Maxillomandibular Fixation

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Abstract

Maxillo-mandibular fixation is a procedure which stabilizis a jaw or facial fracture. Currently an apparatus called an archbar is bound to the teeth with 24 gauge steel wire. The wire ligature is prone to causing lacerations, and puncturing surgical gloves. The team modified the ligature material eliminating risks to patient and surgeon, while maintaining strength and stability. An ace bandage head wrap (the Barton Bandage)is currently used to stabilize these fractures during transportation and waiting periods if operating rooms are unavailable. This device must be comfortable, able to fit a range of head sizes, and put vertical force on the jaw to hold it in occlusion. The team developed the SlingJaw, a prototype of this device, and has tested its functionality and comfort level.

Ligature Modification

Motivation/Background

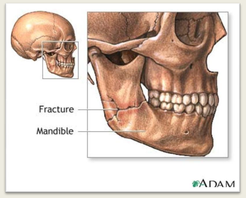


Fig. 1-*A common breaking site of the mandible bone. An injury such as this would require MMF [1].*

- Mandible fractures account for 36-70% of all maxillofacial fractures (males 21-30 having a higher frequency) [2]
- Maxillomandibular fixation creates stable base to hold teeth in occlusion
- Movement along fracture line inhibits bone healing and predisposes to infection

Client Specifications

- Procedure must be completed in a timely manner
- Avoid getting stuck with the wire
- Maintenance of strength and stability for 2-6 weeks
- Cannot increase cost of procedure more than $30

Transportation Device

Current Methods

- Current method – wrapping application of a non-reusable ACE Bandage.
- Requires considerable time to be applied
- Self-application is extremely difficult
- Other current devices – Jaw Bra

Client Specifications

Fig. 2- *The current method used to temporarily stabilize the jaw for transportation [4].*

Client Specifications

- Jaw secured in occlusion – maximum isometric mouth-opening force is 99.6 ± 22.2 N [3]
- Vertical force vectors only
- Comfortable straps
- Avoid irritating injured areas
- Used for a maximum of 12 hours

Problem Statement

When there are fractures in the face, the mandible must be fixed to the maxilla for a period of 2-6 weeks. Our objective is to modify the current fixation system to eliminate risk of injury to surgeon or patient, and still provide strength and stability for the entire duration of use, and to design a device which will allow for more stable transportation of injured patients to the Emergency Room.

Final Designs

Ligature – Modified Wire

- Polyurethane tubing cap for 24 gauge stainless steel wire
- Additional preparation time for surgery – 15 minutes
- Prevents lacerations to patients tissues
- Prevents tearing of surgical gloves
- Adds an additional 26 cents per surgery

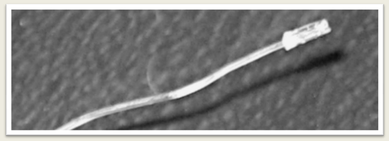


Fig. 3 – 24 gauge wire with cap to prevent injury

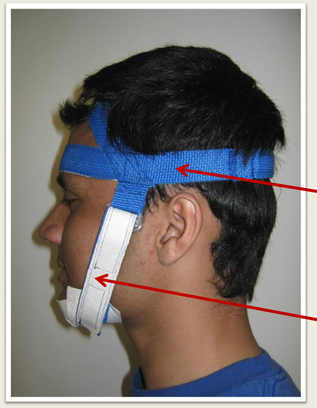
Transportation Device – The SlingJaw

*Velcro used for all adjustable straps

*Material cost = $15

Dorsal Strap
- Adjustable
- Loop attaching dorsal strap to circumference strap ensures dorsal strap positioned straight back

Triangular Strap Section
- Prevents device from slipping forward
- Provides stability for the force vectors
- Maintains force vectors vertical



Chin cup
- Slides along mandible strap
- Cups chin to ensure vertical force vectors
- Provides comfort to the chin

Circumference Strap
- Adjustable strap that wraps around head
- Serves as base for vertical force vector

Mandible Strap
- Adjustable strap which runs along one side of face, under chin, and back up other side of face
- Pulls the jaw upward and keeps teeth occluded

Testing

SlingJaw

Vertical Force Withstood Until Signs of Velcro Failure

Trial #	Force Withstood (lbs)
1	47.40
2	46.30
3	50.71
Average	48.14

Comfort Test

Trial #	Comfort Score (out of 5)
1	4
2	4.5
3	3
4	4
Average	3.875

Ligature

Application trials using teeth model – simulated full procedure

Trial #	# of failures (out of 16)
1	0/16
2	0/16
3	1/16
4	0/16
Average	1/64 = 1.56%

Future Work

Ligature
- Colored tubing - prepared ends more apparent
- Preassembled stock wire with tubing

Transportation device
- Two adjustable straps on sides – easier alignment of chin strap
- Top strap shortened (~ 10 cm)
- More comfortable lining material
- Test for machine washed durability
- Silicon strip to avoid slipping
- Comparison testing of Jaw Bra and SlingJaw

References

[1] www.mdconsult.com

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[3] Bolta, K. J., R. Orchardsona. *Archives of oral biology* [0003-9969] yr:1986 vol:31 iss:12 pg:789.

[4] Murchison, David F. Jaw Fracture. The Merck Manuels Online Medical Library. http://www.merck.com/mmhe/sec08/ch117/ch117d.html. 2008.

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