

Hand Burn Rehabilitation Device

Progress Report

Group 17

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Changes to Need Statement

- Accommodate for the various wrist and hand dimensions
- Not hinder day-to-day activity
- Easily applied and removed
- Must not require the assistance of more than one additional person to administer
- Clear and easy enough for even children to understand

Changes to Project Scope

- Restore the pre-burn range of hand motion for second and third-degree hand burn victims
- Affordable and comfortable to wear for extended periods of time
- Easily accessible to rural population of Nepal,
- Patient compliance of at least 90% and at least 90% of users have their normal hand movement reestablished at the end of their recovery period.

Design Specs

Table 1: Design Specifications

Length of hand + wrist (1 st percentile)	19.57 cm ^[24]
Length of hand + wrist (99 th percentile)	27.1 cm ^[24]
Width of hand (1 st percentile)	7.0 cm ^[24]
Width of hand (99 th percentile)	10.0 cm ^[24]
Circumference of hand (1 st percentile)	16.5 cm ^[24] (adjustable)
Circumference of hand (99 th percentile)	23.75 cm ^[24] (adjustable)
Profile (length above and below wrist)	+/- 2 cm (avoid interference with tasks)
Stability	Static Progressive
Weight	<= 0.45 kg
Pressure applied to wrist and hand	20 mmHg – 30 mmHg ^[20]
Patient Compliance	High (90% target population compliance)
Lifespan	12 Months
Waterproofness	Yes (10 m) ^{[27][28]}
Breathability	Ret 6 to 13 ^[27]
Functional Temperature range	5 deg C to 45 deg C
Resistance to Shock/Drops	2 m
Budget	\$500
Post Supervision	Minimal
Risk Factors	No health risks/side effects
Components	Mechanical, non-electrical, non-digitized, on-computerized
Actual Cost per device	\$15

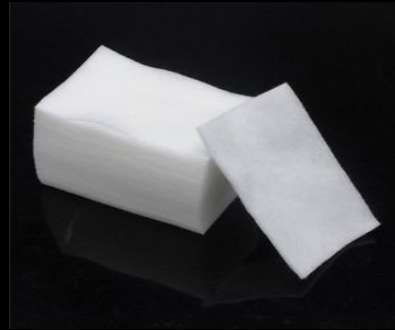
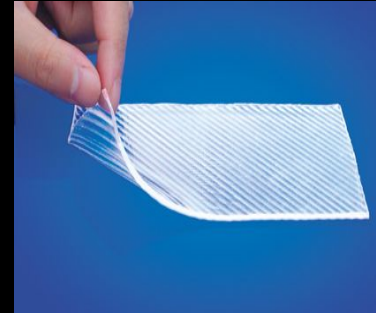
Design Parameter: 3 Categories

- Contact Media
- Hand Enclosure Device
- Materials

Contact Media

Contact Media

1. Hypafix
2. Silicone Gel
3. Elstofix
4. Mederma
5. Aloe Gel
6. Petrolatum Jelly
7. Cotton



Contact Media - Pugh Chart

Design Criteria	Weight (1-5)	Hypafix	Silicone Gel	Elastofix	Mederma	Aloe Gel	Petrolatum	Cotton
Cost	5	10	4	7*	2	5	8	9
Ease of Implementation	5	5	6	4	7	7	6	6
Safety	5	9	9	9	8	8	8	9
Frequency of Reapplication	3	8	4	5	4	4	4	9
Maintenance	2	8	5	5	5	5	5	9
Waterproofness	4	4	8	4	4	4	8	4
Breathability	3	6	8	6	9	9	8	5
Functional Temperature Range	4	9	6	6	6	6	7	10
Comfort	3	5	9	7	9	9	8	5
Effectiveness	5	5	6	7	8	7	6	3
Total weighted score		261	230	239	241	251	270	266
Verdict	-	POSSIBLE					BEST	POSSIBLE

Hand Enclosure Device

Elastic Glove

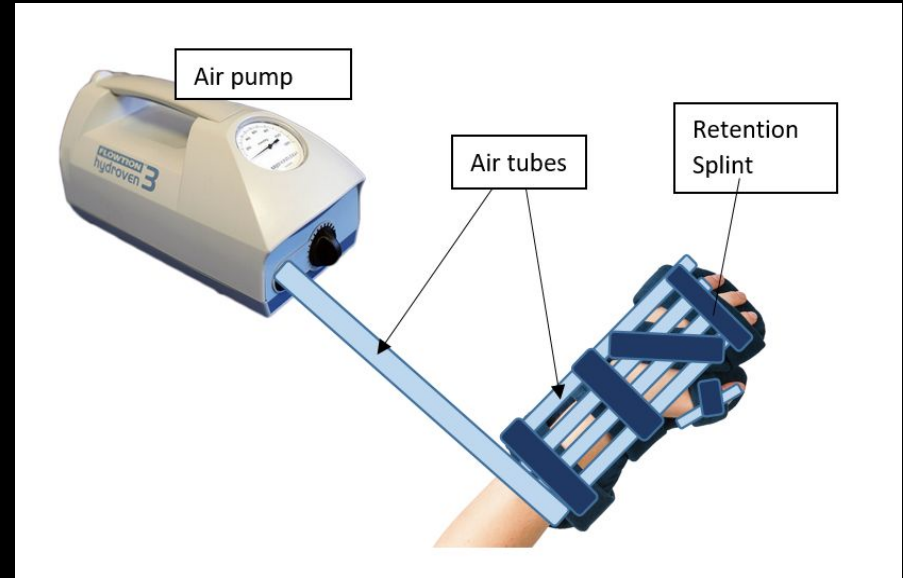
- Inspired by pressure garments with elastic fibers
- Desired Pressure Range
- Elastic adjustments using straps
- Advantage:
 - Fits Multitude of Cost
 - Low cost of Production
 - Minimal post supervision
- Disadvantage:
 - Discomfort in high temperature

Compression Splint

- Based on plaster of paris splint: using Neoprene
- Molding: Thermoplastic polymer sheet
- Additional Physical Therapy
- Advantage:
 - Preserves long term function
- Disadvantage:
 - Not Progressive Static
 - Non reuseable
 - Physical Therapy needed

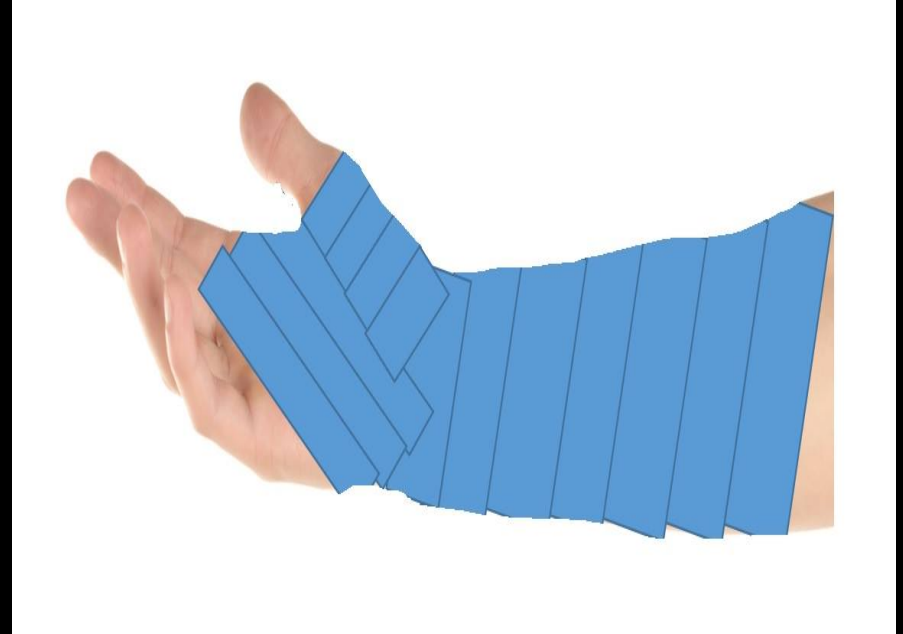
Compression Pump

- Based on Jobst Intermittent Compression Pump: Air pressure
- External Power Supply
- Hand Pump alternative
- Advantage
 - Easy and precise
 - Worn few hours daily
 - Edema reduction
- Disadvantage
 - External Power supply
 - Cost



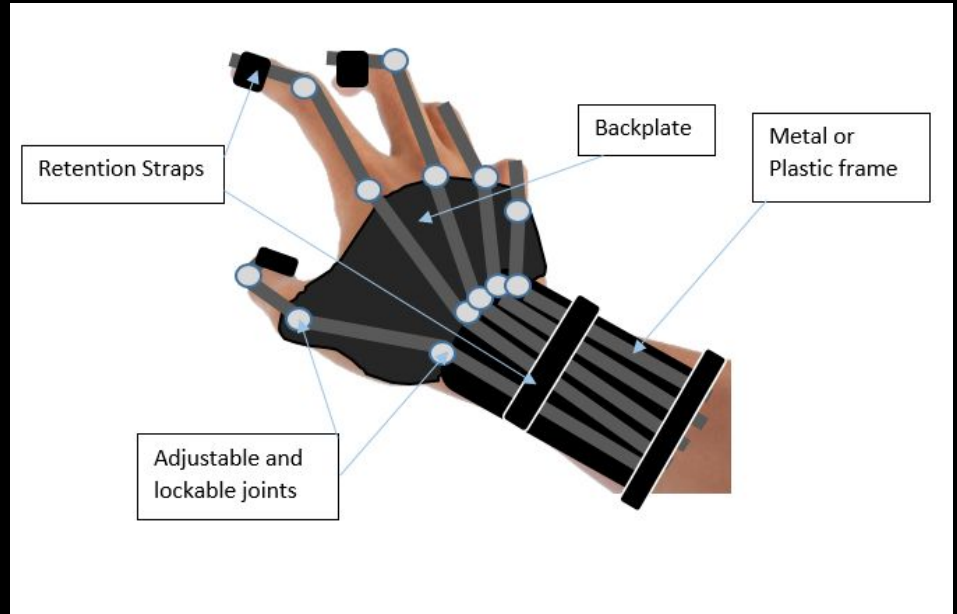
Elastic Wrap

- Based on Coban Wraps
- Elastic Property used for pressure
- Advantage:
 - Low cost
 - Ease of Production
 - Universal size
 - Simple
- Disadvantage:
 - Imprecise Pressure
 - Low lifespan: biweekly



Exoskeleton Splint

- Inspired by Exohand and Exoton Hand Device's
- Hand motion enhancement
- Our solution: mechanical aspect
- Hinges with lock or knob
- Advantage:
 - Progressive Static
 - Efficient alternative to therapy
 - Lifespan
- Disadvantage:
 - High Mechanical Complexity



Hand Enclosure Device - Pugh Chart

Design Criteria	Weight (1-5)	Elastic Glove	Compression Splint	Compression Pump	Elastic Wrap	Exoskeletal Splint
Ease of Implementation	3	7	6	4	10	3
Safety	5	5	7	9	5	8
Weight	4	10	8	3	10	6
Lifespan	4	4	6	9	4	8
Shock Resistance	3	10	6	3	10	7
Maintenance	3	9	7	8	9	5
Breathability	3	6	4	5	6	8
Comfort	4	6	5	6	4	5
Effectiveness	5	5	7	8	4	10
Total weighted score		225	215	217	222	235
Verdict	-	POSSIBLE				BEST

Material Choice

Material Choice

1. Thermoplastic Polymer Tape: Porous, highly elastic.
2. Aquafit NS: Thermoelastic polymer.
3. Spandex: Synthetic fiber with elasticity.
4. ABS: Used in 3D printing.
5. Metal

Material Choice - Pugh Chart 1

Design Criteria	Weight (1-5)	Thermoplastic	Aquafit NS	Spandex
Cost	5	1	4	9
Ease of Implementation	5	8	7	6
Safety	5	8	8	8
Weight	4	9	9	10
Lifespan	4	5	5	5
Waterproofness	4	7	7	8
Biocompatibility	5	7	7	9
Functional Temperature Range	3	5	4	6
Resistance to Shock/Drops	3	8	8	10
Breathability	4	7	7	9
Comfort	2	7	7	9
Total weighted score		285	292	354
Verdict	-			BEST

Material Choice - Pugh Chart 2

Design Criteria	Weight (1-5)	ABS	Metal
Cost	5	7	8
Ease of Implementation	5	10	2
Safety	5	7	6
Weight	4	8	6
Lifespan	4	8	10
Waterproofness	4	9	10
Biocompatibility	5	7	9
Functional Temperature Range	3	8	10
Resistance to Shock/Drops	3	7	6
Breathability	4	6	6
Comfort	2	5	5
Total weighted score		334	311
Verdict	-	BEST	

Chosen Solution: A Hybrid Device

- Hand Enclosure Device: A hybrid design of elastic glove and exoskeleton splint
- Contact Media: Hypafix
- Material Choice:
 - Spandex: Elastic Glove
 - ABS: Exoskeleton

Budget Breakdown Table:

Component	Estimated Cost
Hypafix (inner lining)	\$30
ABS (exoskeleton)	\$60
Spandex (elastic glove)	\$40
Sewing Machine (for Hypafix and Spandex)	\$75
Hinge components for exoskeleton	\$50
Production and Labor	\$100
Extra Materials and Unforeseen costs	\$145
Total	\$500

Next Step..

- Research
 - Glove Design
 - Different mechanics of splint Development
- Developing CAD models

Questions, Comments or Concerns