

Dynamic magnetic resonance imaging of swallowing using a synchronized sampling method

Y. Honda¹, Y. Yanagi¹, N. Kawai¹, K. Kishi¹, D. Jianwu²

¹Department of Oral and Maxillofacial Radiology, Graduate school of Medicine, Dentistry and Pharmaceutical Sciences, Okayama University, Okayama-shi, Okayama, Japan, ²Intelligent Information Processing, Japan Advanced Institute of Science and Technology, Nomi, Ishikawa, Japan

Objective: A synchronized sampling method (SSM) was developed for the study of voluntary movements by combining the electro-cardio-graphic (ECG) gating method with an external triggering device. The purpose of this study is to observe the dynamic motion of swallowing using the SSM of magnetic resonance imaging.

Materials and Methods: One healthy volunteer (female 25 year-old) with no history of swallowing disorders were included in this study. MRI system were used a Shimazu-Marchoni ECLIPSE 1.5T Power-Drive 250 scanner. The auditory stimuli from the external trigger device were noise burst trains consisting of four 100-ms noise bursts in a cycle of 4000 ms, and they were presented through a headset to help the subject perform repetitions of swallowing in a regular manner. The subject hold a small tube in her mouth, and an assistant injected each 2 ml of a liquid bolus (oral MR contrast agent) from a syringe through the tube. While the subject repeated a sequence of swallowing 128 times at an interval of 4000 ms, the orofacial region of the subject was scanned in 2 slices (the mid-sagittal plane and the right 3 mm plane) to compose a movie of 128 volumes at the speed of 60 frames per seconds in supine body position.

Results: We could observe the dynamic motion of swallowing using the SSM. Dynamic images in the oral phase were observed the motion of the lip, tongue and soft palate and maintenance of the contrast medium. In the pharyngeal phase, the motion of the soft palate and the tongue base, closing of the larynx, the wave of the pharynx, and the opening of the pharyngo-esopharyngeal segment were observed. However, the esophageal phase were not observed. The oral contrast medium allowed us to observe the swallowing process within the oral cavity and the pharynx. (Figure 1)

Conclusion: Dynamic MRI of Swallowing using the SSM makes it possible to evaluate swallowing as the dynamic images of 60 frames per seconds. However, the supine body position of a subject was not physiological, and there is room for improvement about the number of repetitions.

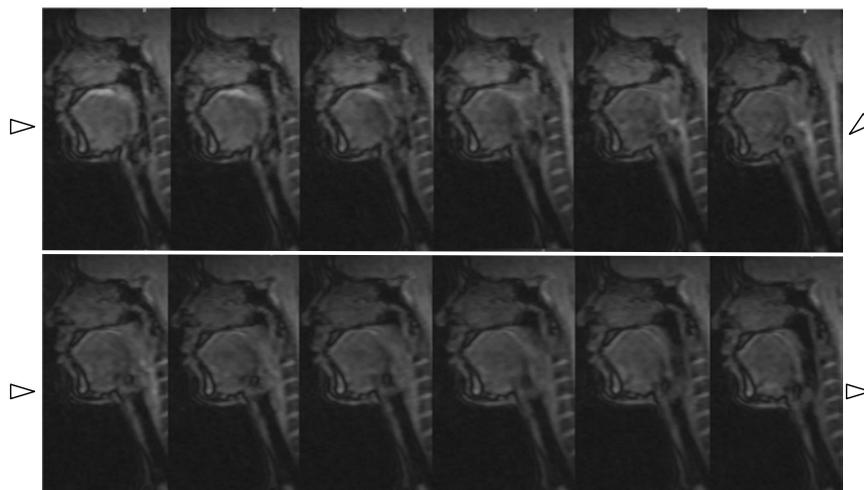


Figure 1 Selected 12 images (310-860 ms, 50 ms interval; See along arrow heads) of 128 frames in the mid-sagittal plane are shown. The oral contrast agent observed as a high intensity area. The motion of the tongue, and soft palate, maintenance of the liquid bolus, and motion of the dorsum of the tongue is clearly observable in the oral cavity.