Evaluation of different fatigue-inducing paradigms (FP) on maximum isometric pressures (MIP) of the anterior tongue in healthy adults and elderly.

Jan Vanderwegen [1,2], Gwen Van Nuffelen [3,4]

[1] Thomas More University of Applied Sciences, Antwerp, [2] Saint-Pierre University Hospital, Brussels,
[3] Antwerp University Hospital, Antwerp, Belgium, [4] Ghent University, Ghent, Belgium

Introduction and Purpose

Maintenance of adequate tongue strength is critical for repeated bolus propulsion during mealtimes. Failure of strength production due to fatigue can result in dysphagia, prolonged mealtimes and/or premature ending of meals. However, no formal test is available to study tongue pressure production-induced fatigue. Therefore no screening exists to identify dysphagic people that could potentially benefit from tongue strength training to resist fatigue. The purpose of this study was to construct a potential fatigability protocol and study it in healthy volunteers.

Subjects

40 healthy people with MIP within normative data[1] were included: 20 adults (20-60 yo) and 20 elderly (70+ yo). Additional inclusion criteria were MMSE > 24, no history of neurogenic disorders or malignancies, and a pass on the Yale Swallow Protocol.

Methods and Analysis

- All testing and measurements used the IOPI (model 2; fig. 1).
- Every participant performed 3 fatigue paradigms (**FP**) in a randomized order, once at the anterior and once at the posterior tongue (fig. 2). The level of resistance during the FP was set at 60, 80, or 100% of the participants baseline (**BL**) MIP at that time. Every FP was repeated twice – totaling 6 FP - with intervals of 48-72 hours.
- During the FP, the participant repeated a sequence of 3 seconds of tongue pressure production according to the level of resistance (confirmed by visual feedback on the IOPI), followed by 3 seconds of rest; MIP measurements were repeated every 5 reps.
- The FP was aborted at major discomfort, a session duration exceeding 30 minutes (equaling a theoretical maximum of 200 reps and 40 MIPs), or when MIPs during FP were <30% of BL MIP. Recovery MIPs were performed 5 and 15 minutes after ending the FP. Different operational definitions of 'fatigue' were analyzed.
- All analyses were performed using SPSS 24 and used ANOVA, Mixed Model ANOVA, and Kaplan-Meier Analysis (Log Rank, Breslow, Tarone-Ware).

Fig. 1. IOPI (hand bulb shown for illustrative purposes)

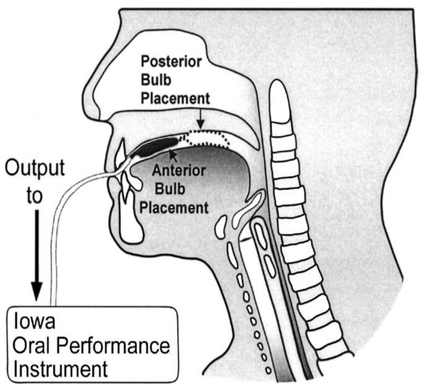


Fig. 2. Positioning of the tongue bulb at the anterior and posterior location.

Data obtained

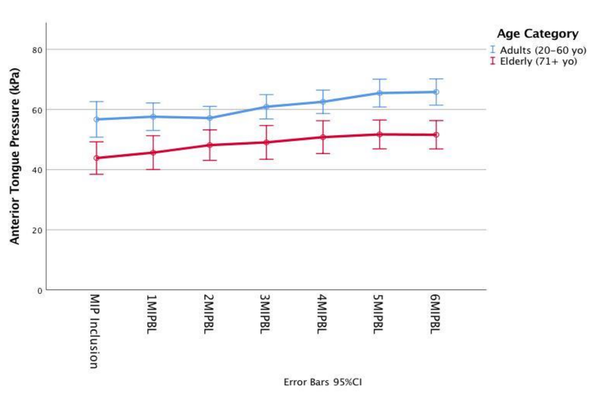


Fig. 3. Evolution of BL MIP Ant

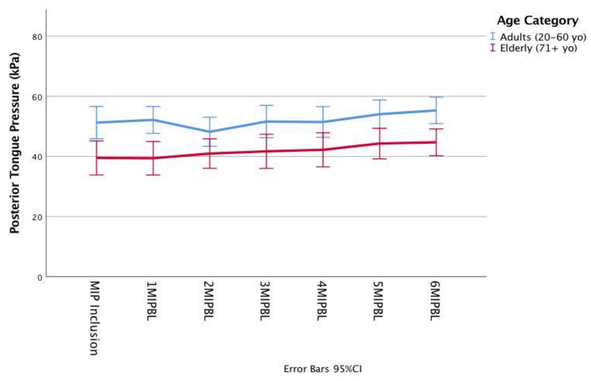


Fig. 4. Evolution of BL MIP Post

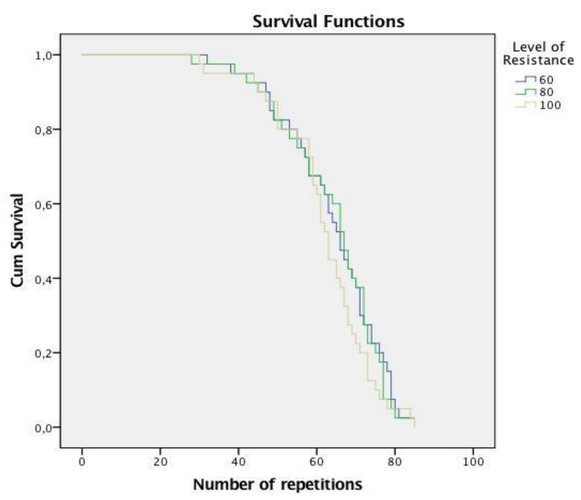
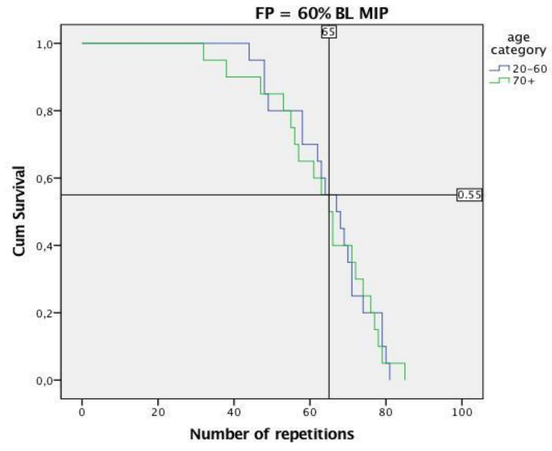
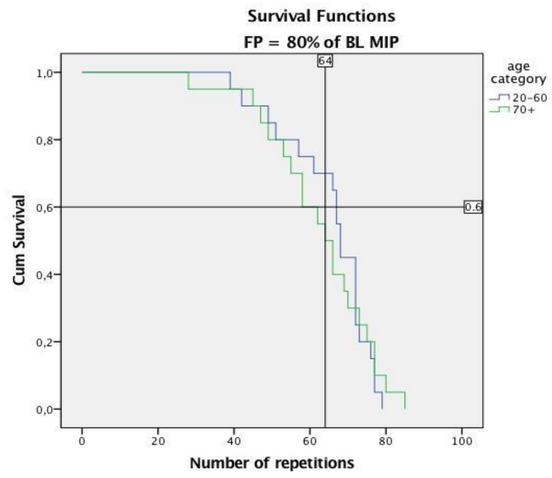


Fig. 5. KM on number of reps for different FPs





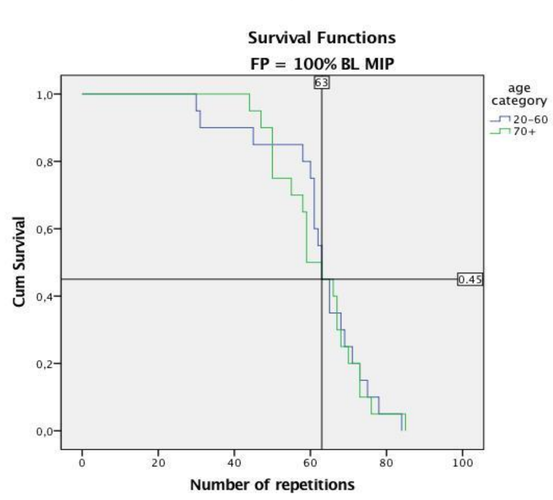


Fig. 6. KM on number of reps for different FPs by age

Results

1. Median/maximum number of repetitions across all FP were 65 and 80 respectively (medians: @60%: 65, @80%: 64, @100%: 63). ***No*** participant showed MIP values during repetitions < 50% of BL MIP (def. 1); the number of reps at any specified level of resistance at which 50% of participants quitted (def. 2) was ***64***.
2. No significant difference within a single FP was noted between BL MIP, MIP immediately following the FP, or recovery MIPs, regardless of age category.
3. Increases in BL MIP over 6 subsequent FP indicated a training effect in both age categories (no interaction effect)(Mixed Model ANOVA)(fig. 3-4):
   - Anterior: omnibus p = .000, η_p^2 = .515 (large); FP1-3 vs FP 4-6; FP 1-2 vs FP 7
   - Posterior: omnibus p = .000, η_p^2 = .217 (large); FP 1-3 vs FP 5-6
4. No significant differences in number of reps were found between a) 2 repeats of a similar FP, or b) different FP (fig. 5) using Kaplan-Meier analysis (KM).
5. KM demonstrated no significant difference in performance between adults and elderly on any FP (fig. 6).

Conclusions

Different FP failed to induce significant fatigue within the time constraints, contradicting earlier reports[2], but confirming previous findings by our group[3]. These data can serve to develop a potential screening for excessive tongue fatigue in dysphagic patients, since tongue fatigue has already been shown to predict meal time performance in Parkinson's Disease[4].

References

1. Vanderwegen J et al. The influence of age, sex, bulb position, visual feedback, and the order of testing on maximum anterior and posterior tongue strength and endurance in healthy Belgian adults. Dysphagia. 2013.
2. Kays S et al. Effects of dining on tongue endurance and swallowing-related outcomes. J Speech Lang Hear Res. 2010.
3. Vanderwegen J et al. No evidence for tongue fatigue induced by consumption of a challenging meal in healthy young and old adults. Poster presentation. DRS 2014.
4. Solomon NP. What is orofacial fatigue and how does it affect function for swallowing and speech? Semin Speech Lang. 2006.

8th Congress
European Society for Swallowing Disorders
25-29 September 2018
Dublin, Ireland

DOI: 10.3252/pso.eu.ESSD2018.2018