Material Selection Process

To start off, we first had to determine what plastics we could use for the tool considering that it must be medical grade.This information then helped us select 15 different plastics for further consideration. We then compared each type of plastic's tensile strength (figure 1) and Young's modulus (figure 2) to the original materials. After careful analysis, we narrowed down our selection to six different materials that we simulated using SolidWorks (figure 3) to assess the tool's performance under a 1.6 N force. This further reduced our material selections to three. These materials would then undergo physical testing to identify the best material for the product.

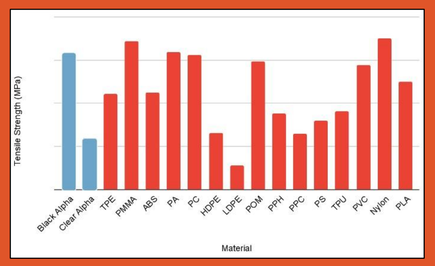


Figure 1. Tensile strength comparison of each material (red) to the original materials (light blue)

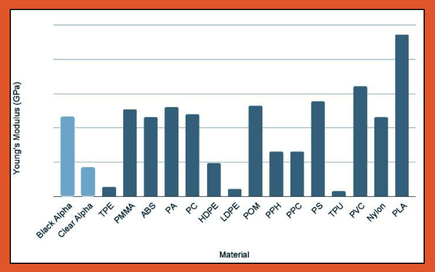


Figure 2. Young's modulus comparison of each material (dark blue) to the original materials (light blue)

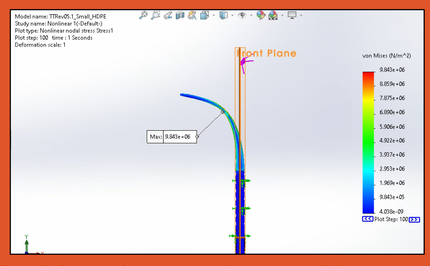


Figure 3. Example of the stress test of the tool with HDPE as the material.

tonsiFIX
by tonsil tech

Oregon State University

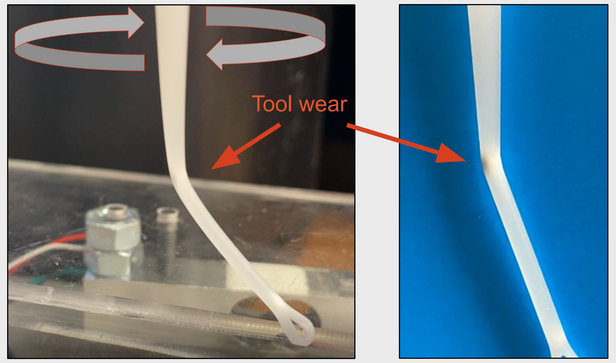
TonsiFIX Material Testing

Team Members: Daniel Capozzola, Haley Harrington, Gabriella Justen, and Kinsey Popham

Our project aimed to identify a new material for the TonsiFIX tonsil stone removal tool that can visually cue the need for replacement after an extended period of time. To achieve this objective, we conducted research on medical grade plastics suitable for this product and used SolidWorks simulations to identify the top three plastics. We also conducted physical tests using solvents to evaluate material durability and drop testing to ensure the material's ability to go through shipping. Lastly, we designed a fatigue testing fixture to assess the product's durability and ability to show wear.

Fatigue Testing Fixture

To simulate the bending that the TonsiFIX tool undergoes during use, our team created a testing fixture based on the same principles behind a Rotating Beam Fatigue testing system. The tool is inserted into a drill chuck, and bent against a force plate at a particular angle. Once the drill turns on, the machine bends the tool as it spins. This applies the same strain to the tool as bending it in all directions. Our testing machine is controlled by an Arduino Uno, and counts the cycles, as well as the forces on the plate as the tool spins.



One-way ANOVA: Diff versus Operator

Source	DF	SS	MS	F	P
Operator	2	315	158	1.08	0.353
Error	29	4241	146		
Total	31	4556			

S = 12.09 R-Sq = 6.92% R-Sq(adj) = 0.50%

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev	---+---------+---------+---------+------
Daniel	10	13.65	8.19	(-----------*-----------)
Gabby	11	19.10	12.84	(-----------*-----------)
Haley	11	11.80	14.10	(-----------*-----------)
				---+---------+---------+---------+------
				6.0 12.0 18.0 24.0

Pooled StDev = 12.09

One-way ANOVA: Final Force 2 versus Operator

Source	DF	SS	MS	F	P
Operator	2	5425	2713	8.04	0.002
Error	29	9789	338		
Total	31	15214			

S = 18.37 R-Sq = 35.66% R-Sq(adj) = 31.22%

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev	------+---------+---------+---------+---
Daniel	10	243.07	10.33	(-------*-------)
Gabby	11	245.46	13.69	(-------*-------)
Haley	11	271.66	26.37	(-------*-------)
				------+---------+---------+---------+---
				240 255 270 285

Pooled StDev = 18.37

Measurement Systems Analysis

A Gage R&R study was performed to test the bending test fixture's consistency and reliability. This involved looking at and comparing force values when different operators performed tests and when different sizes of tools were placed in. To test how consistent the data was an ANOVA test was done as seen to the left. What this showed was the force plate was picking up to much noise to be useful. However, the visual data of whether wear was shown on the tool was consistent enough to approve the machine for testing purposes.

Conclusion

Our tests support the conclusion that the white β material will satisfy our customer requirements. The material has adequate flex range, isn't damaged when dropped, is priced significantly under the target price, within the weight range, comes in the color of white black clear or blue, and is injection moldable. We are able to replicate and measure when the tool starts to show wear. Most importantly, this material has the ability to show wear. We are further recommending that our sponsors add a blue colorant both to make the wear more obvious and to make their logo pop.

Solvents

Through testing in combination with our Fatigue Testing Fixture, our team concluded that the following solvents do not impact the integrity of the tool:

- Isopropyl Alcohol
- Denture Cleaner
- Dish Soap

Drop Test

This was a test to see how the parts could handle extreme shipping conditions. The parts were placed in their packaging and dropped from a 3-story balcony. All of the testing showed that when in the case the parts were able to withstand the drops with no damage shown and no apparent effect on the lifetime of the part even with the packaging being damaged.