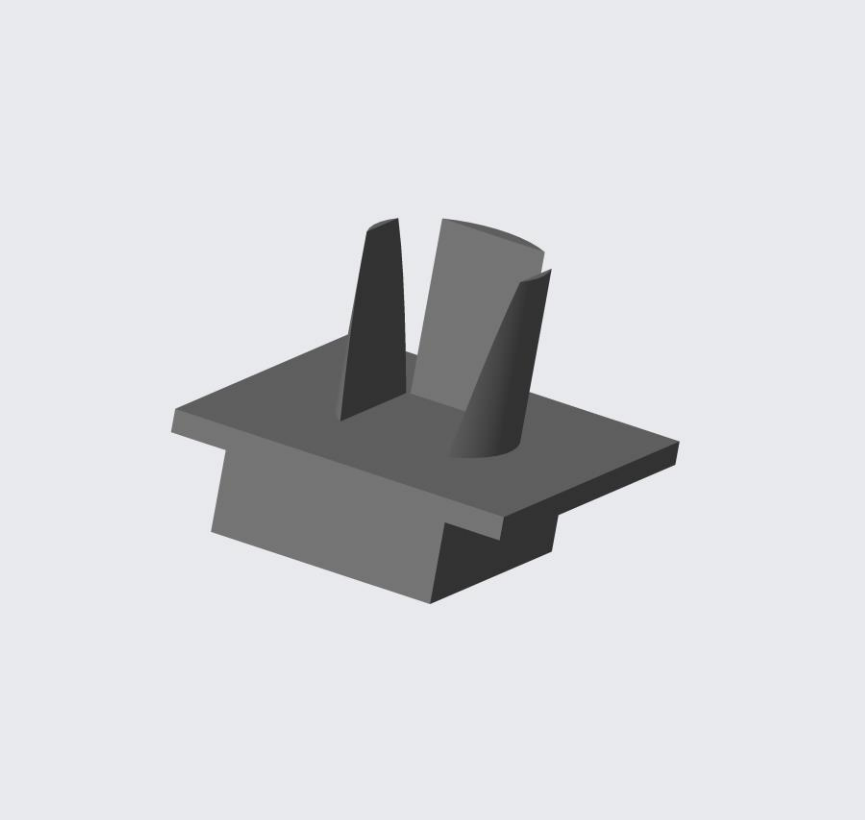
Stage 2 Testing - Apparatus



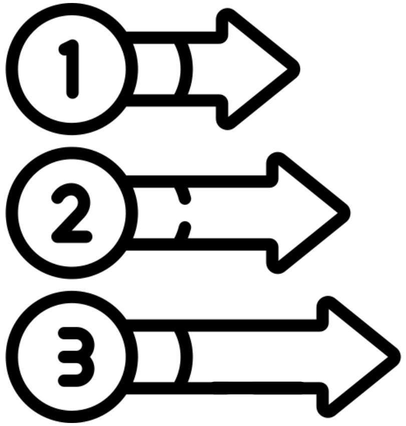


Stage 2 Testing – Implant Tray





Next Steps



- Finish 3D printing all the concepts.
- Complete Stage 2 Testing.
- Test and record data.
- Choose design to modify for better revisions.
- Test using Final apparatus using Boneblocks.
- Print the final design using the SLS machine at Exactech.