



Digital Traction With Japanese Finger Sleeve



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Client **Pape Samb, Prof. Mohamed Soumah**

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Overview

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Client Description

- Mr. Pape Samb
 - Founder/executive of Jamarek
 - Sun Prairie Media Center
- Dr. Mohamed Soumah
 - Physician in Senegalese hospital
 - Expert in hand and wrist surgeries



Figure 1: Mr. Pape Samb



Figure 2: Dr. Mohamed Soumah

Background

- Finger-traction system needed for many procedures
- Two parts to the traction device: base and sleeve
- Needs stable traction and load
- Hand injuries cover significant percentage (30.1%) of workplace-related injuries (WRIs) in Dakar, Senegal [1]



Figure 3: Image of wrist arthroscopy surgery [2]

Problem Statement

Project Description: *develop a locally sourced, versatile traction system*

- Problem #1: No easily accessible traction device in client's hospital in Senegal
- Problem #2: Lack of a modern, reusable tool for traction in medical procedures



Figure 4: Image of traction device in surgery [3]

Competing Designs



Figure 5: Handmade Wrist Traction Tower



Figure 7: Digi Grip

Handmade Wrist Traction Tower [4]

- Standard Ilizarov Apparatus - common medical frame used stabilize/hold bones during treatment
- Hand support tool from surgical table system
 - Wrapped around fingers

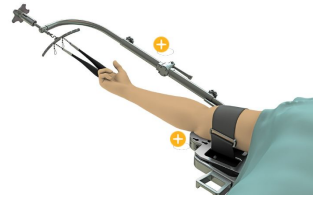


Figure 6: Arc Wrist Tower

Arc Wrist Tower [5]

- Supports the arm while also applying traction
- Used vertically or horizontally
 - Accommodates different surgical approaches
- Adjustable wrist joint
- Can rotate 180 degrees



Figure 8: Wrist Traction Tower

Digi Grip [6]

- Finger Sleeves attached to chains
- Attached to IV pole
- Restraint for bicep to hold arm into positions

Wrist Traction Tower [7]

- Metal structure mounted to table
- Finger attachments where tension can be adjusted
- Hand positioner mounted to allow for wrist movement/mobility

Previous Work

- **Fall 2025**
 - Mechanical stand based on an IV pole consisting of a mounting plate
 - Hand hangs from the top of the stand
 - Attachment points and bead chains
 - Adjustable Finger Sleeves with velcro
 - Ballistic nylon straps

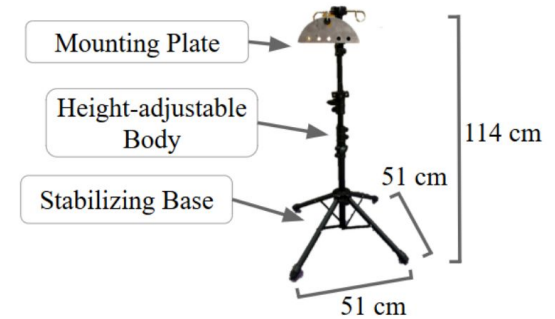


Figure 9: Mechanical Stand

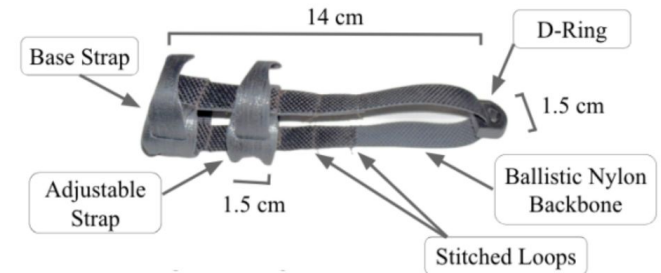


Figure 10: Finger Sleeves

Product Design Specifications

- Support elbow at 90-180 degrees for 50 min procedures
- Allow wrist rotate 180 degrees
- Pull traction at 10% patient's body weight
- Reusable design that can withstand 50 sterilization cycles
- Robust base that's stable and easy to transport



Figure 11: Finger traction device applied during casting procedure [8]

Base Preliminary Designs

Design 1: Wheel or Clamp Base

- Ball and socket joint
- Clamp onto procedure table or mobile base
- Traction device attaches to main rod

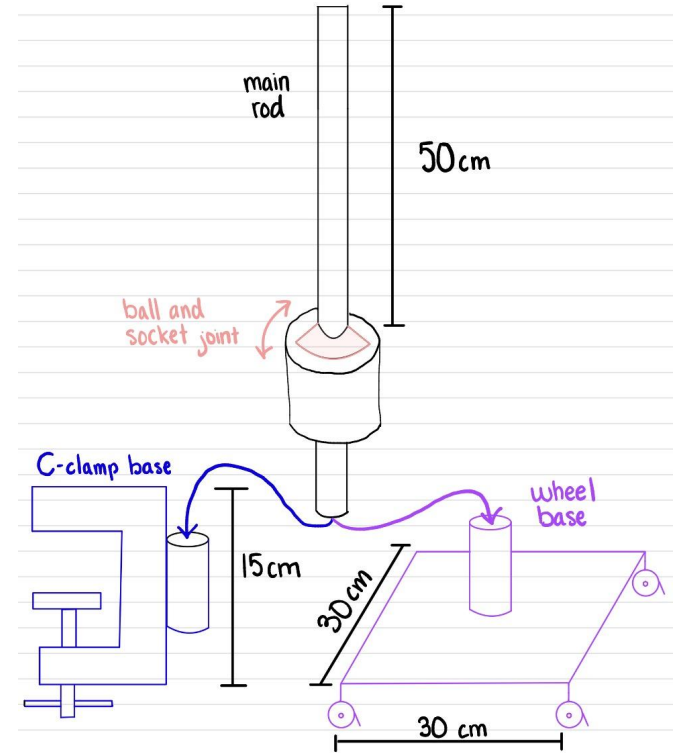


Figure 12: Drawing of the Wheel or Clamp Base design

Base Preliminary Designs

Design 2: Table Attachment

- Clamps onto procedure table via screw in system
- Traction device inserted in top opening

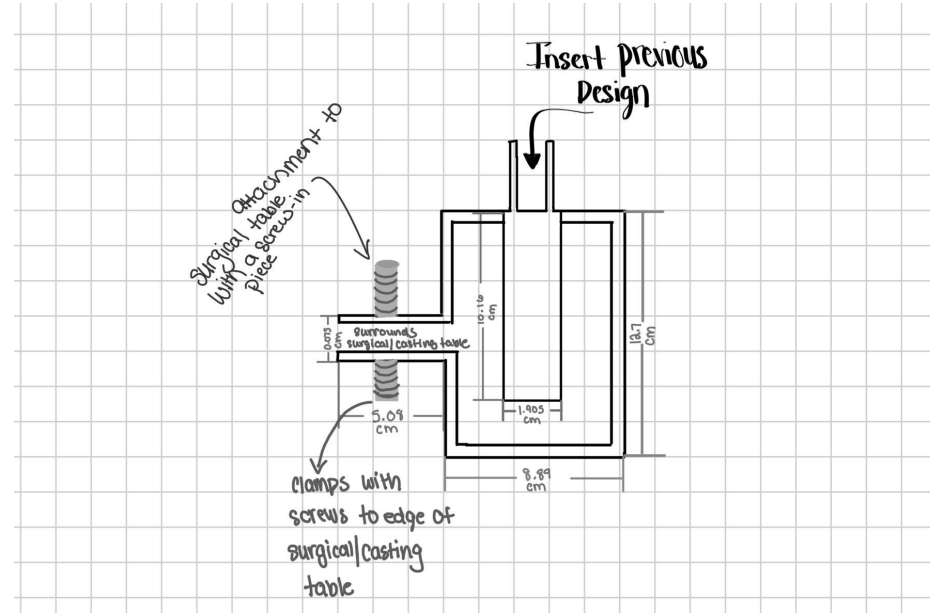


Figure 13: Drawing of Table Attachment base design

Base Preliminary Designs

Design 3: C-bar

- Adjustable vertical height
- Adjustable top support
- Bottom support sits underneath procedure table
- Traction device attaches to top support

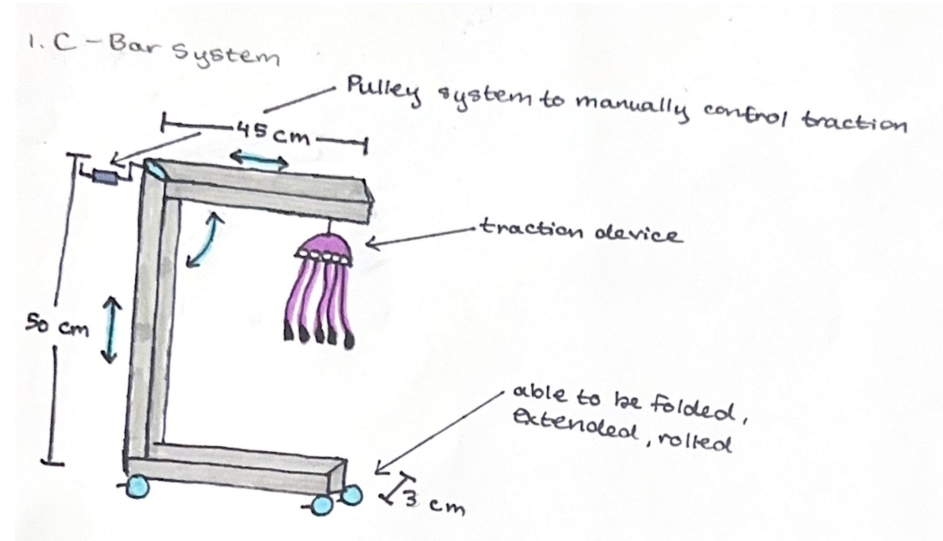


Figure 14: Drawing of C-bar base design

Base Preliminary Design Matrix

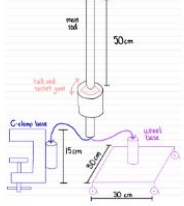
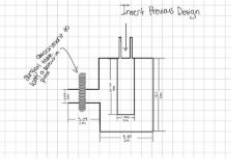
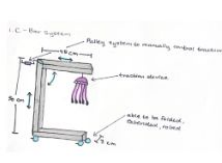
Base Design	#1 - Wheel or Clamp Base		#2 - Table Attachment		#3 - C-bar	
						
Criteria (Weight)	Score (Out of five)	Weight	Score (Out of five)	Weight	Score (Out of five)	Weight
Safety (25)	3	15	4	20	4	20
Ease of Fabrication (20)	2	8	4	16	5	20
Mobility (15)	5	15	3	9	4	12
Ease of Use (15)	3	9	4	12	5	15
Cost (15)	2	6	5	15	4	12
Footprint (10)	4	8	5	10	3	6
Total (100)	61		82		85	

Table 1: Base Prototype Design Matrix

Traction Preliminary Designs

Design 1: Guillotine Pulley Design

- Uses a crankshaft pulley with a locking mechanism to apply traction
- Traction is applied through a finger mounting plate

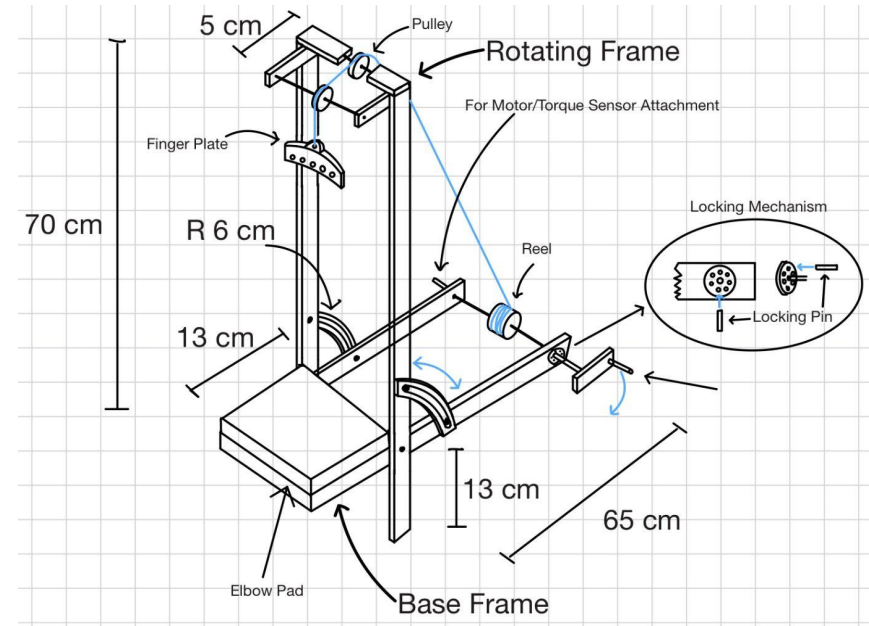


Figure 15: Drawing of the Guillotine Pulley design

Traction Preliminary Designs

Design 2: Tripod Design

- Uses a crankshaft pulley system to apply traction
- Traction is maintained using up to five different pulley finger sleeves

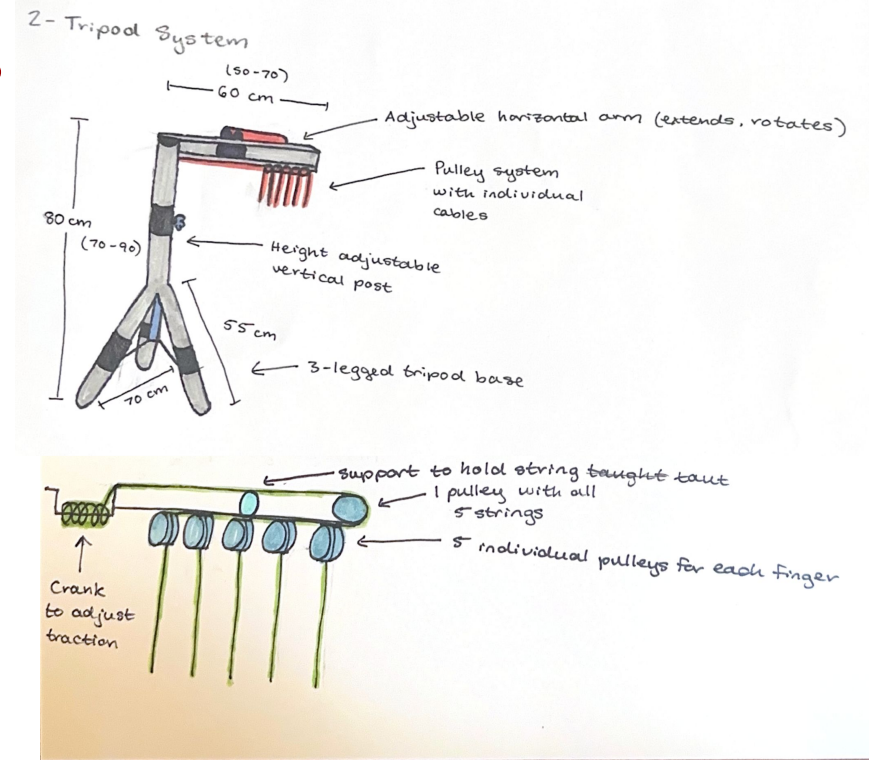


Figure 16: Drawing of the Tripod design

Traction Preliminary Designs

Design 3: Pin-Locking Design

- Uses a Gym-Weight machine style mechanism to apply traction force
- Traction is applied through a finger mounting plate

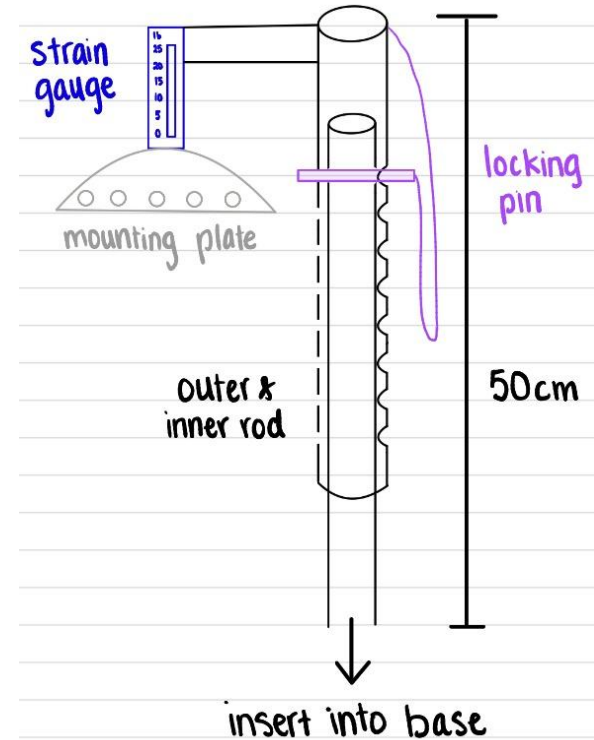


Figure 17: Drawing of the Pin-Locking design

Traction Preliminary Design Matrix

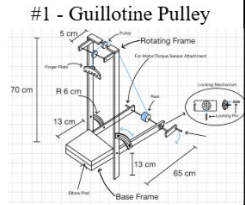
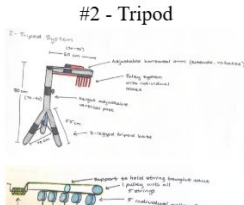
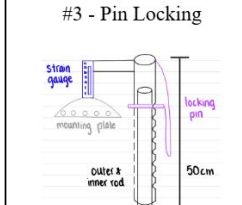
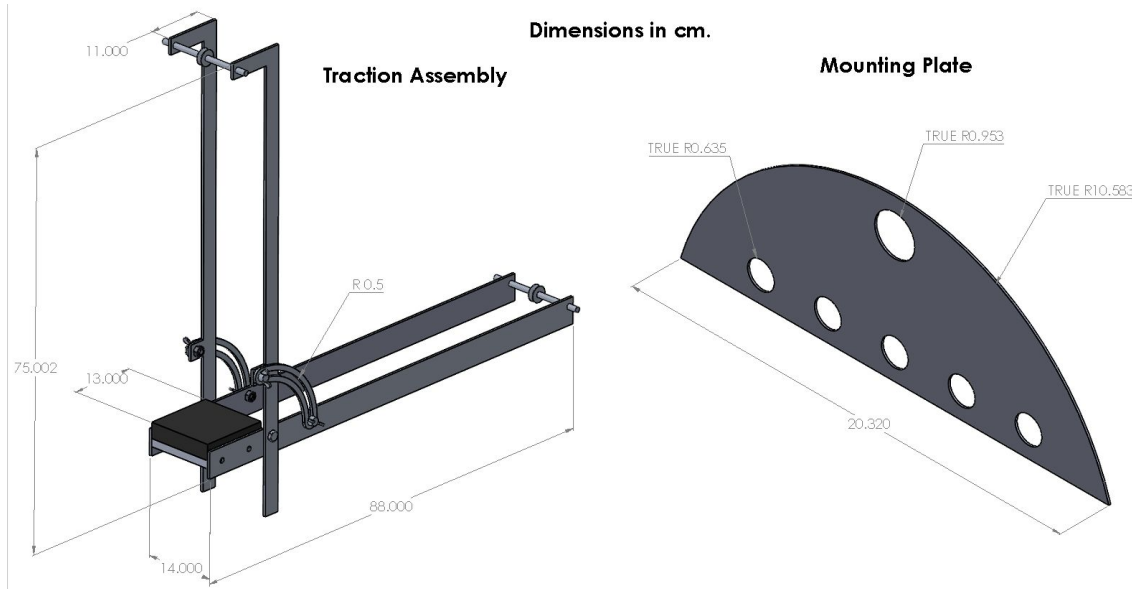
Traction Design	#1 - Guillotine Pulley		#2 - Tripod		#3 - Pin Locking	
						
Criteria (Weight)	Score (Out of five)	Weight	Score (Out of five)	Weight	Score (Out of five)	Weight
Safety (30)	5	30	4	24	3	18
Ease of Fabrication (25)	4	20	2	10	5	25
Ease of Use (15)	4	12	3	9	3	9
Cost (15)	3	9	3	9	5	15
Flexibility/Mobility (15)	5	15	2	6	2	6
Comfort (5)	5	5	3	3	3	3
Total (100)	91		61		76	

Table 2: Traction Prototype Design Matrix

Final Design



Materials:

- Aluminum Sheet Metal
- Bolts and Nuts
- Screws

Figure 18: Final Preliminary Traction Design and Hand Plate Design

Final Design

Dimensions are in cm.

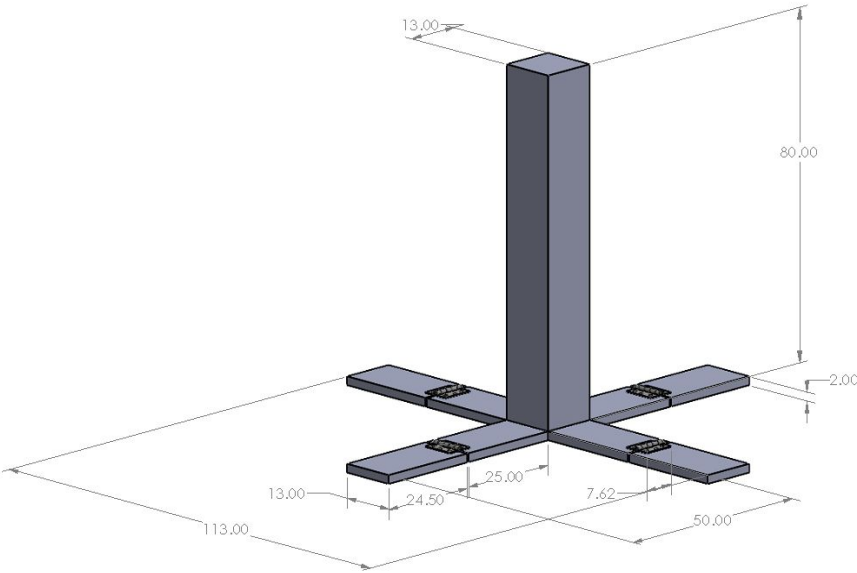


Figure 19: Final Preliminary Base Design

Materials:

- Aluminum Sheet Metal
- Aluminum Tubing
- Hinges
- Bolts and nuts
- Screws

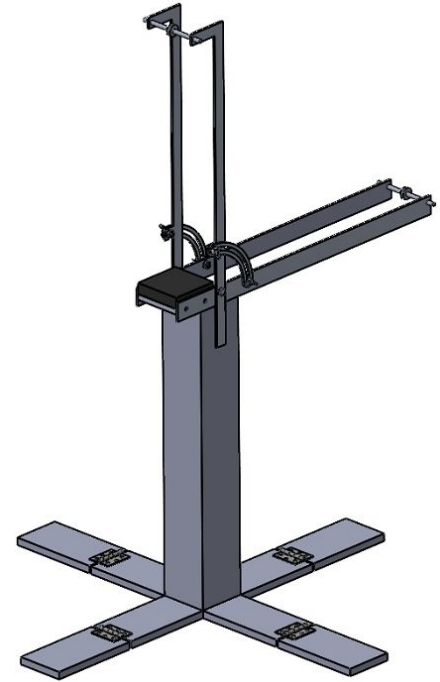


Figure 20: Final Preliminary Design

Next Steps

Fabrication and Prototyping

- Methods:
 - Shop Tools
 - Water Jet
- Materials:
 - No Ferromagnetic Materials
 - Aluminum

Testing

- Mechanical Integrity
 - Withstand 1.25x max load
- Traction Accuracy
 - Tension Gauge
- Physiological Safety
 - Capillary Refill
- Comfort/Usability
 - Surveys

Acknowledgements

Advisor

Prof. Randolph Ashton

Client

Mr. Pape Samb

Prof. Mohamed Soumah



References

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Questions?

