



Climber's Forearm Trainer

Client: Dr. Chris Vandivort
Advisor: Dr. John Puccinelli

Brittany Glaeser, Kaitlin Lacy, Marissa Harkness,
Zoe Schmanski, Jonathon Murphy

February 21st, 2020



Client Information



Dr. Chris Vandivort - Emergency Physician at UW-Health

Problem Statement

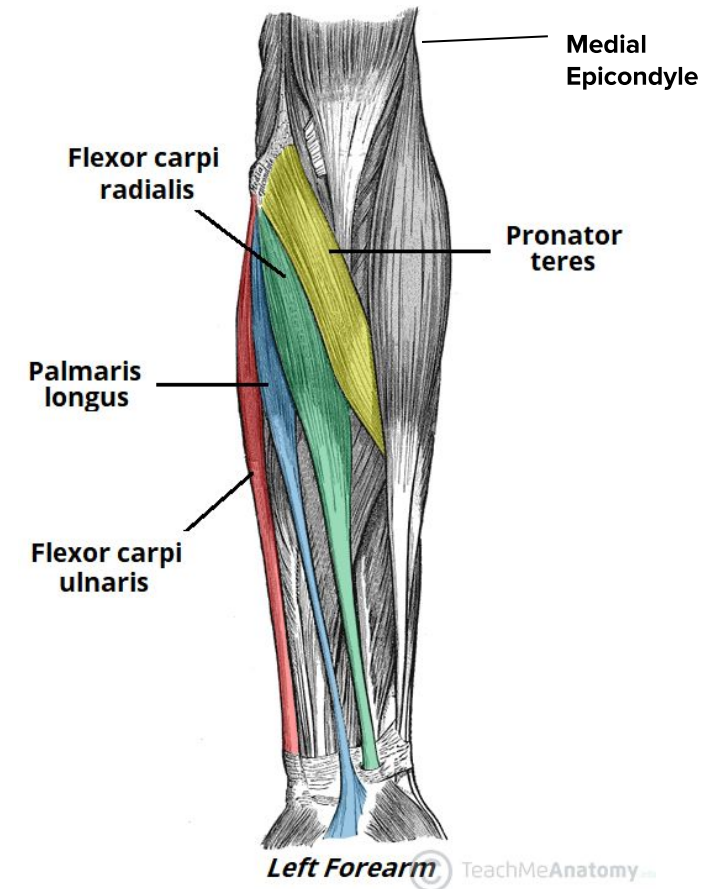
A device is needed for the prevention and treatment of Climber's Elbow. Ideally the device would allow for resisted, slow eccentric training for the wrist extensors and flexors as well as pronators and supinators.

Features:

- Targets specific muscles and tendons affected
- Adjustable resistances
- Portable
- Grip strengthening component

Background

- Four Major Forearm Muscles
 - Connect to the Medial Epicondyle [1]
 - Focus on the Pronator Teres
 - Overuse causes micro-tearing of tendon (Medial Epicondylitis) [2]
- Imbalance in strength [3]



[4]

Competing Designs



Hangboard [5]



Vive Health Finger Exercisers [8]



Forearm Trainer - Black Diamond Inc. [7]



Handmaster Plus [6]

Original Design



Current Handle



Isometric view of original design

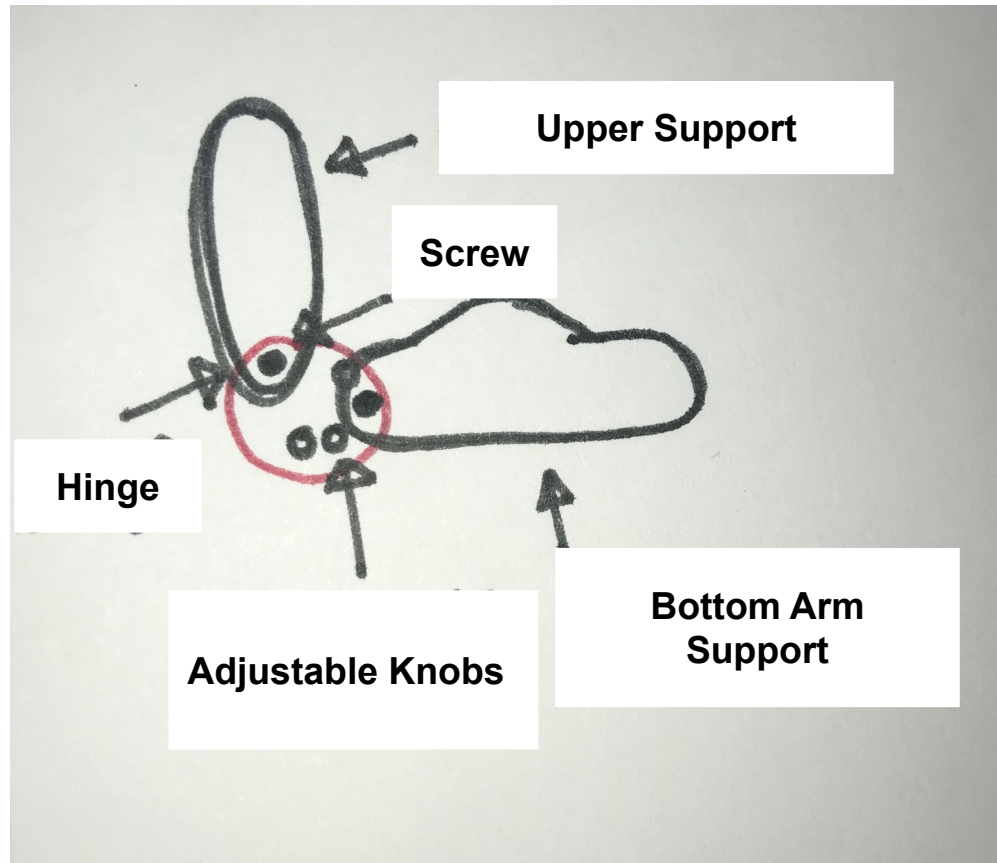


Hooks for adjusting resistance bands

Design Specifications

- Targets Pronator Teres
- Includes component to strengthen grip
- Portable for at-home use
- User safety and comfort
 - Include angles between 90° - 110°
- Accommodate different sized forearms and strengths
 - Fit the average forearm length of 23.1 -26.4 cm
 - Fit the average upper arm length of 29.2 - 33.4 cm
- Meets standards according to the ASTM standards for Fitness

Design 2 : Hinge



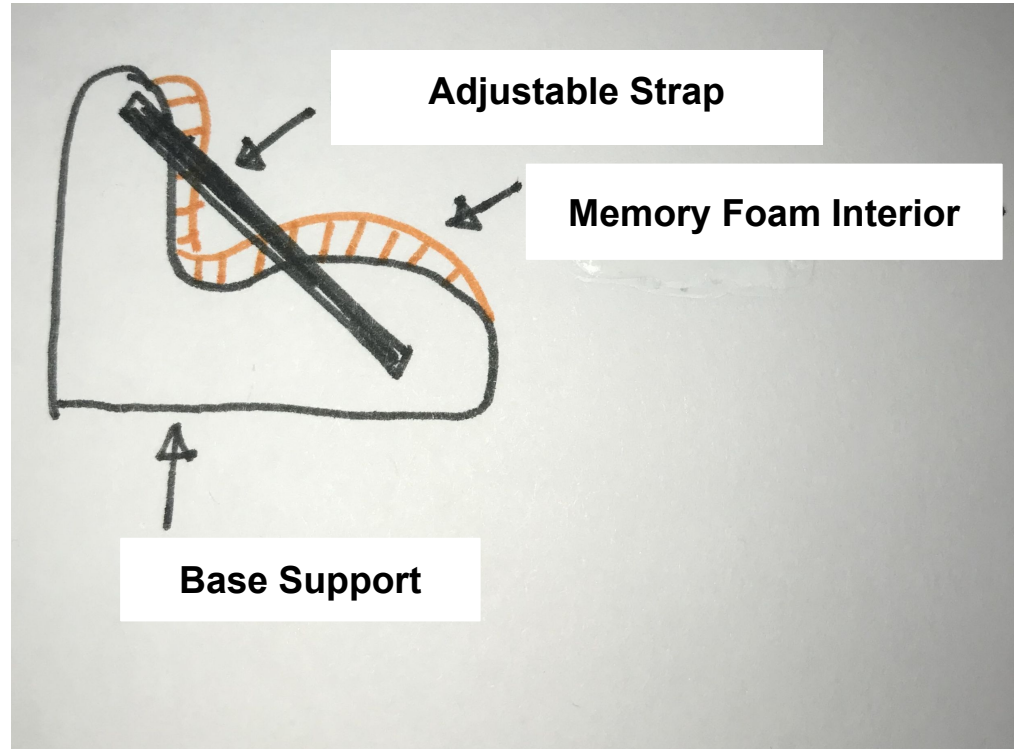
Pros:

- Adjustable angle 60° - 180°
- More brace support
- Allows for proper range of motion required for forearm strengthening

Cons:

- Not adaptable for varying arm sizes
- Upper and bottom support may collide

Design 3 : Straps



Pros:

- 10° adjustable angle
- More brace support
- Memory foam interior allows for more adaptability of various arm sizes

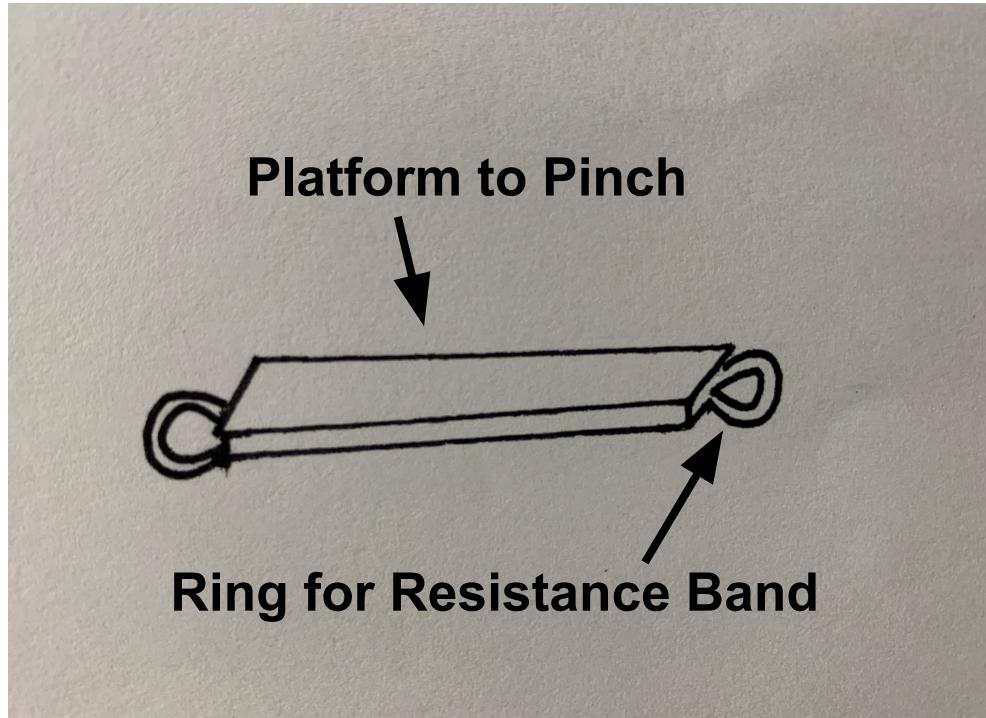
Cons:

- Strap has potential to interfere with stretch
- Memory foam interior increases bulkiness

Base Design Matrix

Criteria	Design 1 “The Original”		Design 2 “Hinge”		Design 3 “Straps”	
Ease of Use (25)	3/5	15	4/5	20	5/5	25
Comfort (25)	3/5	15	5/5	25	4/5	20
Adaptability (20)	5/5	20	5/5	20	4/5	16
Ease of Fabrication (15)	5/5	15	2/5	6	4/5	12
Safety (10)	5/5	10	5/5	10	5/5	10
Cost (5)	5/5	5	4/5	4	5/5	5
Total (100)	80		85		88	

Design 1: Pinch Grip



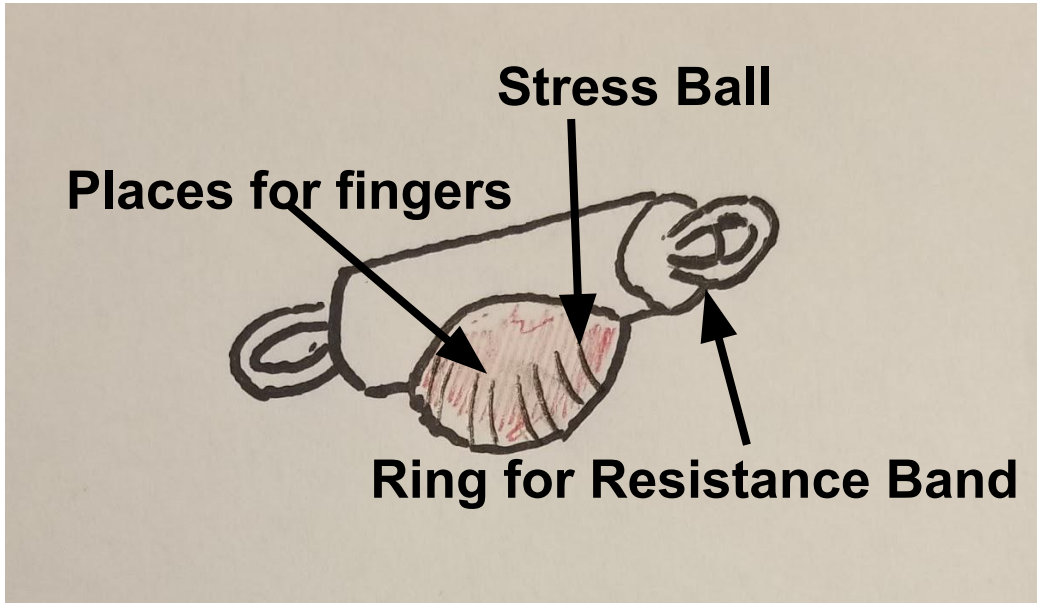
Pros:

- Compatible with current design
- Ability to adjust difficulty

Cons:

- Doesn't strengthen individual fingers
- Only increases difficulty if resistance is changed

Design 2: Stress Ball



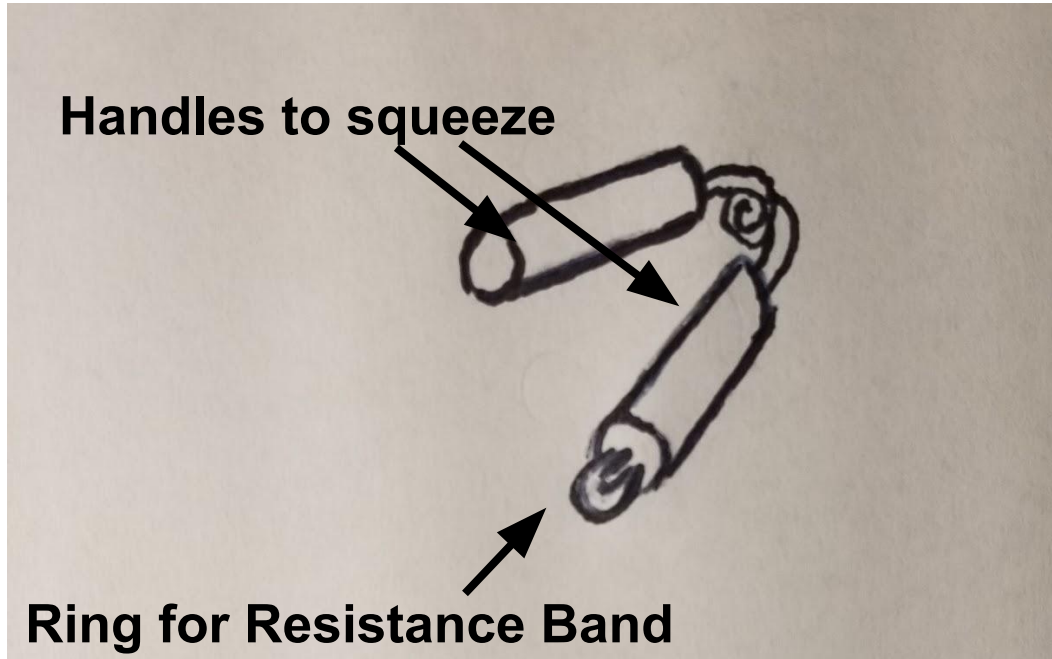
Pros:

- Able to flex individual fingers
- Compatible with current design

Cons:

- Doesn't increase resistance
- More difficult to fabricate

Design 3: Gripper



Pros:

- Simple and easy design to use
- Compatible with current design

Cons:

- Doesn't strengthen individual fingers
- Cost is higher for fabrication

Grip Design Matrix

Criteria	Design 1 “Pinch Grip”		Design 2 “Stress Ball”		Design 3 “Gripper”	
	Weight	Score	Weight	Score	Weight	Score
Ease of Use (25)	5/5	25	4/5	20	5/5	25
Effectiveness (20)	4/5	16	2/5	8	3/5	12
Ease of Fabrication (20)	5/5	20	3/5	12	5/5	20
Compatibility (15)	4/5	12	3/5	9	4/5	12
Safety (15)	5/5	15	5/5	15	4/5	12
Cost (5)	5/5	5	4/5	4	3/5	3
Total (100)	93		68		74	

Future Work

- Final designs: Straps and Pinch Grip
- Student Athletic Performance Center
- Fabrication plan
 - 3D print base structure
 - Incorporating grip handle
- Resistance bands



Resistance bands to replace the current bands being used [9].

Acknowledgements

We would like to thank....

Dr. Puccinelli

Dr. Chris Vandivort

BME Faculty and Staff

References

[1] E. Davis, PhD, private communication, Sept. 2019.

[2] Axelrod, I. (2019). How to Prevent and Treat Rock Climber's Elbow. [online] Moja Gear. Available at: <https://mojagear.com/journal/2014/04/01/got-elbows-a-guide-to-coping-with-climbers-elbow/> [Accessed 7 Sep. 2019].

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[4] TeachMe Series, *Left Forearm*. 2020.

[5] Vola, *Hangboard*. 2020.

[6] Handmaster Plus, *Handmaster Plus*. 2020.a

[7] Black Diamond Inc., *Forearm Trainer*. 2020.

[8] Vive Health, *Finger Exerciser*. 2020.

[9] eBay, "Resistance Bands Set Yoga Pilates Latex Exercise Fitness Tube Workout Band 11PCS," *eBay*. [Online]. Available: <https://www.ebay.com/itm/Resistance-Bands-Set-Yoga-Pilates-Latex-Exercise-Fitness-Tube-Workout-Band-11PCS-/142871710120>. [Accessed: 18-Feb-2020].