



Ergonomic Syringe Adaptor For Office-Based Injection Procedure

Matthew McMillan, Jared Muench, Emma Herrig, Qi (Lexi) Cheng

Advisor: Dr. Megan McClean Client: Dr. Bobby Nourani



Abstract

- An ergonomic syringe adaptor to relieve physician thumb and wrist discomfort during injections is desired
- Previous designs fail to address poor thumb orientation and grip
- Further testing was done to validate last semester's design functionality
- Plans for filing a provisional patent with the UW Law and Entrepreneurship Clinic have been secured
- Future work will consist of marketing and mass producing

Project Motivation

- Syringes are used in a wide variety of professions ranging from physicians and nurses to dentists and veterinarians
- Repeated injections in any of these fields can lead to pain and hand discomfort, which limits ability to practice effectively
- One such repeated injection therapy is Prolotherapy, which is a regenerative technique that has shown considerable recent growth
- UW-Madison is the hub for Prolotherapy, which allows the team to interact with prolotherapists and explore the market effectively

Background

- Repetitive injections lead to hand fatigue and increase the risk of soft tissue damage
- Fatigue in the hand creates instability during syringe use
- De Quervain's tenosynovitis and tenosynovitis of the finger flexors at the wrist, beneath the flexor retinaculum, may result from repeated thumb movement and a pinch-like grip
- The pinch grip fails to disperse forces across the fingers and places more strain on the tendon pulley

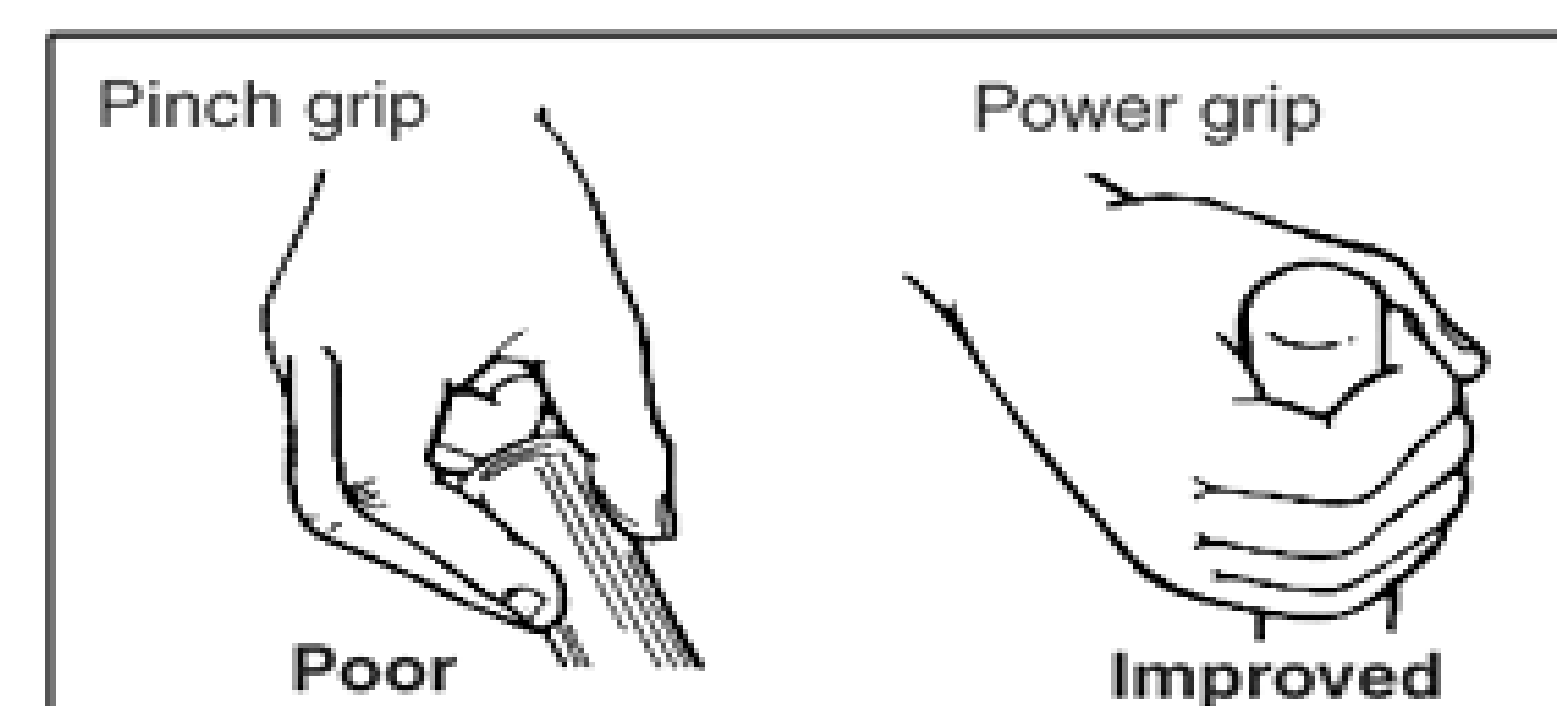
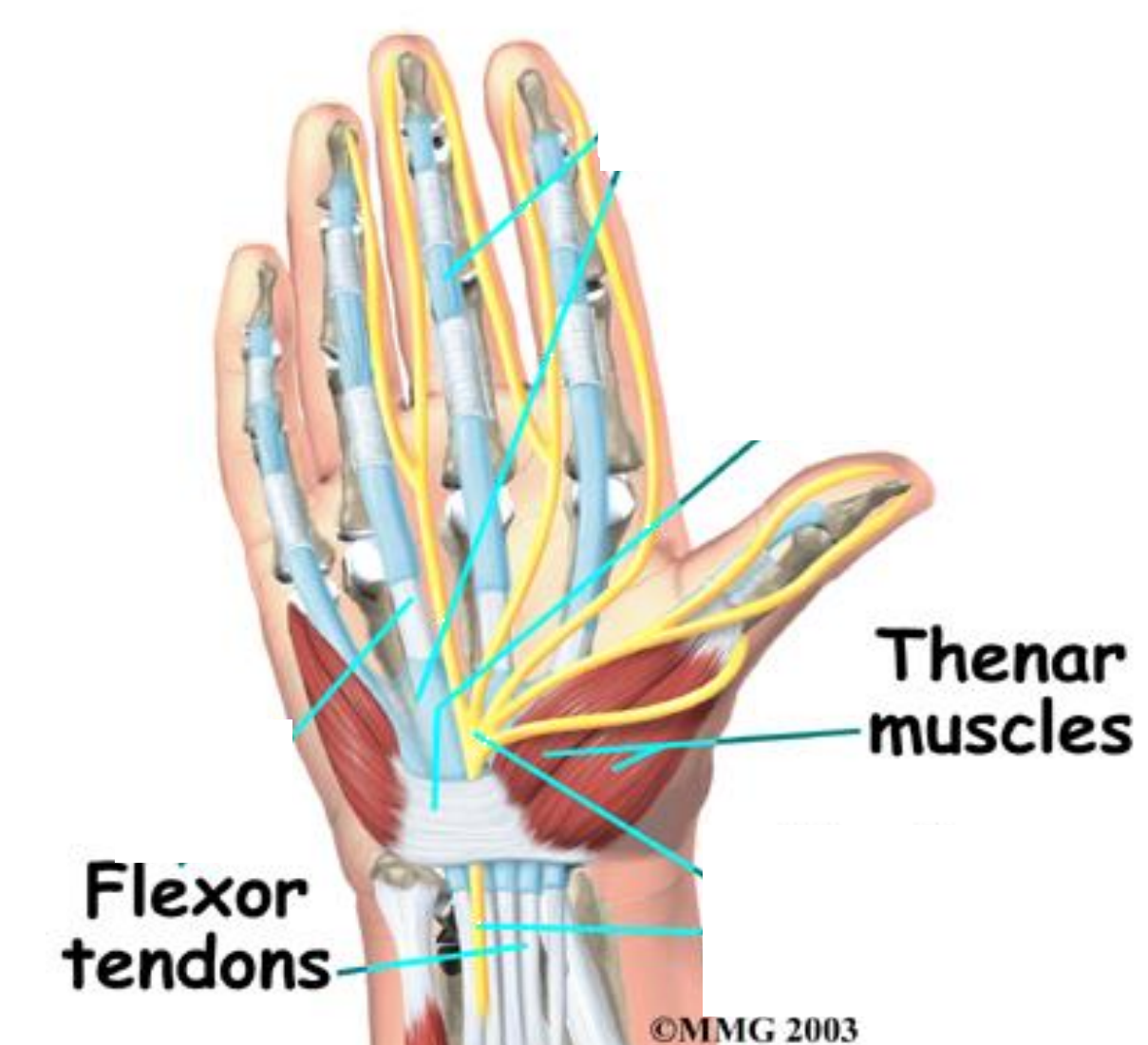


Figure 2. Difference between the power and pinch grip

Preliminary Design Selection

- Comfort, safety, and sterilizability were most important criteria
- Slanted design scored highest in design matrix
- All three designs were used for initial survey-based testing

Criteria	Horizontal Grip		Elevated Horizontal Grip		Slanted Grip	
	3/5	21	4/5	28	5/5	35
Comfort (35)	3/5	21	4/5	28	5/5	35
Safety (25)	5/5	25	5/5	25	4/5	20
Sterilizability (20)	5/5	20	5/5	20	5/5	20
Manufacturability (10)	5/5	10	3/5	6	4/5	8
Cost (5)	5/5	5	3/5	3	4/5	4
Aesthetic (5)	5/5	5	5/5	5	4/5	4
Total	86		87		91	

- Through survey results and feedback from prolotherapists at the Hacket Hemwall Patterson Prolotherapy conference, the slanted design was selected to test further

Testing

- Fatigue testing involved assessing grip strength before and after injecting three syringes as quickly as possible



Figure 3. Grip used to assess fatigue with dynamometer

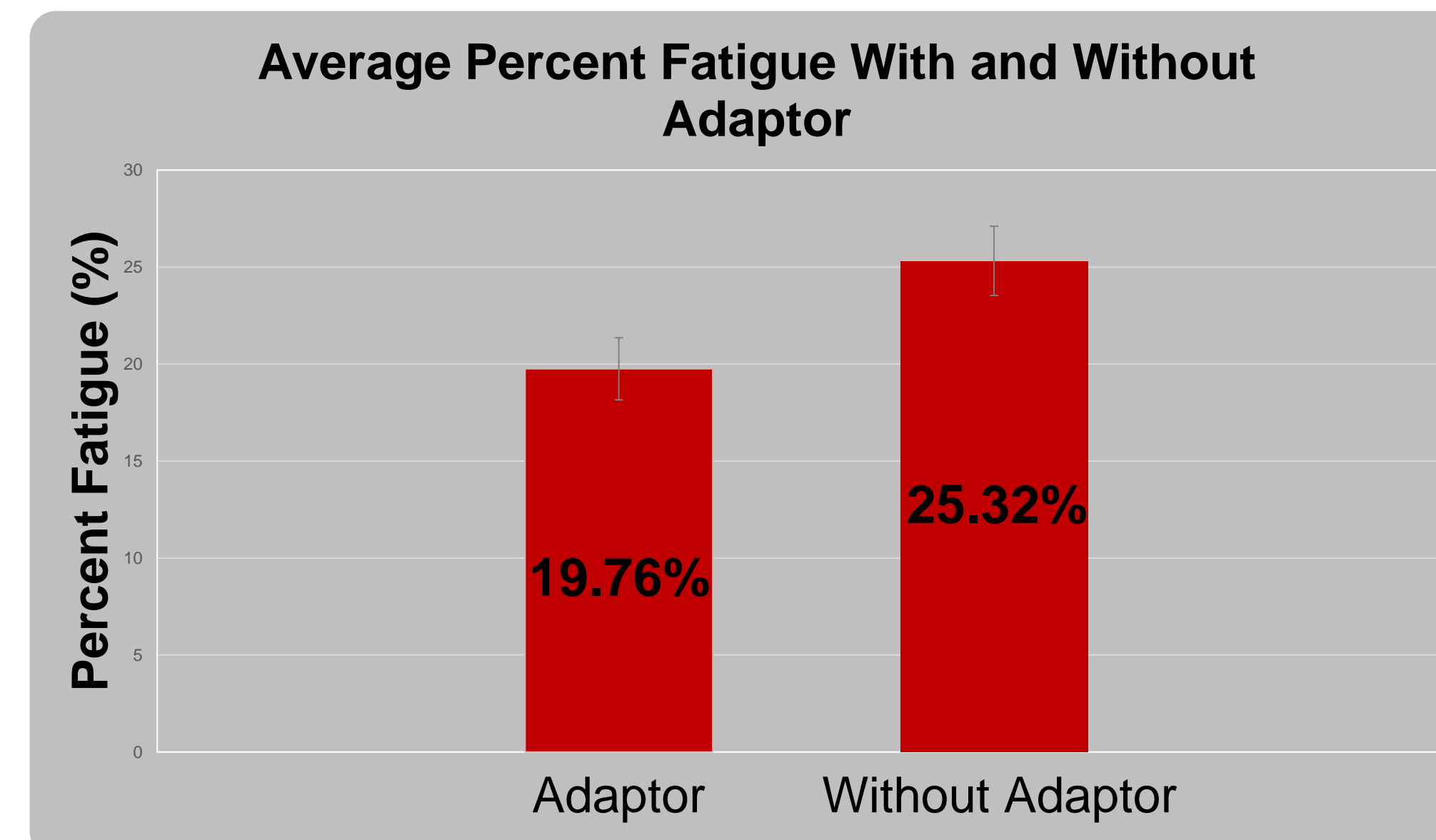


Figure 4. Average percent fatigue was determined for two groups, one with the adaptor during injections and the other without the adaptor. A significant difference between these two groups was found (p=0.034)

- The team conducted a survey of prolotherapists during a service trip to Honduras in March 2017
- Adaptors were sent with varying angles of 25°, 30°, and 35°
- Demographic data was obtained and four categories were used to assess functionality of the adaptors
- Results indicated that:
 - the angle of the adaptor did not affect physicians' ratings in any of the functionality categories
 - those who reported experiencing pain in their career rated the adaptors higher than those who had not reported pain

Discussion

- 70% of people surveyed preferred using the adaptor over using the bare syringe without an adaptor
- Fatigue testing showed a 5.5% decrease in fatigue for the group that used the adaptor (p=0.034)
- Testing results have guided subsequent adaptor design
 - Injection simulation testing was conducted to determine a maximum manual injection force of 40 N on the plunger
 - Using maximum force data and finite element analysis, multiple materials were capable of withstanding necessary strain, stress, displacement, and overall factor of safety
 - Structure optimization was performed by incorporating ribs with hollow wings to achieve the desired functional strength with minimum material volume

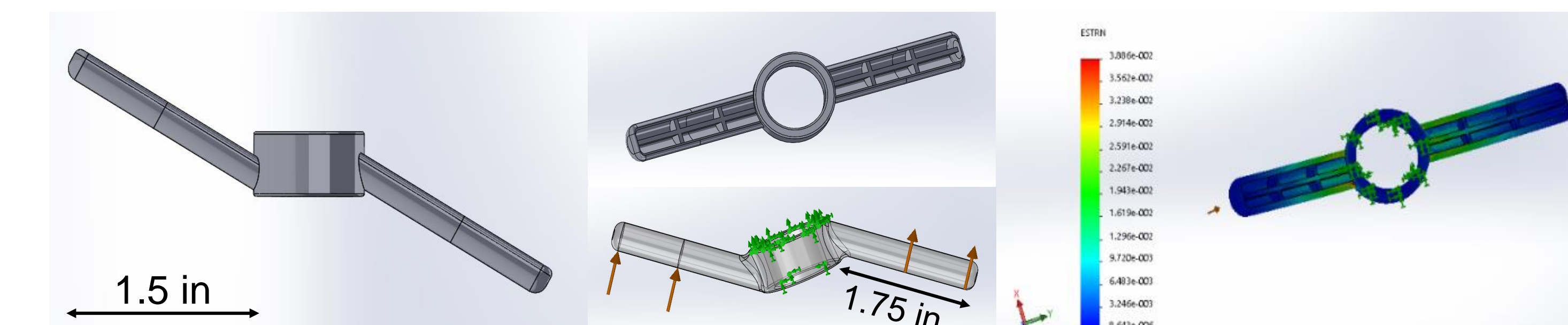


Figure 5. CAD model and finite element analysis of disposable adaptor

Future Work

- The team is working with Law and Entrepreneurship Clinic to file a provisional patent, granting the team protection for one year
- The team is finalizing the adaptor design and material while reaching out to injection molding companies
- The team will eventually sell the adaptor as both a disposable and non-disposable product

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