“Super Splint” – Dynamic splint for pediatric distal radius fractures

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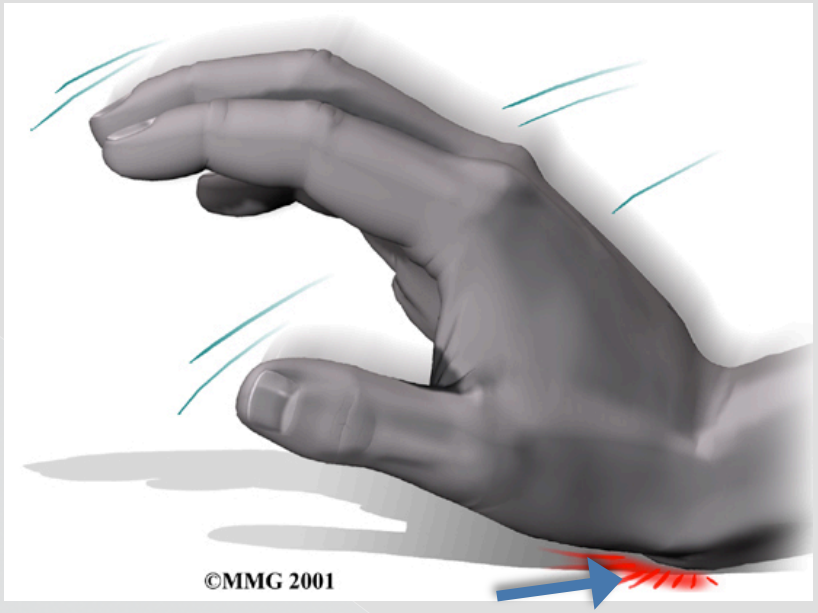
UW BME Design

Overview

- Background: Wrist Fractures
- Current Methods
- Motivation: Casts vs. Splints
- Problem Statement
- Design Requirements
- Alternative Designs
- Design Matrix
- Final Design
- Future Work

Wrist Fractures

- Wrist fractures account for 40% of all pediatric fractures
- Most common treatment of fractures: Casts
  - Bones are reduced to correct deformity
  - 4-12 weeks depending on fracture
  - Complications arise if cast is not applied correctly



Point of contact

Figure 1: Wrist fracture as a result of a fall.

Current Methods

- Casts
  - Fiberglass
  - Plaster
- Splints
  - Non-displaced fractures
- Aircast StabilAir Wrist Orthosis
  - Adjustable air bladders

Figure 2: Aircast StabilAir Wrist Orthosis in use on patient.

Motivation: Casts vs. Splints

Casts	Splints
No difference in healing and pain	
Relies on technique of doctor	Reduces the need for follow up visits
Risk of reduction loss if poor fit	Less inhibiting on lifestyle
~$300-400	~$30
Cast saw can frighten and burn children	Current splints don't offer 3 point stabilization

Problem Statement

- If a splint existed with an adjustable pressurized lining that can be applied accurately and easily by the doctor, then patients could receive the needed pressure for proper healing without the inconvenience of a cast.

Figure 3: Casts need to have covers while bathing and swimming.

Figure 4: Casts need to be removed with cast saws.

Design Requirements

- Pediatric use
- Maintain reduction
- Easy to implement
- Dynamic and controllable pressure lining
  - Three point loading
- Radiolucent materials
- Non-irritating lining

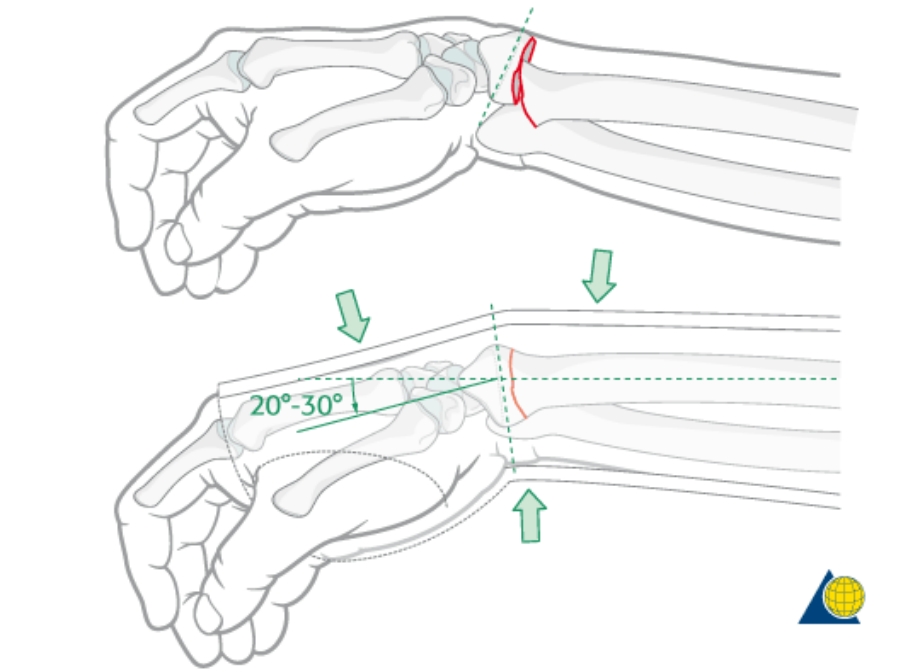


Figure 5: The three loading point locations are shown in relation to the break.

Alternative Designs: Velcro Straps

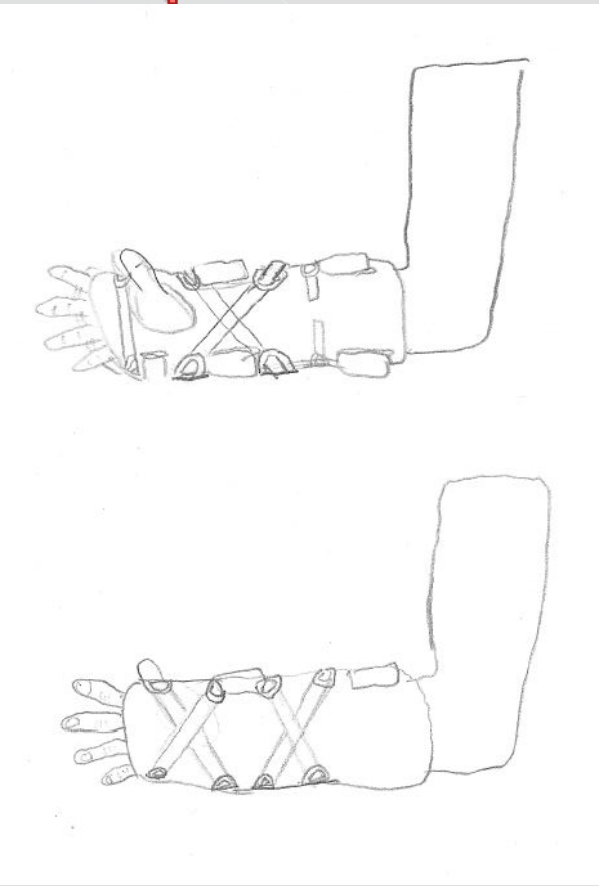


Figure 6: Velcro straps can be adjusted during healing.

- Use additional overlapping crisscross to secure reduction
- Easy to use
- Easy to adjust
- Shear force
- Not a precise pressure

Alternative Designs: Football Helmet Pads

- Individual inflation parts
- Hard covering for protection
- Pads disperse pressure over an area
- Around $30 each
- Variable sizes and types

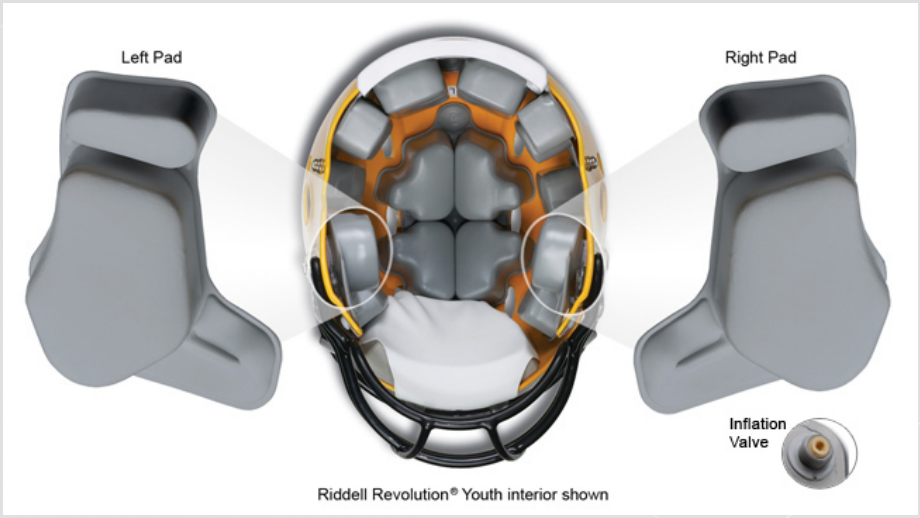


Figure 7: Exterior (Top) and interior (Bottom) of a football helmet. The interior pads are inflatable and provide support.

Alternative Designs: Thermoplastics

- Becomes moldable at certain temperatures
- Can be molded to produce desired pressure
- Most can be remolded to change pressures
- ~$80 per sheet
  - Multiple splints per sheet ~3

Figure 8: A simple thermoplastic splint.

Design Matrix

Category (Points)	Velcro Straps	Football Pads	Thermoplastic
Maintains Reduction and Pressure (30)	20	27	25
Easy to Application (20)	17	20	5
Protection/Stability (20)	10	15	20
Ability to Change Pressure(15)	8	12	5
Biocompatible/ hypoallergenic(10)	10	10	10
Price (5)	5	3	1
Total (out of 100)	70	87	66

Final Design

- 3 individual inflation parts
- 3 pressure points
- Conforms to arm
- Guard under palm to prevent full flexion/extension

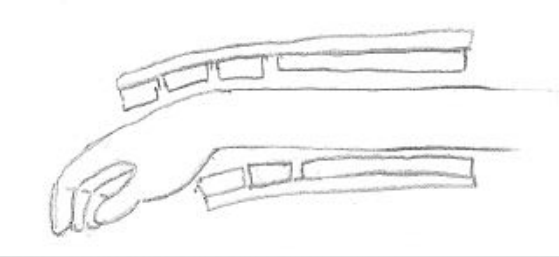


Figure 9: Smaller individual bladders will be near the fracture to allow three point pressure.

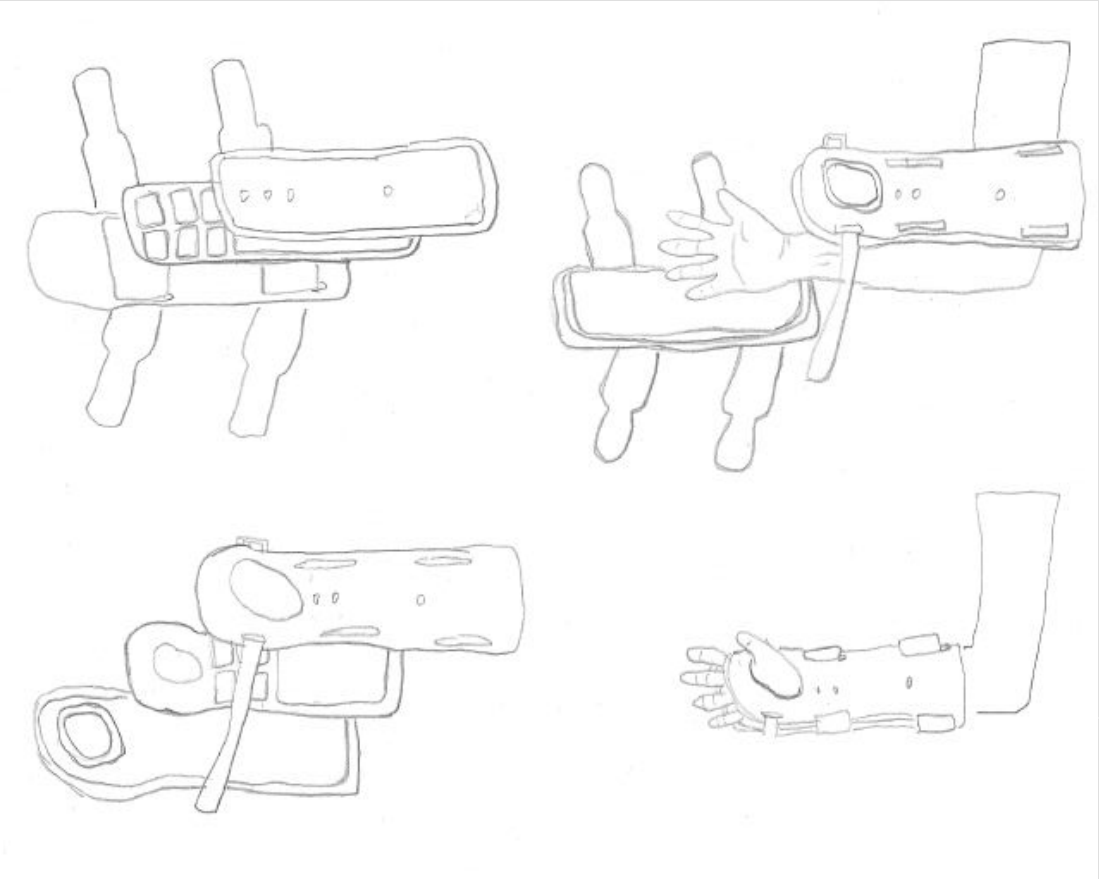


Figure 10: The splint will have three layers: a lining, the air bladders, & hard cover.

Future Works

Fall Semester

- Material Selection
- Test pressure of casts using sensors
- Fabrication of prototype

Spring Semester

- Test on saw bones
- Modifications to prototype

Figure11: A piezoelectric sensor will be used to detect the pressure applied to fractures.

Figure 12: Saw bones are artificial but have similar properties to bone.

Special Thanks to:

- Dr. Halanski
- Dr. Thompson

Sources

- Slide 1: Image from: www.pubmed.com
- Slide 3: Halanski, Matthew. "Pediatric Wrist Fractures Indications for Pinning" Presentation. Image from: www.concordortho.com
- Slide 4:Image from: http://www.betterbraces.com/aircast-stabilair-wrist-braceImage from: Hargrave, D.C., & Prais, E. "Fracture Brace." Patent No. 7,942,840 B2. 11 May 2011. "Care of Casts and Splints." April 2011. American Academy of Orthopaedic Surgeons. <http://orthoinfo.aaos.org>. Boyd, A.S., Benjamin, H.J., & Asplund, C. "Splints and Casts: Indications and Methods." Am Fam Physician. 2009;80(5):491- 499.
- Slide 5: Images from: www.whatsupfamilies.com & www.rehabmd.com
- Slide 6: Images from: www.hazomedequp.com & www.store.friddles.com
- Slide 7: Image from: www.summitmedicalgroup.com
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