Preliminary Presentation

# Digital Traction Device with Japanese Finger Traps

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Client: Mr. Pape Samb

Advisor: Prof. Justin Williams

# Background Material

- Traction systems needed for many procedures
- Two parts of the design included
- Stable traction and static load
- Hand injuries have a substantial share of workplace injuries in Dakar, Senegal (~30%) [1]

Figure 1: Wrist Arthroscopy Procedure [2] https://www.aptivahealth.com/wrist-surgery

# Problem Statement

**Client:** Mr. Pape Samb and Dr. Mohamed Soumah

**Problem #1:** No existing traction device available in clients hospital

**Problem #2:** Lack of a modern, reusable tool for digital traction

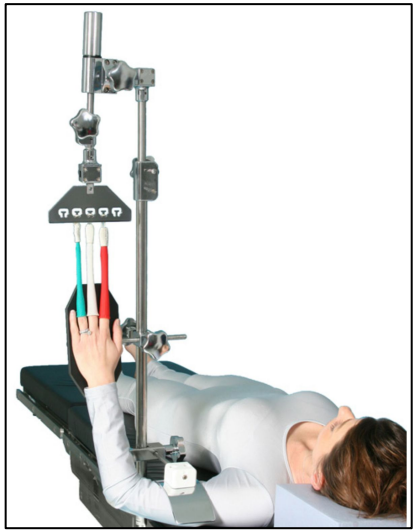


Figure 2: Wrist Traction Tower [3] https://www.swmedsource.com/traction_finger_traps.htm

**Goal:**

Develop a locally manufacturable, adaptable traction system

Sam

# Competing Designs

- **Reison** [4]
  - Stable and adjustable
  - Static and heavy
- **Chinese Finger Traps** [5]
  - Simple, gravity-based
  - Not readily available
- **Handmade Traction Tower** [6]
  - Adjustable rods
  - Large and metal
  - Foam-padding

Figure 3: Reison Hand traction [4]
https://reison.se/product/hand-fixation/

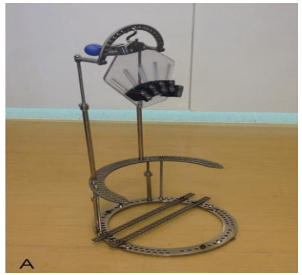


Figure 5: Hook-and-Trumpf [6]
https://pmc.ncbi.nlm.nih.gov/articles/PMC4098593/

Figure 4: Chinese finger traps [5]
https://pmc.ncbi.nlm.nih.gov/artaicles/PMC4098593/

Maria

# Product Design Specifications

- Stabilize hand and wrist position
- Support patient's hand for **50 minute** procedures
- Avoid excessive finger compression
- Support **22–44 N** per finger for **500** cases
- Contain adjustable sleeve sizes
- Allow for sterilizability through **100,000** load cycles

Figure 6:
Commonly-used finger sleeve and traction [7]
https://pmc.ncbi.nlm.nih.gov/articles/PMC4098593/

Maria

# Method 1: Standing Platform

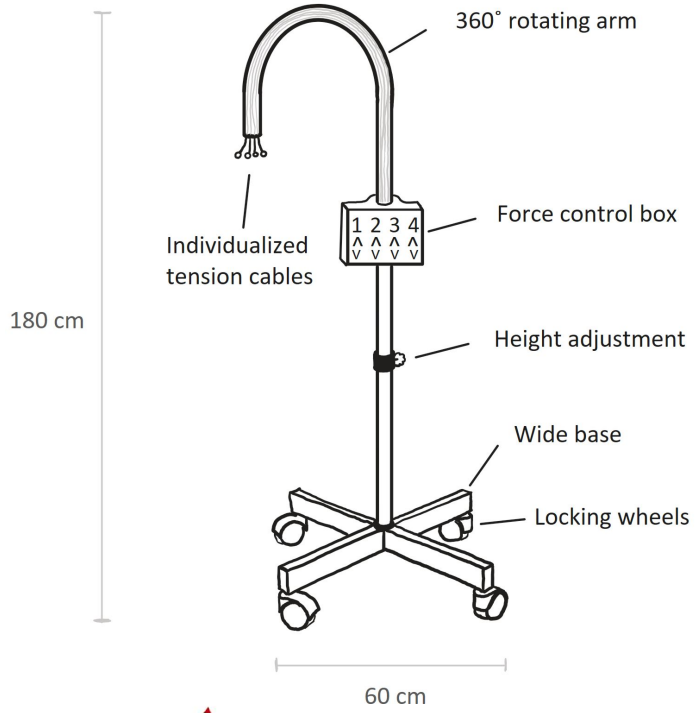



Figure 7: Standing Platform Design

**Advantages**

- High mobility and adaptability
- Individualized traction control
- Potential digital integration

**Disadvantages**

- Higher cost of production
- Large physical footprint
- Stability concerns

# Method 2: Bed Clamp & Restraint

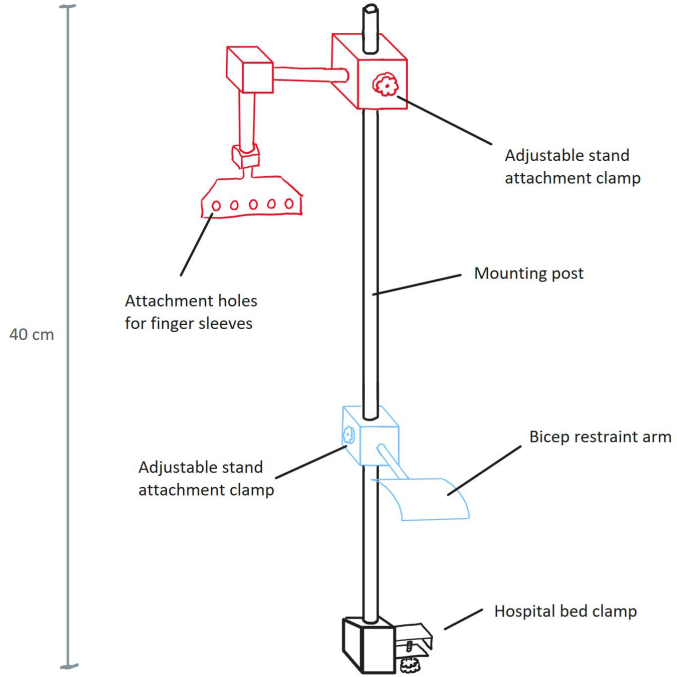



Figure 8: Bed Clamp & Restraint Design

## Advantages

- Bed-mounted stability
- Slim profile
- Comfort and support

## Disadvantages

- Restricted mobility
- Increased setup time

# Method 3: Extension Brace

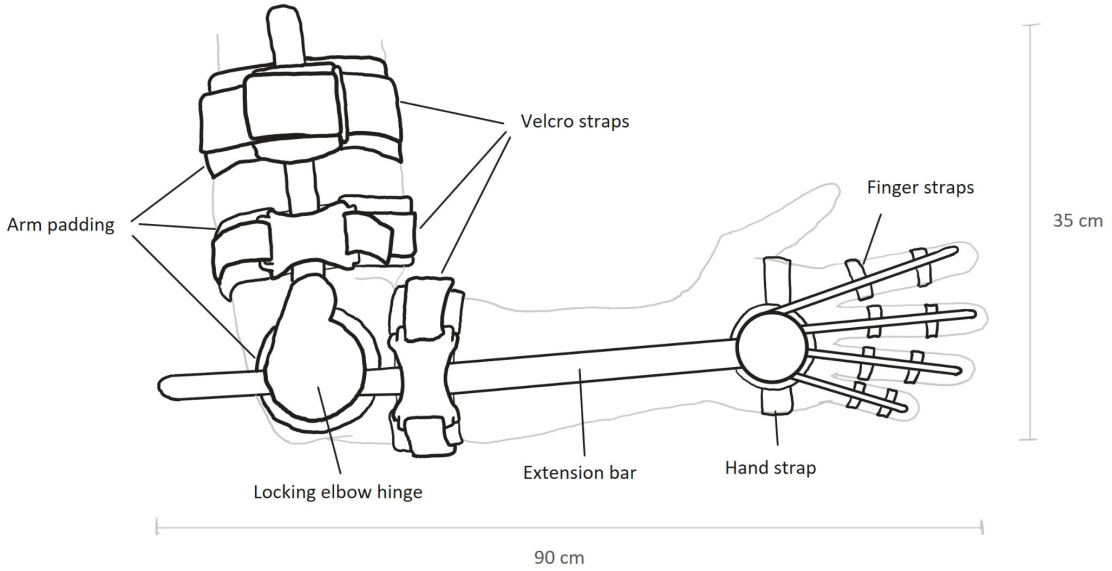



Figure 9: Extension Brace Design

## Advantages

- Enhanced patient comfort
- Reduced joint strain
- Compact system

## Disadvantages

- Procedural adaptations required
- Restricted accessibility
- Difficult sterilization

# Design Matrix: Mechanical

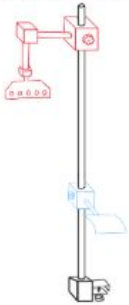
| Design Criteria | Standing Platform  | | Bed Clamp & Restraint  | | Extension Brace  | |
|---|---|---|---|---|---|---|
| Ease of use (25) | 4/5 | 20 | 5/5 | 25 | 3/5 | 15 |
| Cost (20) | 4/5 | 16 | 5/5 | 20 | 2/5 | 8 |
| Reusability (15) | 4/5 | 12 | 5/5 | 15 | 2/5 | 8 |
| Safety (15) | 3/5 | 9 | 4/5 | 12 | 5/5 | 15 |
| Ease of Fabrication (15) | 4/5 | 12 | 5/5 | 15 | 2/5 | 6 |
| Versatility (10) | 4/5 | 8 | 3/5 | 6 | 2/5 | 4 |
| Total (100) | 77/100 | | 93/100 | | 56/100 | |

Figure 10: Mechanical Design Matrix

# Method 1: Nylon Sleeve

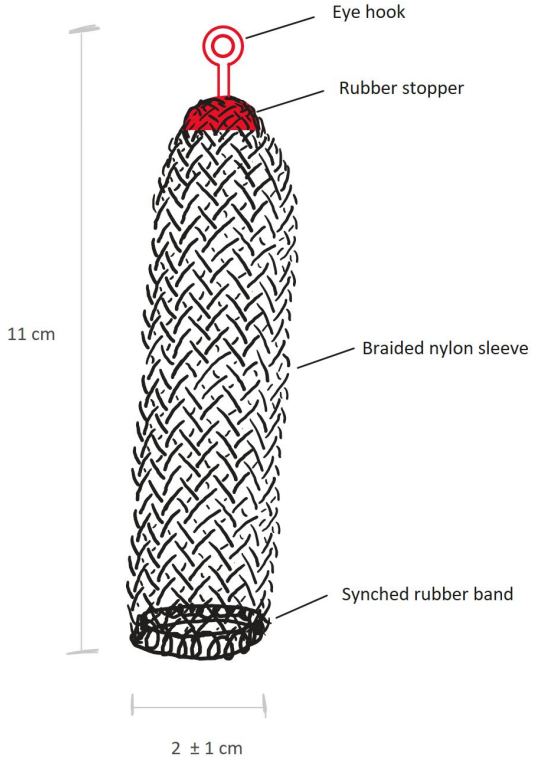



Figure 11: Nylon Sleeve Design

**Advantages**

- Ease of application to finger
- High client familiarity

**Disadvantage**

- Difficult to fabricate
- Requires multiple sizes
- High material cost ~ $50 [8]

Ben

# Method 2: Hand Brace

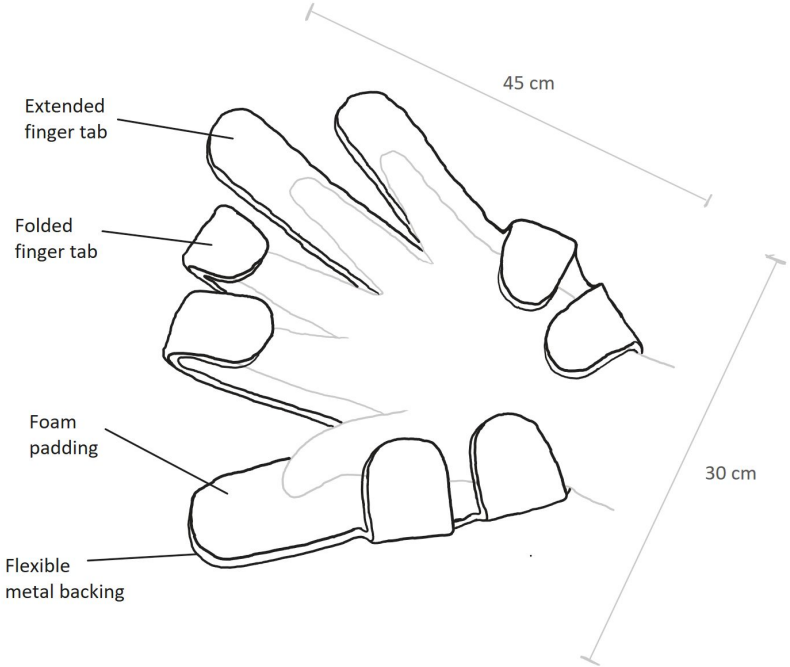



Figure 13: Hand Brace Design

**Advantages**

- Complete hand immobilization
- Sterilizability for reuse
- Similar to current product

**Disadvantages**

- No direct finger attachment
- Incompatible for certain surgeries

Ben

# Method 3: Buckle and Strap

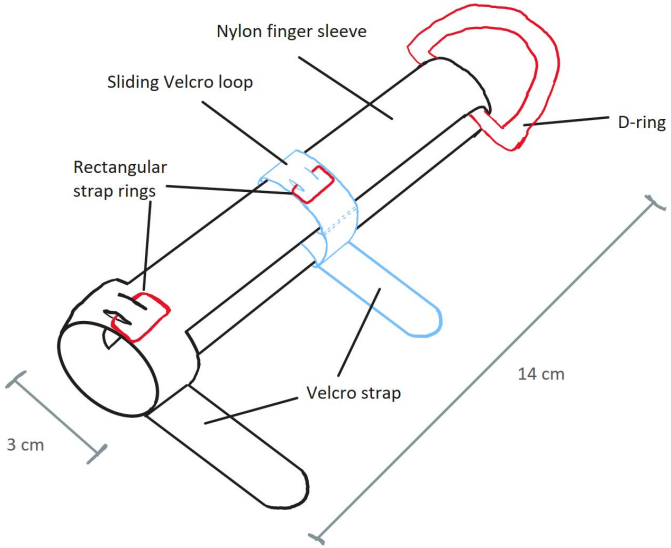



Figure 12: Buckle and Strap Design

**Advantages**

- One size fits all
- Highest adjustability
- Straight-forward fabrication

**Disadvantages**

- Inefficient finger straps
- Low client familiarity

# Design Matrix: Finger Sleeve

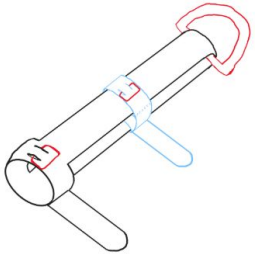
| Design Criteria | Nylon Sleeve  | | Buckle and Strap  | | Hand Brace  | |
|---|---|---|---|---|---|---|
| Safety (25) | 5/5 | 25 | 4/5 | 20 | 2/5 | 10 |
| Ease of Fabrication (20) | 2/5 | 8 | 5/5 | 20 | 4/5 | 16 |
| Cost (20) | 3/5 | 12 | 5/5 | 20 | 2/5 | 8 |
| Ease of Use (15) | 5/5 | 15 | 4/5 | 12 | 3/5 | 9 |
| Comfort (10) | 4/5 | 8 | 3/5 | 6 | 5/5 | 10 |
| Reusability (10) | 2/5 | 4 | 4/5 | 8 | 2/5 | 4 |
| Total (100) | 72/100 | | 86/100 | | 57/100 | |

Figure 14: Finger Sleeve Design Matrix

# Future Work

- Material Choice
  - Cost
  - Available options
  - Reusability
- Construction
  - Mechanical Portion
  - Sleeve Portion
  - Combination
- Testing
  - Force Range
  - Slippage

# Acknowledgements


- BME Department
- Mr. Samb
- Dr. Justin Williams

# References


[1] S. A. Dia *et al.*, “Caractéristiques des accidents du travail et devenir des victimes: à propos de 133 cas déclarés auprès de la Caisse de Sécurité Sociale de Dakar (Sénégal),” *Pan Afr Med J*, vol. 30, p. 156, June 2018, doi: 10.11604/pamj.2018.30.156.10517.

[2] “Wrist Arthroscopy,” Aptiva Health. Accessed: Oct. 02, 2025. [Online]. Available: https://www.aptivahealth.com/wrist-surgery

[3] “Surgical Finger Traps | Non-Sterile Finger Traps | SW Med-Source.” Accessed: Oct. 02, 2025. [Online]. Available: https://www.swmedsource.com/traction_finger_traps.htm

[4] “Hand Fixation» Reison Medical®,” Reison Medical, Apr. 08, 2025. https://reison.se/product/hand-fixation/ (accessed Sep. 30, 2025).

[5] K. Akhtar, D. Akhtar, and J. Simmons, “A readily available alternative to Chinese finger traps for fracture reduction,” Royal College of Surgeons of England, https://publishing.rcseng.ac.uk/doi/full/10.1308/rcsann.2013.95.2.159 (accessed Sep. 9, 2025).

[6] A. Zolotov, “Handmade Traction Wrist Tower,” *J Wrist Surg*, vol. 7, no. 5, pp. 441–444, Nov. 2018, doi: 10.1055/s-0038-1649504.

[7] BSUH Hand Service, “How to Reduce and Hold a Distal Radius Fracture Using Finger Traps,” *YouTube*, Mar. 23, 2019. https://www.youtube.com/watch?v=9QFZzajwiqI (accessed Sep. 30, 2025)

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[8] “Techflex® nylon multifilament braided cable sleeving,” Cabletiesandmore.com - Cable Management At The Lowest Prices, https://www.cabletiesandmore.com/nylon-multifilament-braided-sleeving?pid=3908&gad_source=1&gad_campaignid=1768785984&gbraid=0AAAADfXKhiIiBkRM33RoUz23C4rniWS2&gclid=CjwKCAjwxfjGBhAUEiwAKWPwDlY5OgPutgXrGCwy5KC4Gujc5Cwht_ZyNzBlLTJewyJrX4zlUwLyORoCLCsQAvD_BwE (accessed Oct. 2, 2025).

# Thank You! Questions?

- Title slide
- Overview of the presentation - do not present the outline (per BSAC 2017)
- Problem statement - initial problem as given by the client and some indication of how the problem statement was changed (not a long paragraph)
- Introduction - client description, background material - include relevant prior work, competing designs and other materials as needed
- Summary product design specification - PDS (quantitative list of client requested functions)
- Design alternatives considered (advantages and disadvantages related to PDS)
- Design matrix 1
- Design matrix 2
- Final design
- Future work - what pitfalls are expected through the design process
- References and acknowledgements (no QR codes)