Team ProClip

RENAL DEVICE

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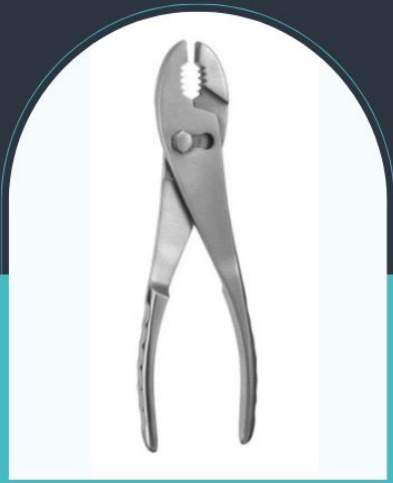
PROJECT PROPOSAL

Our team was tasked to design a device that can help nurses clip and unclip the clamps on the rigid plastic blood tubing that is ergonomic and be ambidextrous and can be easily cleaned.

CUSTOMER NEEDS

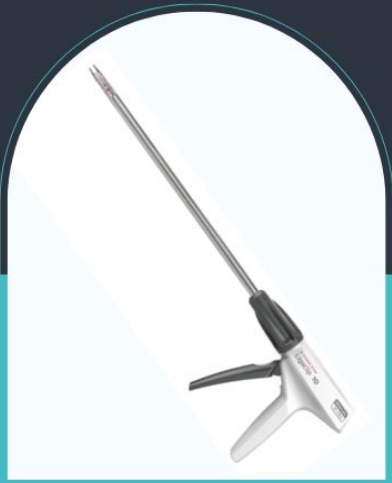
#	Needs	Weight
1	Lightweight/small enough to be able to clip onto clothing/ fit in the pocket.	0.6
2	Designed for ambidextrous use.	0.4
3	Can withstand the repetitive task of closing clips.	0.6
4	Reduce stress on thumb joints with the motion to clip	1
5	Eliminate the use of the thumb as the primary mechanism to operate the device.	1
6	Needs to be affordable.	0.2
7	The speed of the clip application stays the same/ increases.	0.8
8	Easy maneuverability in confined spaces around medical equipment.	0.8
9	Robust to withstand rigorous daily use. Lasts a long time	0.6
10	Doesn't degrade/ rust when consistently cleaned daily with cleaning agents containing alcohol.	0.8
11	Not time-consuming to accommodate different sizes of tubing and clips.	0.8
12	Fits well and can be used with all different types of hands.	0.6
13	Adjustable to different renal clip sizes	0.4

BENCHMARKING



Medical Pliers

Hydraulic Crimp



WECK Clip Applier

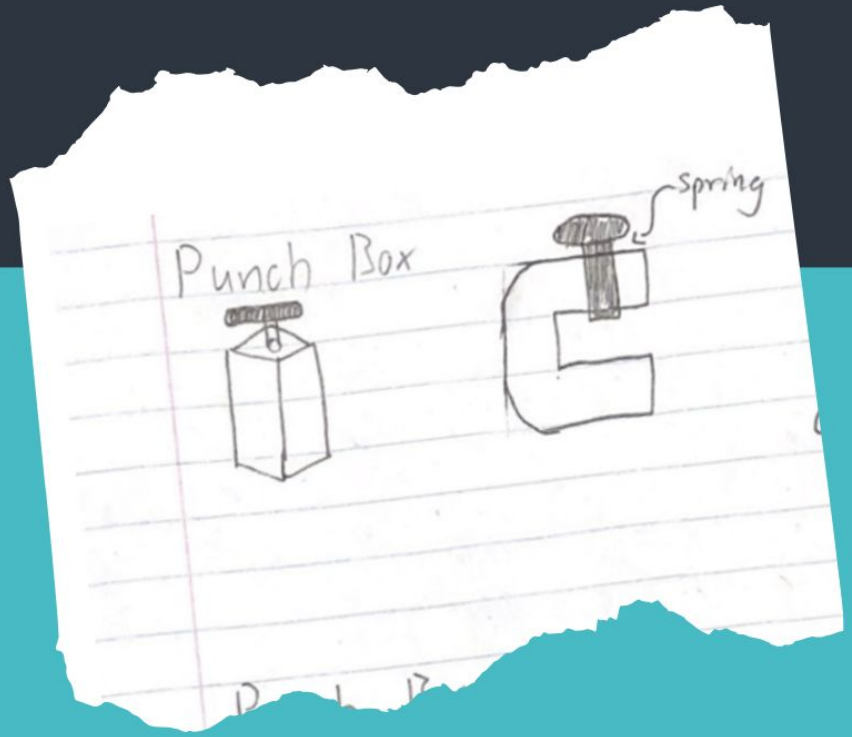
BENCHMARKING RESULTS

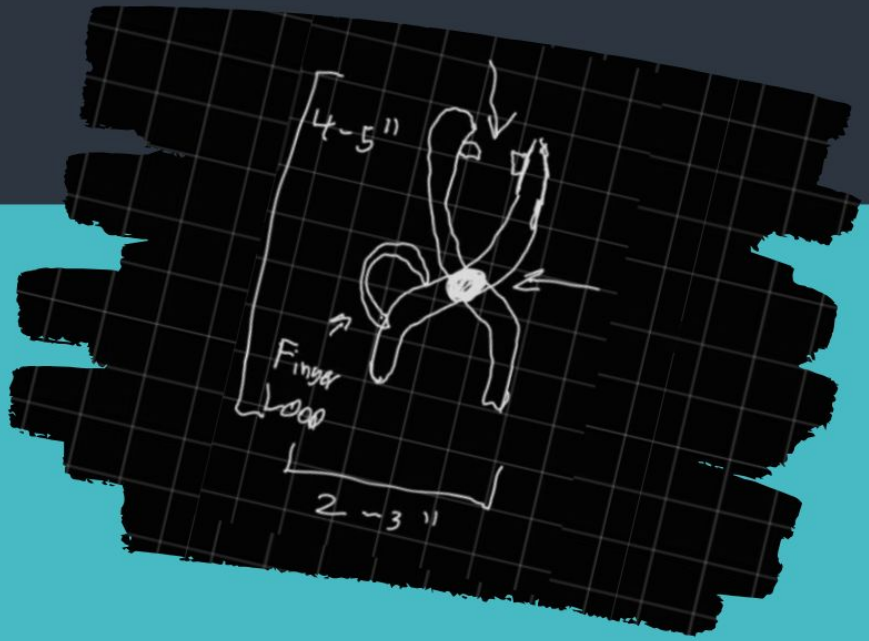
Metrics	Weight	Units	Products		
			Medical Pliers	**Hydraulic Crimp**	**WECK**
Number of clips the device can close before failure	0.6	# of clips	1,000,000	800,000	500,00
Reduction in thumb joint stress (compared to manual operation)	1	%	64	80	60
Time taken to apply a clip using the device (should not exceed manual operation time)	0.8	sec	4	3	2.5
Ability to maneuver in space of X cm width (binary: yes or no)	0.8	cm	17.5	20	6
Total weight of the device	0.6	g	250	2720	300
Number of operations using thumb only	1	#	0	0	0
Manufacturing cost of the device (markup estimated to be 50%)	0.2	CAD $	84	31	140
The lifespan of the device under normal daily use	0.6	years	10+	7+	2+
Adjusts to several different renal clip sizes.	0.4	1 to 5 cm	1 to 4	1 to 4	4.9mm to 9.2mm
Rank			1.8	1.6	1.6

DESIGN SPECIFICATIONS

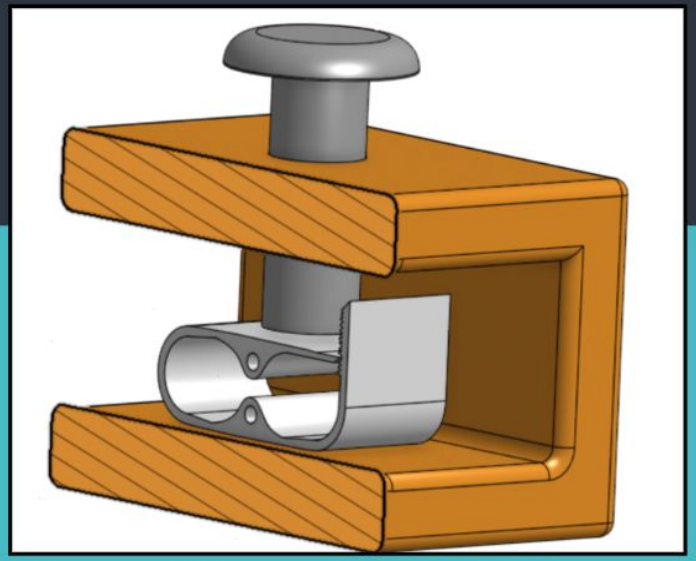
#	Metric	Units	Value
1	Number of clips the device can close before failure	# of clips	>700,000
2	Reduction in thumb joint stress (compared to manual operation)	%	>75
3	Time taken to apply a clip using the device (should not exceed manual operation time)	seconds (s)	<3
4	Time taken to adjust the device for different tubing and clip sizes	seconds (s)	<10
5	Ability to be used with both left and right hand (binary: yes or no)	binary	Yes
6	Ability to maneuver in space of X cm width (binary: yes or no)	cm	5
7	Resistance to alcohol-based cleaning agents (no degradation after X wipes)	# of wipes	500,000
8	Compatibility with different hand sizes (e.g., can be used with X% of adult hand sizes)	%	>95
9	Total volume of the device	cm^3	<200
10	Total weight of the device	g	<300
11	Number of operations using thumb (should be 0)	#	0
12	Manufacturing cost of the device	CAD $	<50
13	The lifespan of the device under normal daily use	years	>8
14	Adjusts to a number of different renal clip sizes.	1 to 5 cm	1 to 5

DESIGN CONCEPTS





CLIENT FEEDBACK

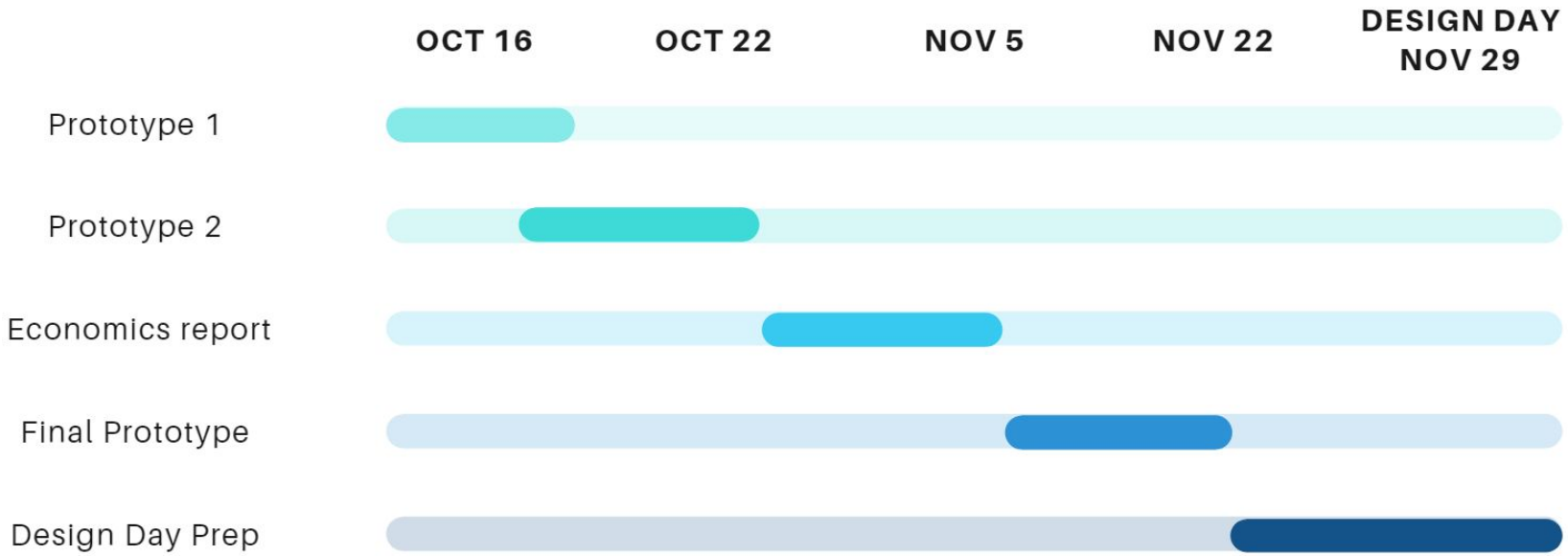


The client liked the box design because:

- It was small and compact
- Allowed for quick clipping process
- Was not operated by the thumb
- Fits different sized clips

Project Plan

Target : November 29, 2023



PROTOTYPE 1 - ERGONOMICS

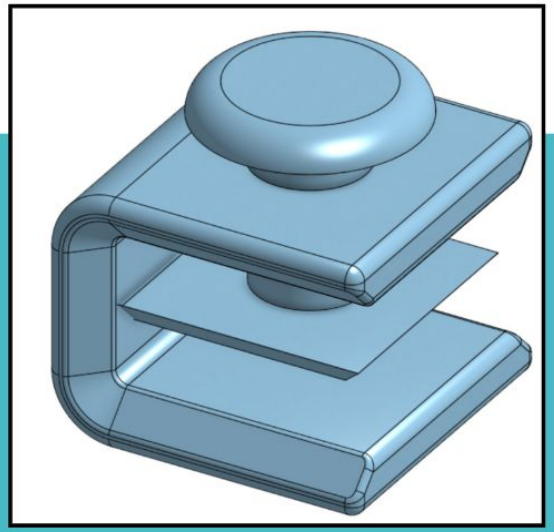
Prototype 1 testing goals:

- Determine ideal dimensions
- Find the ideal weight
- Evaluate tools maneuverability/portability
- Analyze stress to the thumb joint
- Improve the overall comfort of the device

TEST 1

Lessons Learned

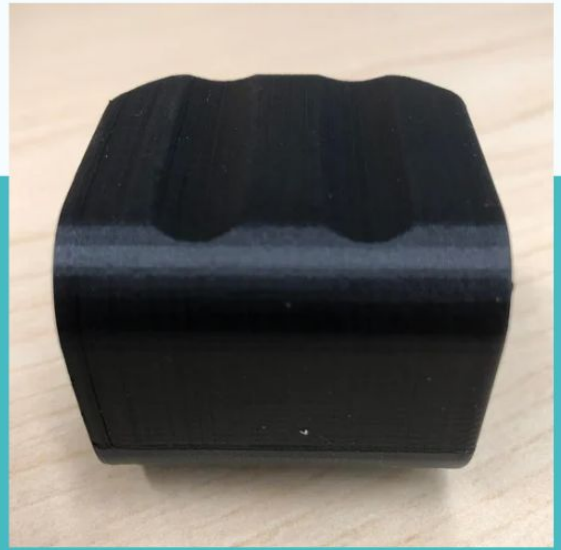
- To more accurately determine target values
- Increase infill of 3D print
- Change printing supports to prevent rough edges



TEST 2

Lessons Learned

- Decrease size of the tool to accommodate smaller hand sizes
- Remove some of the material to reduce weight
- Tool is successful at eliminating thumb stress



TEST 1 AND 2 COPAIRED TO TARGET SPECIFICATIONS

Design Specification	Units	Design Value	Test 1	Test 2
Reduction in thumb joint stress (compared to manual operation)	%	>75	80	80
Compatibility with different hand sizes (e.g., can be used with X% of adult hand sizes)	%	>95	10	90
Total volume of the device	cm^3	<200	63	26
Total weight of the device	g	<300	63	48
Number of operations using thumb (should be 0)	#	0	0	0

Control Group

Part of prototypes testing was to bring show test 2 to a variety of people to get their opinion on the comfort of the tool.

The main feedback was:

- The tool was to tall for their hands
- The finger groves could be deeper
- The plunger could be improved to prevent it digging into the palm

NEXT CLIENT MEET

Questions for client:

- Ask if the client has access to a 3D printer
- Confirm the maximum and minimum size of renal clips
- Check for an update on shipping the clips and tubing
- Advice on how to make the device easy to carry for the nurses

QUESTIONS?