

Climber's Forearm Trainer

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Abstract

Many climbers may develop a condition known as "Climber's Elbow," in which the tendon between the forearm flexors and the medial epicondyle of the elbow develops microtears. A device has been created to aid in prevention of, and rehabilitation from, this condition. The device includes adjustable resistances that allows the user to change the resistance in order to match their strength level. Worn on the elbow, the forearm trainer is a portable device that can be used to strengthen the flexors and extensors of the forearm, which also take part in pronation and supination of the wrist.

Motivation

Medial epicondylitis, or "Climber's Elbow," is a condition affecting many rock climbers. Resistance training to strengthen the muscles in the forearm both helps prevent, and aids in the recovery from, this condition [1]. A portable device is needed that strengthens the flexors and extensors of the forearm.

Background

Anatomy

- Flexors utilized while climbing [2]
 - Pronator teres very involved
- Microtears in tendon from [3]
 - Overuse [4]
 - Imbalance between flexors and extensors [5]
- Strengthening flexors and extensors
 - Prevents medial epicondylitis
 - Assists in rehabilitation [1]

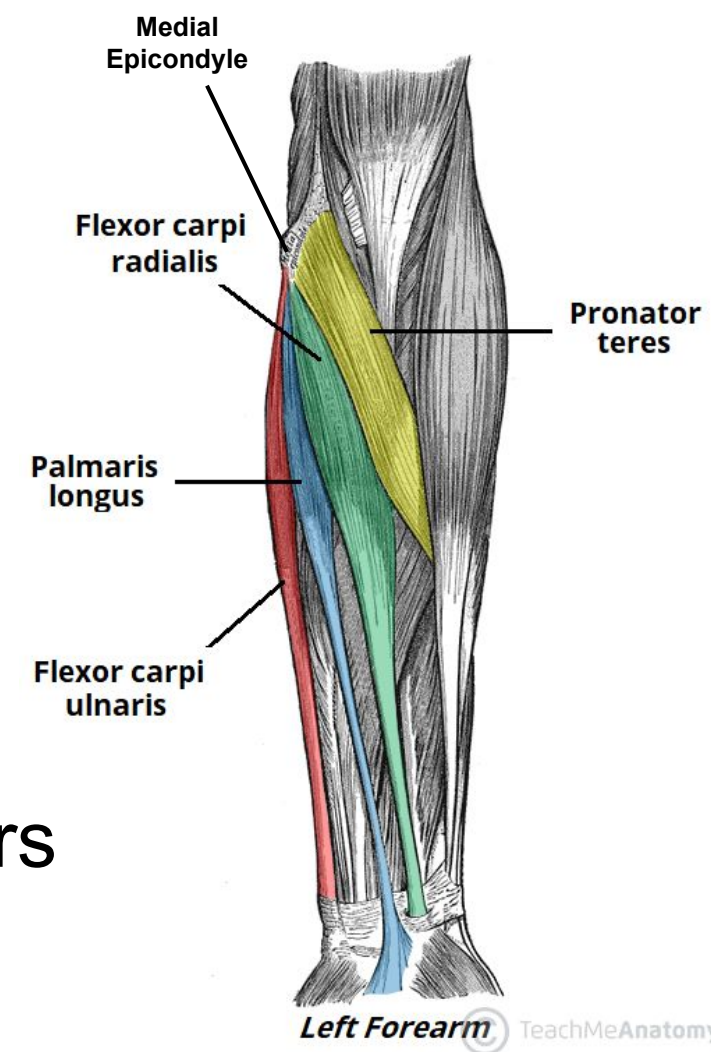


Figure 1: A labeled diagram of the forearm flexors. Adapted from TeachMe Series (2019) [6].

Current Products



Figure 2: The Metolius GripSaver Plus [7].



Figure 3: An athlete training on a hangboard [8].



Figure 4: The Black Diamond Forearm Trainer [9].

Design Criteria

- Effectively targets forearm muscles
- Variable resistances
- Safe to use without risk of injury
- Portable and able to be used without a table
- Adaptable to different sized forearms
- Durable to withstand daily use for many years
- Comfortable to use
- Easy to use and assemble
- Minimal cost of production

Materials

- Upholstery Visco Memory Foam, 3.5 lb High Density
- 18x2" and 18x1" cinch straps with eyelet
- PLA
- Knurled Threaded Brass Inserts
- AZURELIFE Resistance Bands
- M4x8mm Screws

Cost to Reproduce: \$80.00

Final Design



Figure 5: Angled view of the handle.



Figure 6: Side view of the forearm trainer in training position.



Figure 7: Back of the forearm trainer with a resistance band in place.

Instructions for Use:

- Select the desired resistance band and place over upward facing hooks on back
- Pull the band in between the top hooks and place loop around desired downward-facing hook
- Place arm in device and fix velcro straps across the forearm and bicep, threading through velcro loops
- Perform desired exercises while holding onto handle.
- If necessary, pull the band on the back down around an additional hook to increase resistance

Testing

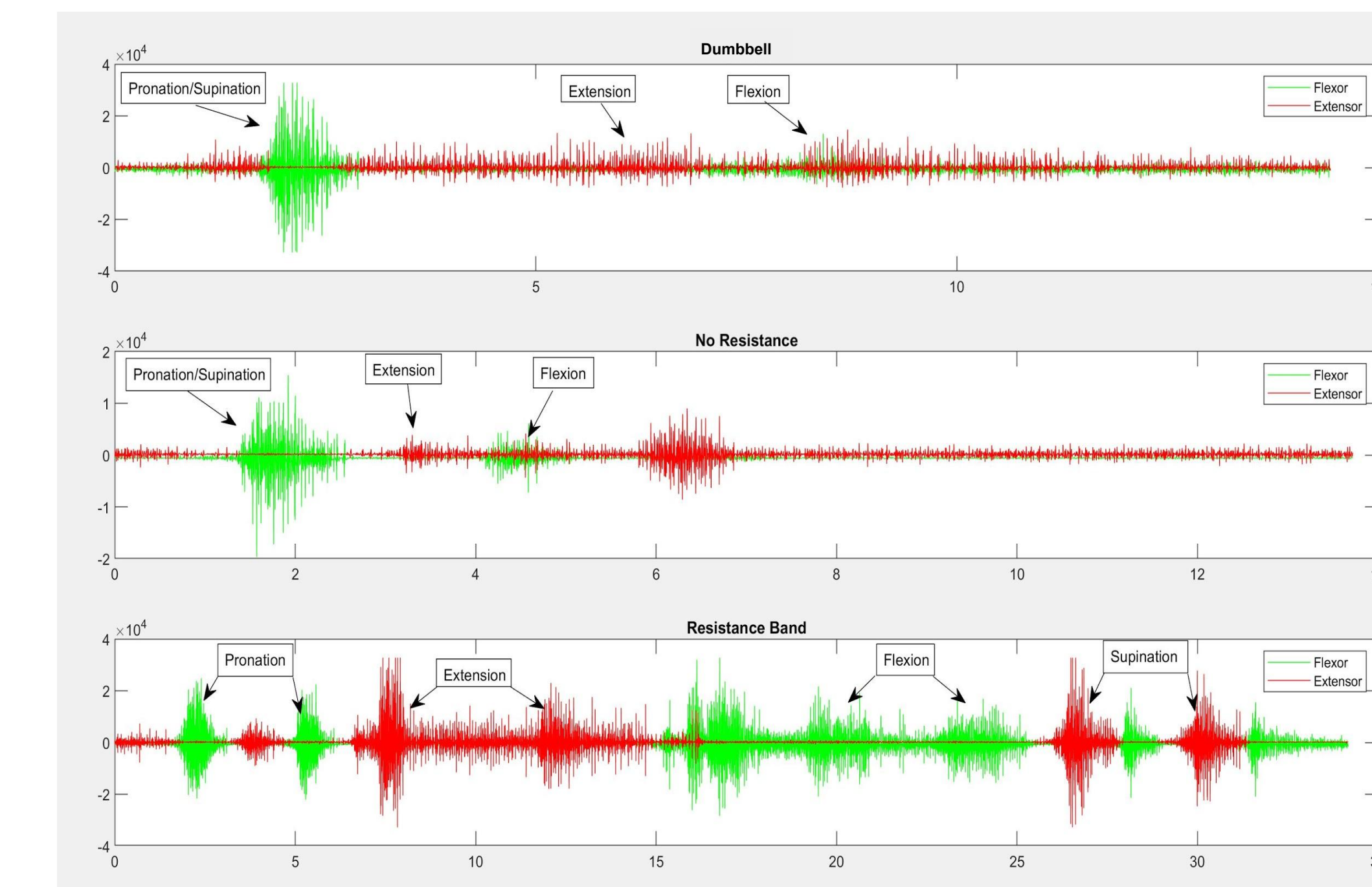


Figure 8: Subject 1, EMG testing of extensors and flexor muscles.

EMG Testing Results

- Device activates the flexor and extensor muscles
- Limited inclusion of the bicep muscle was inconclusive
- Resistance increases magnitude of muscle activation in order to strengthen

Conclusion:

The device will accurately target the flexor and extensor muscles and will strengthen them when resistance is provided.

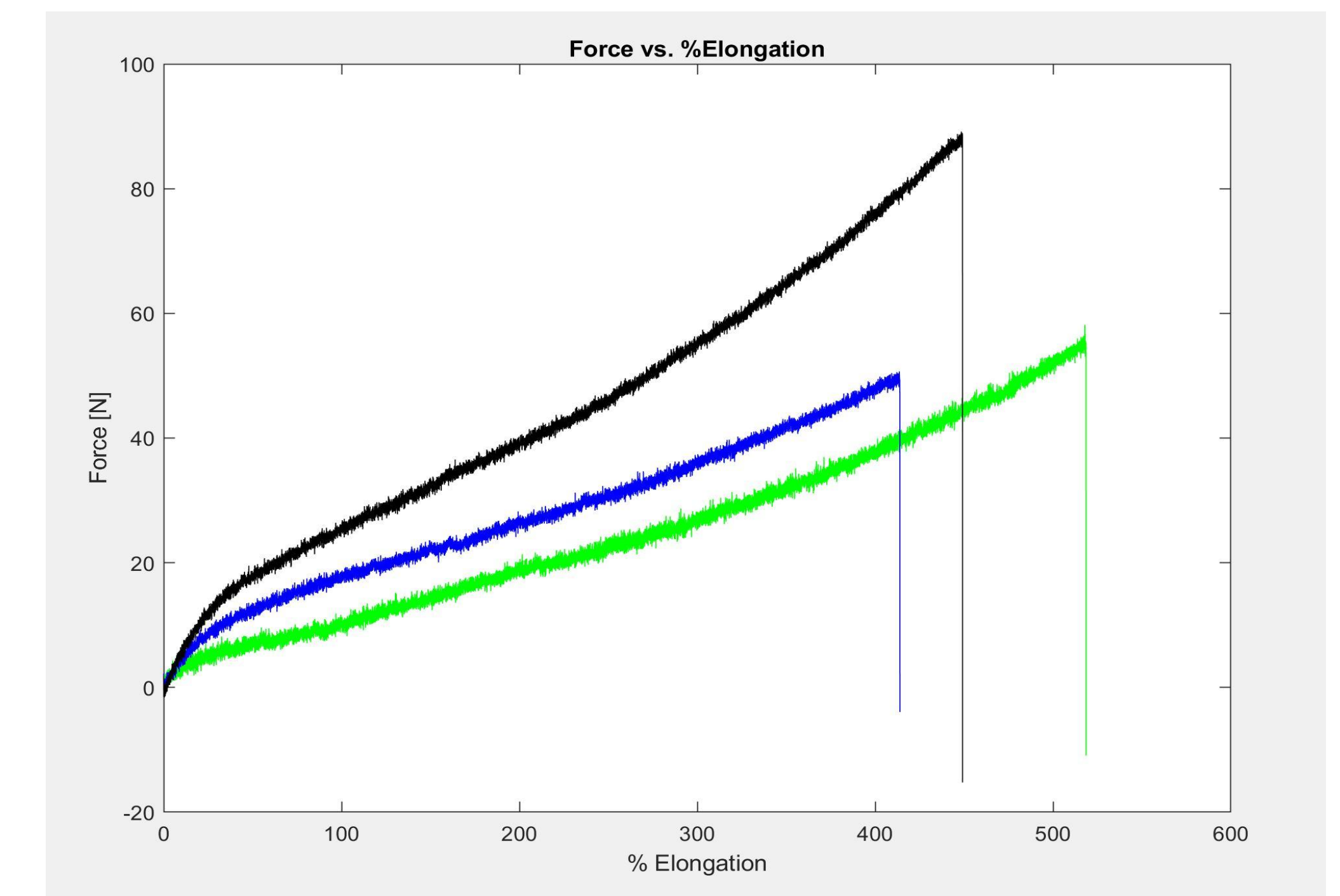


Figure 9: Force vs. Elongation of sample resistance band from tension testing.

Tension Testing Results:

- Max Fracture at 88.8 N and 450% elongation
- Green to Blue had a 60.6% force increase at 100%
 - Theoretical was 53.5%
- Blue to Black had a 46.4% force increase at 100%
 - Theoretical was 108%

Conclusion:

Changing the resistance bands or increasing elongation will change the force to adapt to different needs.

Future Work

- Continue testing device
 - Use EMG testing to better understand bicep activation within different exercises
 - Evaluate whether the device activates muscles more effectively than existing products
- Research and incorporate better materials to be used in design
 - Tube resistance bands
 - More comfortable straps and L-piece
 - Variable handle sizes and shapes

References/Acknowledgements

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