May 4th, 12:00 AM

Swallowing Disrupts Tongue-Jaw Coordination During Chewing in a Rat Model of Parkinson's Disease

Meejan Palhang
Rowan University

N. Charles

Francois Gould
Rowan University

Swallowing disrupts tongue-jaw coordination during chewing in a rat model of Parkinson's disease

Palhang, M.; Charles, N. R.; Gould, F. H. D.
Department of Cell Biology and Neuroscience, Rowan School of Osteopathic medicine, Stratford, NJ, USA

Introduction

Dysphagia (pathological swallowing) affects up to 90% of patients with Parkinson's disease, and is resistant to current treatments (Coehlo et al. 2010; Yu et al. 2020). Swallowing is a complex musculoskeletal behavior which is integrated with with other oropharyngeal behaviors such as chewing (Kwon and Lee 2019). The goal of this project is to understand how Parkinson's disease affects coordination of oropharyngeal feeding function.

Hypotheses

H1: chewing cycles that co-occur with swallows will be longer in rats with rotenone induced Parkinson's disease.
H2: Tongue-jaw coordination will be affected by rotenone treatment during chewing and swallowing.

Materials and Methods

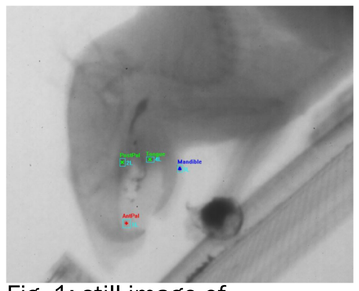


Fig. 1: still image of videofluoroscopic recording of rat feeding

Twenty-two 14 week old Lewis rats received either vehicle or 2.75mg/kg rotenone IP daily for seven days. Radio opaque markers were implanted into the tongue, upper jaw, and lower jaw. Animals were recorded with high speed (200fps) videofluoroscopy feeding on hard food (fruit loops) coated in barium sulfate.

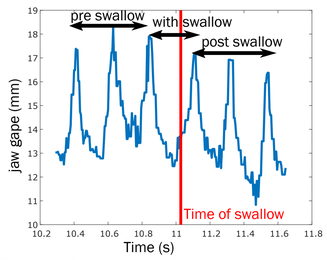


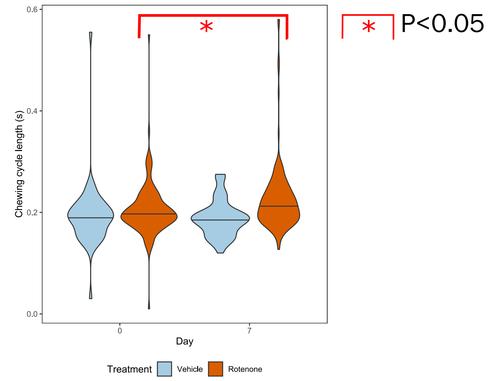
Fig 2: Classification of chew cycles

Swallow time scored in day 0 and day 7 videos. Markers digitized, distances between upper jaw and lower jaw and upper jaw and tongue calculated in Matlab. Onset and duration of chewing cycles calculated. Time of minimum tongue-upper jaw distance calculated.

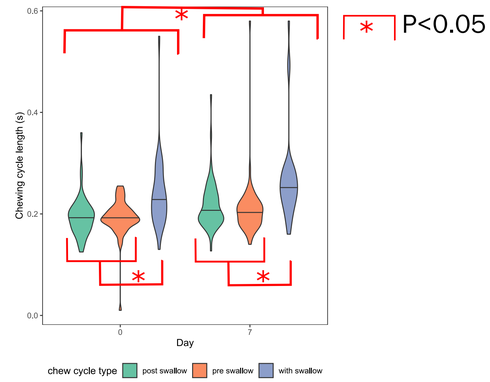
Chewing cycles classified as pre swallow, post swallow, or during swallow. Impact of rotenone treatment and swallow occurrence on chew cycle length and tongue jaw distance changes was evaluated with linear mixed models.

Results

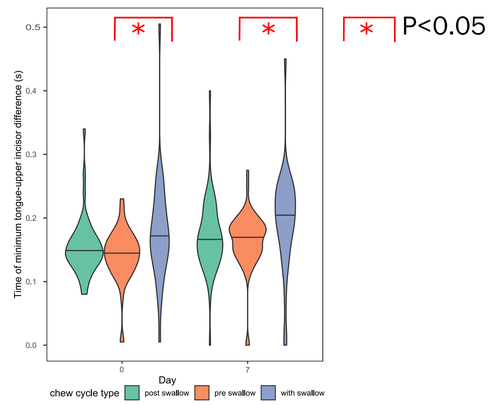
Chewing cycles are longer in day 7 rotenone treated rats than vehicle treated rats



Chew cycles that co-occur with swallows are longer than chew cycles that don't in both treated and untreated rats



Tongue jaw coordination is different in swallow associated chews but does not differ between treated and untreated rats



Discussion

All chew cycles are longer after treatment with rotenone: PD like pathology (bradikinesia).
H1 is not supported. Chews associated swallows are longer than other chews pre and post treatment: the impact of PD on chew cycle length is independent of the effect of swallowing on chew cycle length. Suggests chew swallow coordination is not impaired.
H2 is partially supported. No impact of treatment on tongue/jaw coordination whereas this is changed in chew associated swallows: suggests differential impact of rotenone induced PD like symptoms on tongue versus jaw movement in feeding.
Future directions:
Collect more detailed kinematics to identify how tongue and jaw movement differ pre and post treatment.
Record muscle activity of tongue and jaw muscles during chewing to identify changes in motor control of different orofacial structures.

Conclusion

Rotenone induced Parkinsonianism lengthens chewing cycles in rats irrespective of whether they occur before, with, or after a swallow. Thus coordination of jaw movement and swallowing appears unnaffected by Parkinsonian symptoms in rats. However timing data suggests that tongue-jaw-swallow coordination is slightly disrupted in rotenone treated rats. The neurological mechanism for this shift is unknown.

Acknowledgments

The authors would like to acknowledge the support of the animal care staff at Rowan SOM. This work was supported by Rowan funds to F. Gould and SMRF student fellowship to M. Palhang.

References

Coelho, M., Marti, M. J., Tolosa, E., Ferreira, J. J., Valldeoriola, F., Rosa, M., & Sampaio, C. (2010). Late-stage Parkinson's disease: The Barcelona and Lisbon cohort. Journal of Neurology, 257(9), 1524–1532.
Kwon, M., & Lee, J.-H. (2019). Oro-Pharyngeal Dysphagia in Parkinson's Disease and Related Movement Disorders. Journal of Movement Disorders, 12(3), 152–160.
Yu, H., Takahashi, K., Bloom, L., Quaynor, S. D., & Xie, T. (2020). Effect of Deep Brain Stimulation on Swallowing Function: A Systematic Review. Frontiers in Neurology, 11, 547.