Pediatric NMES and Dysphagia Research Summary

1. Andreoli, Steven, et al. Neuromuscular electrical stimulation improves feeding and aspiration status in medically complex children undergoing feeding therapy. *International Journal of Pediatric Otorhinolaryngology*. 2019 http://doi.org/10.1016/j.ijporl.2019.109646
   - Design: Case studies
     - N=15 medically complex children with severe dysphagia and aspiration, 0-5 years, mean age 2.51 years (+/- 3.31 years)
   - Conclusion: NMES safely completed. Improvement in aspiration status seen on 83.3% of patients with MBSS. Feeding status measured by texture advancement and significant improvement on FOIS seen in all patients.

Aim: Study efficacy of NMES as a therapeutic adjunct to improve aspiration and feeding status in medically complex children with severe dysphagia and aspiration
Inclusion: Severe dysphagia and aspiration on MBSS and FOIS scale. Diagnoses included: seizure disorders, cerebral palsy, hypotonia, anoxia, HIE, hemiplegia, developmental delay, BPD, extreme prematurity, congenital heart disease, syndromic diagnoses, near drowning and non accidental trauma
NMES: 20 - 26 treatments. Mean amplitude used 7.5 (+/- 2.7 mAmps)

2. Marcus S, Friedman JN, Lacombe-Duncan, A, Mahant S. Neuromuscular electrical stimulation for treatment of dysphagia in infants and young children with neurological impairment: a prospective pilot study. *BMJ Paediatrics Open* 2019;3:e000382. Doi:10.1136/bmjpo-2018-000382
   - Design: Prospective pilot study
     i. N=10 infants and young children, 0-24 months, median age 8.9 months with neurological impairments and severe dysphagia
   - Conclusion: Improved swallow function measure on VFSS before and after treatment intervention

Aim: Study effectiveness and safety of NMES for treatment of dysphagia in infants and young children with neurologically impairments with severe dysphagia
Inclusion: Severe dysphagia on VFSS with NI. (neurodegenerative patients excluded). Includes hypotonia, HIE, Grade III/IV IVH
NMES: 20-45 minutes 2x weekly for 2-4 months
Conclusion: ALL intervention subjects demonstrated improved swallow function on VFSS. 5 patients who were not safe to orally feed on any consistency at baseline, 3 established full oral feeding and 2 established partial oral feeding. 5 of 7 were completely GTT dependent at start and 0/7 at conclusion. No adverse effects other than mild skin irritation with one patient. 5/7 caregivers were satisfied with improvement and intervention.

3. Song Woo Jin, et al. "Effects of NMES on Swallowing Functions in Children with CP: A Pilot Randomised Controlled Trial." *Hong Kong Journal of Occupational Therapy* (2015) 25:1-6.
    - Design: two group experimental randomized control study. Blinded
        - n=10 for each group, ages 3.5 – 9 years
        - both received oral sensorimotor treatment (OST), experimental group received additional NMES x20 min 2x/week x 8 weeks
    - Conclusion: OST and NMES facilitated significantly improved feeding and swallowing functions more than OST and Sham NMES in children with CP

Aim: Evaluate effects of OST and NMES on pediatrics with CP and dysphagia
Inclusion: CP, dysphagia by VFSS or rehab documentation, no vision or hearing loss, no active seizures, no pacemaker
OST: tactile to lips, cheeks, chin, tongue and palate, also vibrator and ice stick done for 10 minutes
NMES: 80 hz, 300ms with 1 sec interval, supra and infra hyoids horizontal, Palpated for amplitude (3-5mA)
Outcome tools: BASOFF (behaviors) and ASHA NOMS swallow scale (diet and supervision level)
Conclusion: NMES facilitated swallow functions for lip closure while swallowing, swallow without excess loss, sip liquid, swallow liquid without excess loss, swallow without cough.

4. Kelvin LS and Radika V. Role of NMES in Dysphagia management for children with hypertonia and dystonia: A case study. (2015). Paper presented at the 7th European Society for Swallowing Disorders Congress, Barcelona, Spain.
    - Design: Case study
        i. 11-month old with hypotoxic dystonia CP
        ii. MBSS before. Received NMES and sensory motor exercises
    - Conclusion: Increased jaw opening, reduced drooling, increased swallowing and HLE, reduced coughing and maintenance of vital signs during oral feeding

5. Rice, Kelly L. "Neuromuscular Electrical Stimulation in the Early Intervention Population: A Series of Five Case studies." *The Internet Journal of Applied Health Sciences and Practice,* http://ijahsp.nova.edu (2012) 10.
    - Design: Case studies
        - n=5, ages 3 - 32 months, male and female with pharyngeal phase dysphagia
        - MBSS before and after treatment
        - OT performed Vital Stim 2x/week for 1-hour sessions in the home setting
    - Conclusion: Suggests NMES is effective intervention for children with pharyngeal phage dysphagia. All 5 improved their swallow safety and advanced at least one or more consistencies or textures.

Aim: Describe home – based pediatric treatment with NMES for pharyngeal phase dysphagia
Inclusion: referral by child's evaluation team for need for assist in feeding or swallowing
Diagnosis: Developmental Delay, perinatal asphyxia with IVH, 26-weeker with BPD, congenital anomalies, FTT with GJ tube and fundo
Conclusion: This paper covers 5 pediatric case studies with pharyngeal dysphagia and they all made gains with swallowing skills when NMES was employed as part of the treatment.

6. Christiaanse, Mary E. MD, et al. "Neuromuscular Electrical Stimulation is No More Effective Than Usual Care for the Treatment of Primary Dysphagia in Children." *Pediatric Pulmonology* (2011) 46:559-565.
    - Design: retrospective analysis
        - N=46 (NMES) and n=47 (non NMES); Ages 11-51 months
    - Conclusion: NMES on heterogeneous pediatric patients with dysphagia did not improve the swallow function more than those who did not receive NMES. However, significant gains were noted with pediatric patients with acquired dysphagia with NMES.

Inclusion: All children who received a VFSS before and after treatment were put in treatment group. Control group were those who got VFSS within 6 months of each other to eliminate room for maturational growth. Ages from 11 – 51 months.
Methods; All had initial abnormal VFSS. Treatment group older and 61% had primary dysphagia, 68% used enteral tubes

Control: thought to be weekly sessions of 45-60 minutes with OT or ST and got OME and diet manipulation, as well as HEP.

Treatment: All from ST with NMES protocol, both peds channels, except infants got one channel Peds A. All 2-3x/week 30-45 min.

SLP did all VFSS and scored FOIS
Results: both groups improved in the FOIS, but no more change in NMES group than the non NMES group. Acquired dysphagia group did improve more than congenital peers. Both groups had 5 children that got GTT 6 months after treatment.
Larger retrospective study which actually did revealed statistical difference with acquired dysphagia (an acute event) but no statistical difference with congenital, or primary dysphagia (dysphagia from birth or congenital anomalies). It is important to note that subjects were not well matched in severity levels with congenital dysphagic patients as well as age and length of dysphagia.
NMES: 22 treatment

7. Mitchell K, Ramirez K, Ahlswede J, Robles M, McKenna D, Katz M, Cleary JP. The effectiveness of neuromuscular electrical stimulation (NMES) in swallowing therapy with neonates. 2012. Presented at ASHA & AAP National Convention.
    - Abstract: randomized control, double blind study with single blind evaluator and 2-year follow up. 18 neonates were included in the study. All failed traditional feeding and swallowing therapy and were eligible for G-tube placement to meet their nutritional and hydration needs. All demonstrated pharyngeal dysphagia to

the point it was impacting ability to take oral volumes (significant physiologic stability during oral feeding attempts). MBSS performed on all patients prior to treatment with all infants demonstrating pharyngeal dysphagia. Repeat only if demonstration of aspiration on initial study (13/18). Treatment variables the same with exception to sham NMES vs true NMES. Cross-over phase was available for those who did not make significant gains in a 2-week period.

- Design: Double blind, randomized control. Blind evaluator
- Initial intervention group was blinded until completion of 2-year follow up. Single blind evaluator to determine improvements throughout the study, by clinical analysis, oral volumes as well as MBSS for those with initial aspiration.

Results:

NMES group achieved safe and efficient swallowing faster than the control group. After 2 weeks of therapy, the experimental group demonstrated significantly higher percent to full oral feedings compared the control group.

8/9 control patients needed to cross over into a known "live" unit before significant gains were achieved. Only 1/9 experimental group needed to cross over

Two year follow up: indicated that all patients maintained safe swallowing skills with appropriate acceptance of purees and solid foods.