

# Maxillo-Mandibular Fixation

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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 change the ligature material used to fixate and archbar system in order to eliminate risk of injury to surgeon or patient, and still provide strength and stability for the entire duration of use. We are also asked to design a device which will allow for more stable transportation of injured patients to the Emergency Room.

## Client Requirements:

- Ligature
  - Procedure must be completed in a timely manner
  - Avoid getting stuck with the wire
  - Maintenance of strength and stability for 2-6 weeks
  
- Transportation Device
  - Vertical Force Vector
  - Padded for Patient Comfort
  - Adjustable for every head shape
  - Ease of Application

## Design Requirements:

- 1.) Physical and Operational Characteristics:
  - a. Performance Requirements:
    - i. Ligature
      - Used for only one patient
      - Period of 2-6 weeks
      - Must attach to the teeth in a secure manner
    - ii. Transportation Device
      - Reusable
      - Adjustable
  
  - b. Safety :
    - i. Ligature
      - Must avoid puncturing the surgeon's gloves or patient to ensure a sterile environment throughout the procedure
      - Nothing small enough to fall into open throat if falls during application
    - ii. Transportation Device
      - Must be padded to avoid causing lacerations on patient's face

- c. Accuracy and Reliability:
  - i. Ligature Material
    - Must maintain strength and durability for 2-6 weeks
    - Usable on patients with varying dental health
  - ii. Transportation Device
    - Adjustable to accurately apply pressure to varying head sizes
- d. Life in service:
  - i. Ligature Material
    - Single use
    - Remains inside the mouth for 2-6 weeks
  - ii. Transportation Device
    - Multi-use
- e. Operating Environment:
  - i. Ligature Material
    - Blood and possibly other bodily fluids
    - Exposed to food and saliva for entire 2-6 week period of use
    - Body temperature
  - ii. Transportation Device
    - Possible blood and bodily fluids
- f. Ergonomics:
  - i. Ligature Material
    - Withstand the force of a human jaw without breaking, bending, or in any other way allow shifting of the jaw
      - a. 0-100 N for incisal edge loading and 0-200 N for range of molar loading
    - At minimum must secure from cuspid back to first molar
  - ii. Transportation Device
    - Vertical force vectors
    - Withstand force of human jaw
- g. Size:
  - i. Ligature Material
    - Fit between the teeth (width less than 3 mm)
    - Teeth fully touching when mouth is closed.
    - Must fit with current archbar design
  - ii. Transportation Device
    - Adjustable
    - Pediatric size
- h. Weight:
  - i. Ligature Material
    - Comfortable weight to be held by the teeth
  - ii. Transportation Device
    - Under 5 lbs
- i. Materials:
  - i. Ligature Material
    - Non-absorbable
    - Safe for human mouth.
    - Cannot be degraded by saliva , toothpaste, or food
  - ii. Transportation Device

- Must be soft on skin
- Preferable to not absorb
- Washable
- Non-elastic

2.) Production Characteristics

- a. Target Product Cost:
  - i. Ligature Material
    - \$5 per patient
  - ii. Transportation Device
    - \$30 or less per unit

3.) Miscellaneous:

- a. Standard and specifications:
  - i. Approval by client (Surgeon)
- b. Customer:
  - i. Ligature Material:
    - Prefers anything that will avoid hurting the surgeon's hands, or spreading of diseases passed through the blood.
  - ii. Transportation Device:
    - Ease of application very important
- c. Patient-related Concern:
  - i. Patient comfort is a priority
  - ii. Avoid materials that will cut gums/lips
  - iii. Allow cleaning of teeth as much as possible
  - iv. Young, active people = general patients
- d. Competition:
  - i. Ligature Material
    - Rapid IMF