Effects of Strength Training on Neuromuscular Facial Rehabilitation

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Introduction

Within a month after denervation facial muscles (animal model) lose

- *70% mass*
- *90% of maximal contractile force*

Within 1-3 years after denervation, skeletal muscles (human forearm) lose

- *75-80% axonal diameter*

Years after an injury, exercise can:

- *Improve blood flow*
- *Stimulate angiogenesis (growth of new capillaries*
- *Stimulate arteriogenesis (enlargement of pre-existing vessels)*

Previous facial nerve rehabilitation research focused on Range of Motion (ROM)

The present study posits that strength training alone or prior to ROM rehabilitation may:

- *Augment blood flow*
- *Increase oxygen exchange*
- *Stimulate angiogenesis and arteriogenesis*
- *Improve muscle performance*

Questions

Q1. Can facial muscles be strengthened 13 years post-injury?

Q2. Does increasing strength result in increased range of motion (ROM)?

Q3. How do methods used to measure the effects facial nerve rehabilitation compare?

Participants

- 1 participant 13-years post unhelmeted motorcycle accident resulting in temporal bone fracture with long-term facial nerve damage and facial paresis
- 1 gender- and age-matched control without facial nerve damage
- 5 graduate student graders

Method

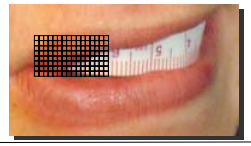
Facial nerve rehabilitation program (participant)

- Maximum volitional contraction exercises
  - Standard Iowa Oral Performance Instrument (IOPI) tongue bulb placed in muscle regions of participant's affected side of face
- Obicularis oris-superior (upper lip), obicularis oris-inferior (lower lip), buccinator (middle cheek), zygomaticus (upper cheek)
- 10 repetitions/muscle region, 2x/day, 6 days/week

Weekly measurements (participant & control)

- Measurement methods
  - *Overlay grid*
    - 1 mm^2 grid superimposed on photos
  - *House-Brackman Facial Nerve Grading Scale-2 (FNGS-2)*
    - Oral commissure, brow, eye, nasal labial fold, synkinesis
  - *Perry Appliance*
    - Dental whitening tray with attached tape measure

Perry Appliance

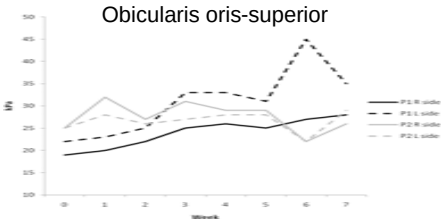


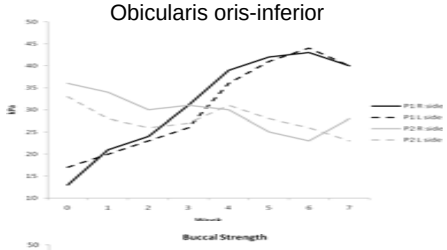
Overlay Grid

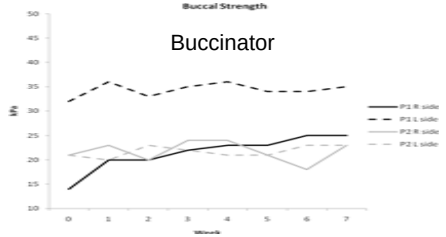
- Measurement methods
  - 5 graders scored pre- & post-rehab videos (*FGNS-2*) and photos (*Perry Appliance*, *Overlay Grid*)

Results

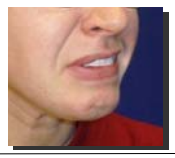
Q1. Significant increase in strength in 3 of 4 muscle regions on participant's affected side



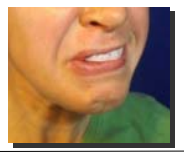




Q2. The *Overlay Grid* showed 50% increase in area exposed during maximal lip retraction due to increase in vertical height with no statistically significant change in oral commissure (horizontal lip retraction).



Before



After

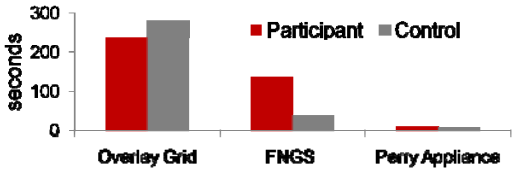
The *FNGS-2*, the "gold standard" for measuring effects of facial nerve did not show significant changes pre- and post-rehab. Previous studies have reported that the *FGNS-2* was not sensitive to changes with moderate facial nerve involvement.

The *Perry Appliance* did not show a significant change in lip retraction as measured by the mm marks on the tape measure.

Q3.

FNGS Brow	FNGS Eye	FNGS Nasol-abial Fold	FNGS Oral Comm-issure	FNGS Syn-kinesis	FNGS Total Score	FNGS Grade	Perry Appli-ance	Overlay Grid
0.866	0.531	0.863	0.882	0.789	0.899	0.855	0.999	0.973

Inter-rater reliability was greater for the *Overlay Grid* and *Perry Appliance* compared to the *FNGS-2*.



The *Perry Appliance* was the most time efficient of the measurement methods

Conclusions

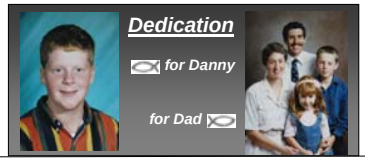
Facial muscle strength can be increased years after facial nerve damage using the IOPI.

Increase in strength resulted in vertical increase during maximal lip retraction.

Strengthening program may be more effective when paired with range of motion (ROM) exercises.

Present study intended as a 12-week strengthening program, but terminated after 7 weeks due to neck muscle spasms on participant's affected side.

Modified *Perry Appliance* with horizontal and vertical grids would provide time efficient and objective measure for facial rehabilitation.



[1] Morrison, D., Ng, M., Ramsey, M. J., Schlaikjer, B.M., Smouha, E., Toh, E.H., Wax, M.K., Williamson, R.A., & Smith, E.O. (2009). Facial Nerve Grading System 2.0.*Otolaryngology-Head and Neck Surgery*; 140, 445-450.