

**MOUTHSTICK TO FACILITATE  
QUADRIPLEGIC'S  
USE OF A COMPUTER  
KEYBOARD**

*Biomedical Engineering Design, 201*

**Group Members:**

Cindy Chan, Dan Hartman, Emily Putzer, Liz Thottakara

**Clients:**

Dr. John Doyle, Dept. of Surgery, University of Wisconsin  
Mr. Steve Christensen

**Advisor:**

Prof. Nimmi Ramanujam, Dept. of Biomedical Engineering

**Other Contributors:**

Mr. Randy Olson, Williams Dental Lab

*Abstract*

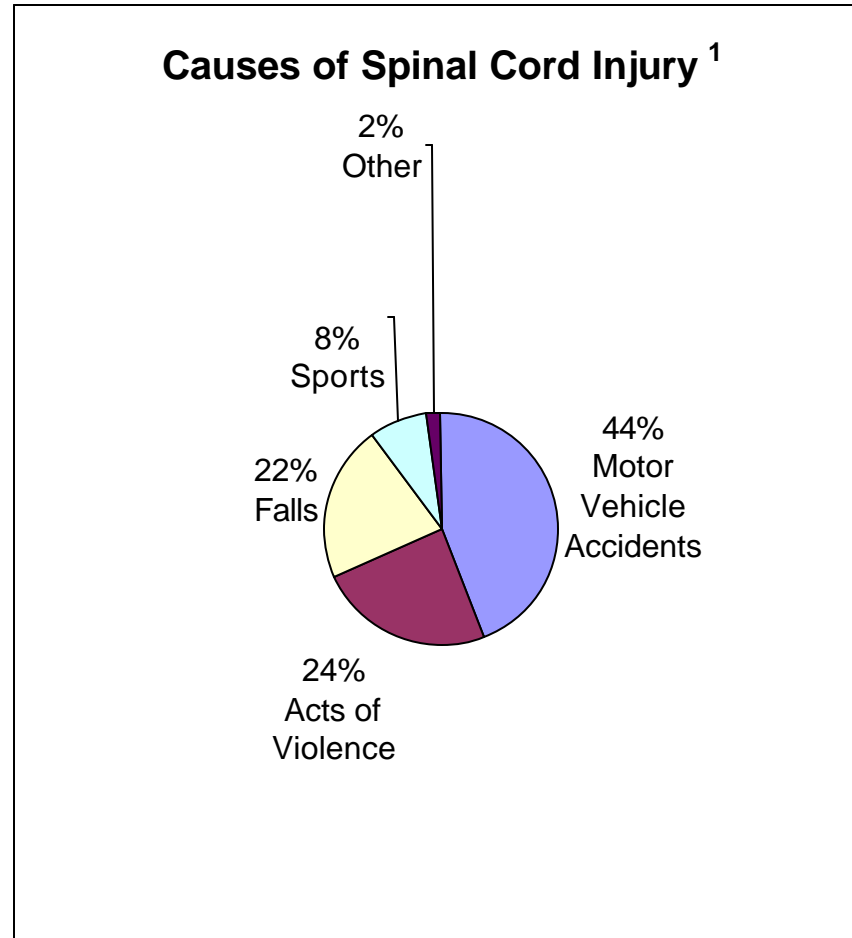
Mouthsticks are used by quadriplegics to communicate in their daily lives. One important aspect of this communication is using a computer. In order to depress keys on a computer keyboard, quadriplegics use a mouthstick. Jaw movement causes the mouthpiece to slide across the teeth. Hence, the user suffers wear and chipping of the teeth from repeated grinding of mouthpiece against the teeth. The purpose of our design is to solve this problem of the current mouthstick. Our final design keeps the mouthpiece stationary on the teeth. The upper and lower mouthpieces slide against each other when the lower jaw extends. This accomplishes our objective of preventing damage to teeth while using a mouthstick.

*Problem Statement*

To design a device that will allow quadriplegics to more easily depress keys on a computer keyboard without causing the wearing or chipping of the teeth caused by the current mouth stick design.

*Background Information*

Approximately 450,000 people in US (82% men, 18% women) with Spinal Cord Injury (SCI) or Spinal Dysfunction.

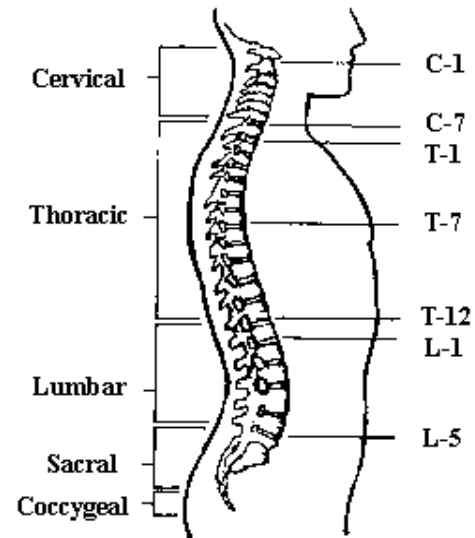


The spinal cord is the major bundle of nerves that transmits nerve impulses to and from the brain to the rest of the body.

There are eight cervical vertebrae (C1-C8) present in the neck. The level of SCI depends on which vertebra of injury:

- C1-3 Vertebra: Limitation of movement of head and neck
- C4 Vertebra: Head, neck movement and shoulders
- C5 Vertebra: Head, neck control, shoulders, elbows and palms

## THE ANATOMY OF THE SPINE <sup>2</sup>



Vertebral Sections and Numbers

Pic Taken from: <http://www.mckinley.uiuc.edu/health-info/fitness/back/section1.html>

## HIGH-TECH DEVICES IN THE MARKET

Microsoft Tracer<sup>3</sup>--a new type of computer mouse that uses a small gyroscope to sense the user's head motion.

- Not affordable (~\$700)



## *Product Design Specification*

### **Performance Requirements**

- Used for 1-2 hours at a time
- No grinding of mouthpiece across teeth
- Depress keys using only force from jaw movement (and not applied by neck)

### **Life in Service**

- 3 years

### **Safety**

- Mouthpiece composed of non-toxic material (e.g. hard-soft acrylic)
- Material can be cleaned/sterilized and reused
- Not present a choking hazard

### **Operating Environment**

- Conducive to oral environment (100% salival humidity, 95°F)
- Withstand forces from biting down ~150-250N
- Should not shatter/crack if dropped from height of up to 2m.

### **Ergonomics**

- Lightweight
- Torque applied to mouth not exceeding 0.08Nm
- Angle between plane of mouth piece and stick should be 18° (specific for client)

### **Size**

- Mouthpiece
  - Top piece: 4.9cm X 7cm
  - Bottom piece: 3.5cm X 5.8cm
  - Total extension outside mouth: 2.4cm
  - Sliding track: 2cm
- Stick
  - Length of stick: 56cm
  - Diameter of stick: 0.6cm

### **Weight**

- Mouthpiece: 0.6 oz

- Stick: 0.5 oz

### **Materials**

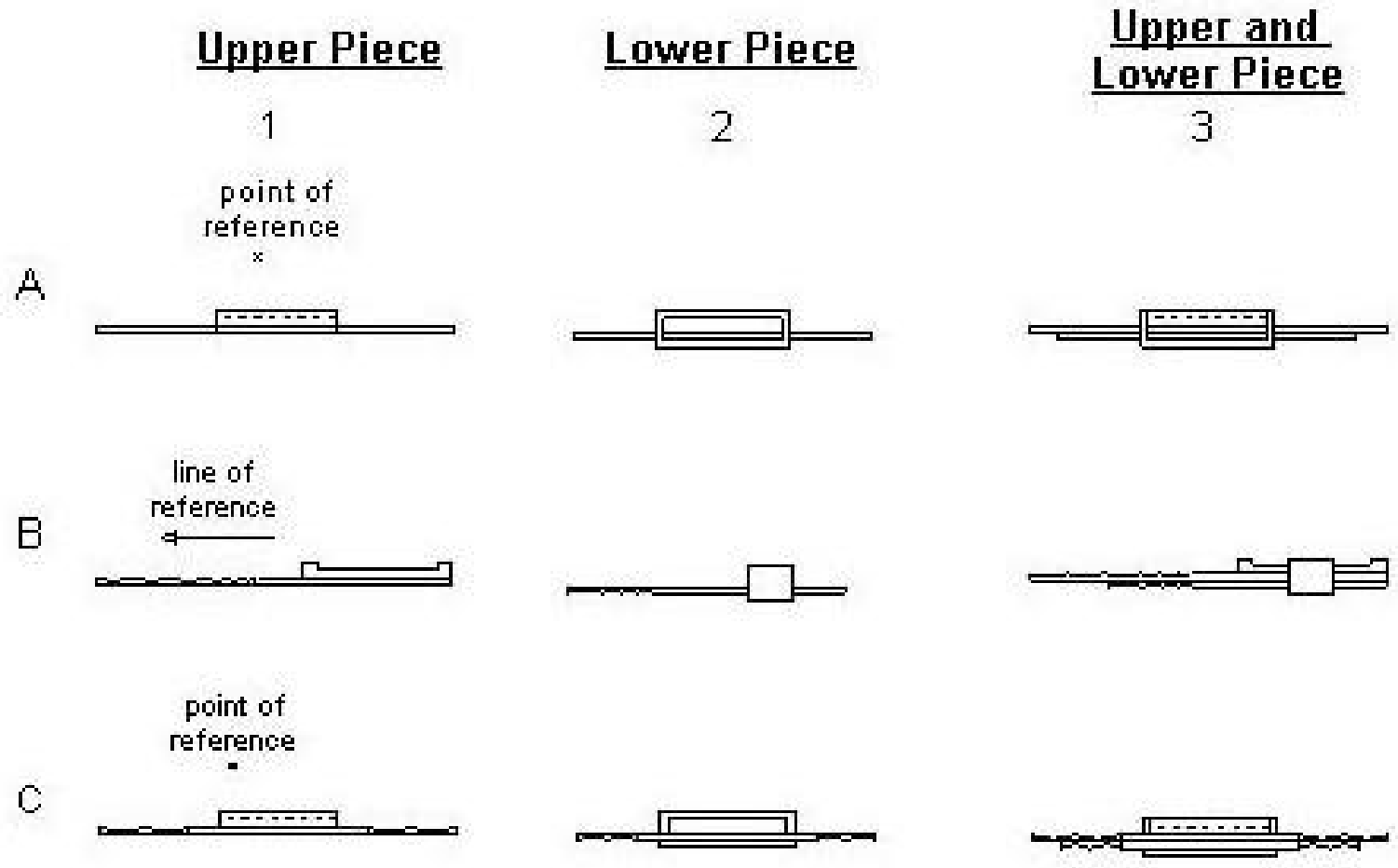
- Mouthpiece: hard-soft acrylic
- Sliding track: hard acrylic
- Stick: T-6 aluminum alloy

### **Client Concerns**

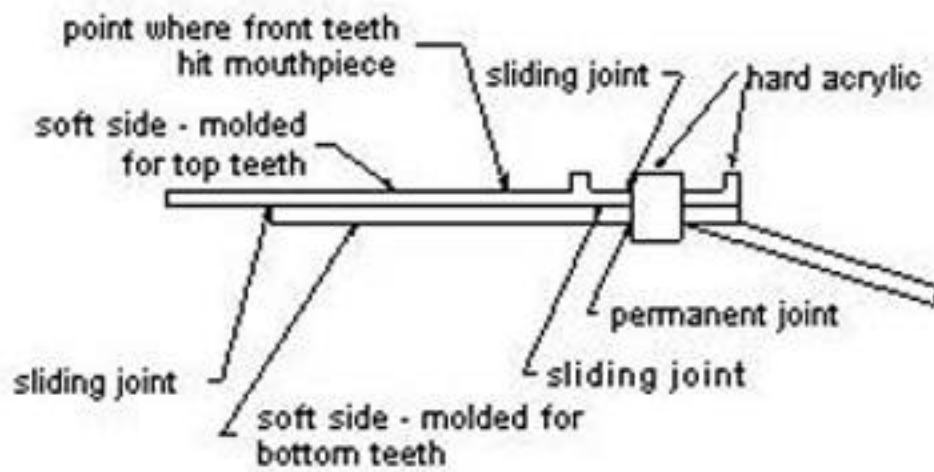
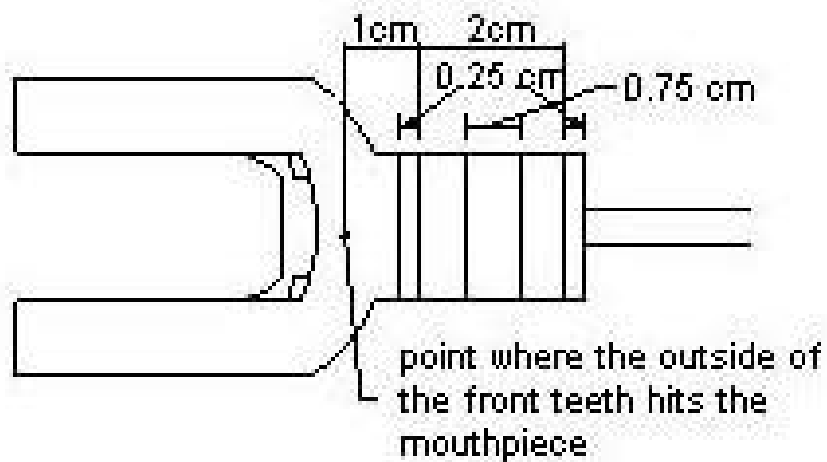
- Thickness of current mouthpiece desired (~0.25cm)

Material of old mouthpiece is too hard

*Design Details*



## Design Details



### *Motivation*

- Low cost of products important to client
- Computers important means of communication as well as entertainment value
- Remedy grinding of current mouthpiece against the teeth of users

### *Prototype*

- Client's teeth fit into the top and bottom mouthguard
- Top mouthguard is stationary
- Bottom mouthguard is connected to oval ring and stick
- Horizontal movement of lower jaw extends and retracts bottom mouthguard and stick
- Extension of stick depressed keyboard keys

Prototype pictures may be viewed on the website.

### *Future Development*

- Design could be more suited for mass production
- Angle between plane of mouthpiece and stick could be made adjustable
- Smoother sliding motion
- Accuracy could be improved

### **References:**

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