

BACKGROUND

Temporomandibular joint disorder, or TMJ disorder, encompasses both acute and chronic inflammation of the temporomandibular joint, which connects the mandible to the skull. Currently, patients with chronic and severe TMJ disorder use bite guards or bite plates. These devices help relieve pain, but mainly serve to protect the teeth. However, these devices have proven to be ineffective since patients with bruxism clench and/or grind their teeth on the bite guards, resulting in chronic pain and inflammation due to increasing pressure on the joint and strain on the jaw muscles.



Figure 1. A typical TMJ bite plate

MOTIVATION

The aim of this project is to develop a jaw massaging device for our client to use in combination with her current bite plate. The massaging device will help relieve the chronic pain our client experiences due to the disorder while the bite plate will continue to protect her teeth from grinding and clenching.

REQUIREMENTS

- Provide relief of discomfort and pain to the jaw muscles with vibration or shiatsu techniques
- Quiet enough to wear during sleep
- Can use while standing/sitting upright or laying down
- The device must be easy to put on and take off by a single person
- Has adjustable straps to conform to patients head
- The device is comfortable to wear
 - Lightweight
- Withstand use for up to 8+ hours at a time
- Safe to operate
- Use in conjunction with bite plate

BUDGET

Description	Vendor	Cost
Foot Massager	Wal-Mart	\$40.00
Pillow Massager	Bed, Bath & Beyond	\$40.00
Miscellaneous Hardware	True Value	\$30.53
Flexshafts	Ace Hardware	\$74.63
Arduino Microcontroller	jameco.com	\$35.14
GreatStuff Foam	Home Depot	\$4.00
Box	Home Depot	\$1.50
Bolts	True Value	\$2.50
Headgear	matmonster.com	\$28.00
Dremel tip, bolts, Velcro, and cotter pins	True Value	\$25.00
TOTAL		\$281.30

FINAL DESIGN

Mechanical Components

- Homedics foot massager device contained compact massaging component
- Homedics pillow massager supplied adequate power to turn massaging component while remaining quiet
- Plugs in to common power outlet
- Easy to use on/off button
- Dremel flexible shafts allowed torque of massager to be delivered to massaging component in headgear
- Pins attaching the Dremel shaft to massager easily removable for storage
- Massaging drive shaft easily removable from massaging component for comfort sleeping

Headgear

- Asics wrestling headgear
- Hole drilled in ear piece for receiving massaging shaft
- Velcro extensions to adjust massaging component to desired position on face
- Repositioning of strap for snug fit



Figure 3. Headgear with holes on the sides for different strap placement and center hole for massaging device

TESTING

- Client tested the device for 3 days and provided feedback
- After applying moist heat to jaw for 5 minutes and using the device for 15 minutes, client's jaw muscle felt more relaxed and client felt less pain and tension.
- Suggestions for improvement:
 - Have massager come in closer contact with the most tense portions of the jaw
 - Use smaller rotating massager



Figure 2. Final prototype (Clockwise from top left): headgear with Dremel attachments; Dremel flexible shaft; device with Dremel shafts attached; motor and electrical controller

FABRICATION

Headgear

- Cut holes in earpiece for different strap placement
- Cut center hole in earpiece for receiving massaging device
- Added extended Velcro straps for proper positioning
- Modified chinstrap position
- Added Velcro strap to hold flexible Dremel shaft

Mechanical Massager

- Deconstruction of foot massager and pillow massager
- Modified bolts to attach to Dremel head and motor drive shaft
- Used cotter pin to attach bolt to motor drive shaft
- Welded Dremel attachment to massaging shaft which allows for easy attachment and removal
- Attached motor and electrical controller to holding tray with zip ties



Figure 4. The rotating massaging component (left) and the massager attached to the Dremel shaft (right)

ADJUSTMENTS

- Adjusted smoothness and angle of massager by adding a strap to hold the Dremel shafts perpendicular to the head
- Attached motor to the holding tray to offer different positioning of the motor
- Installed cotter pins so that they don't bind with the machine
- Adjusted positioning of chin strap

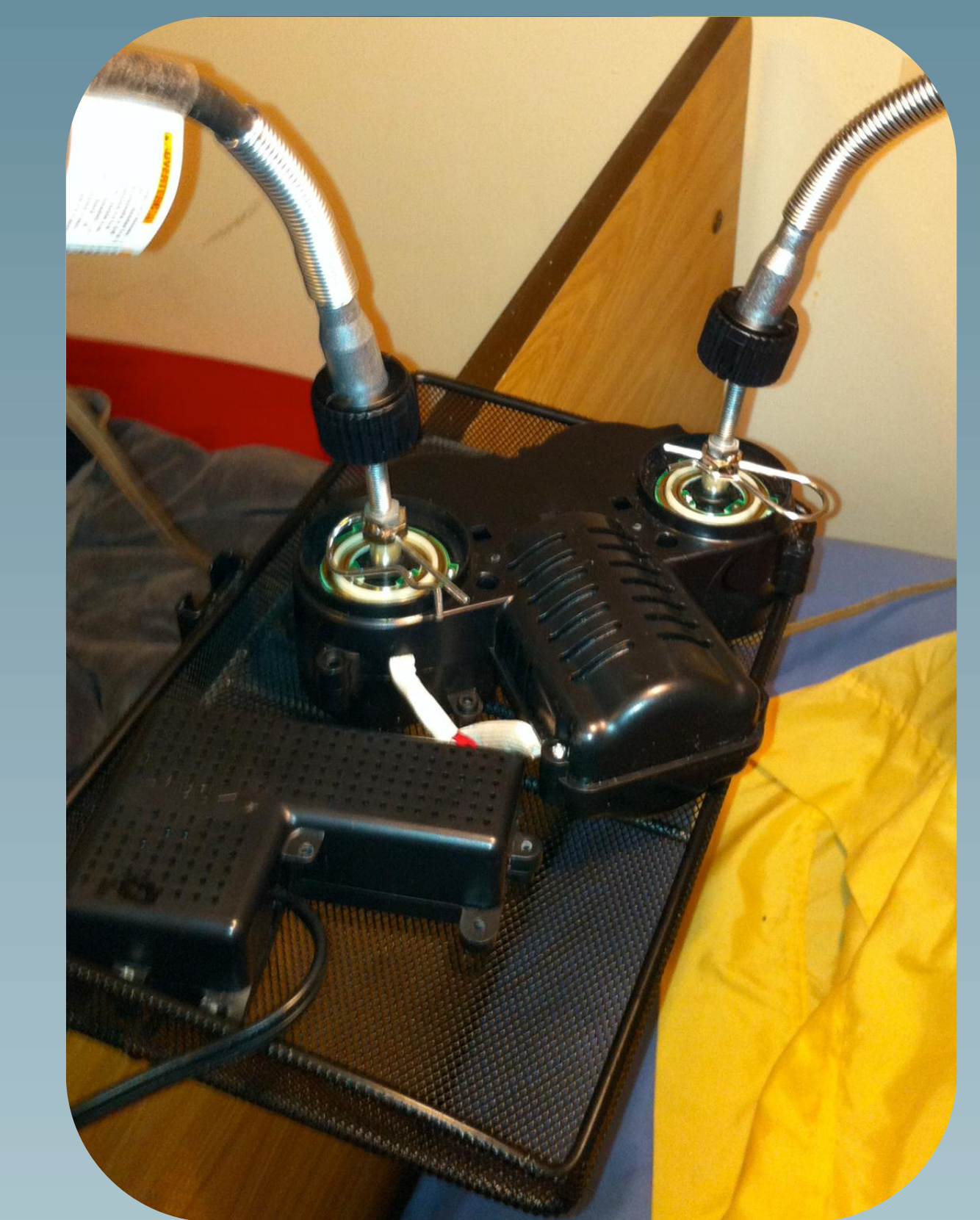


Figure 5. Holding tray, with motor and Dremel shafts, attached to a bed for easy positioning

FUTURE WORK

- Add heating component
- Incorporate Arduino to run massager off pressure sensors while client sleeps
- Find compact massaging components that could attach to the headgear instead of Dremel shafts
- Ability to operate the device at various speeds
- Allow for compact disassembly and transport

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