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## 学 位 論 文 要 旨

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論文題名：Validation of the optimal site in the neck region for detecting swallowing sounds (頸部における嚥下音聴取のための最適部位に関する検討)		
論文内容の要旨 (2000字程度)		
<p><b>Background</b></p> <p>Recently, the swallowing sound has been used to detect swallowing events non-invasively. A previous study, using an accelerometer, showed that the site over the lateral border of the trachea immediately inferior to the cricoid cartilage was the optimal site for detecting swallowing sounds. However, the optimal site for detection of the swallowing sound using a microphone remains undetermined. Thus, the purpose of this study was to validate the optimal site in the neck region for detecting swallowing sounds using microphones.</p> <p><b>Methods</b></p> <p>Fourteen healthy subjects (mean age, <math>27.6 \pm 2.2</math> years; seven male and seven female) participated in this study. Twenty condenser microphones were attached to 20 sites on the left neck surface to detect swallowing sounds. Participants were instructed to swallow five different stimuli three times as follows: Resting saliva, 1 and 5 mL of Japanese tea, and 1 and 5mL of yoghurt.</p> <p>The mean relative peak intensity (MRPI) was calculated as the average value of the 2nd, 3rd, and 4th highest sound wave in each swallow. For each swallow, each of the 20 MRPI values was converted into percent MRPI (PMRPI); a relative value to the largest value in the 20 MRPIs observed for an identical swallow. The optimal site where the highest PMRPI was recorded was evaluated for each swallow. A sound spectrogram was used to illustrate the difference in the properties of swallowing sounds recorded from different MRPI sites.</p> <p>The Ethics Committee of the Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama University, approved the study protocol (Approval No.1507-044).</p> <p><b>Results</b></p> <p>The number of MRPI was highest in sites at the inferior border of the mandible just above the sternocleidomastoid muscle (site 11), and sites over the lateral border of the trachea immediately inferior to the cricoid cartilage (site 8) regardless of the type of stimuli. In all participants, the highest value of PMRPI was observed in the superior sites to the level of cricoid cartilage.</p> <p>Compared site 11 with site 8, the spectral region of swallowing sound below 750 Hz contained the majority of the frequency components in both spectrograms. However, comparison of the spectrograms showed a more dense distribution of higher frequency components in site 11 than site 8.</p>		

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### **Discussion**

Our results showed that sites 7, 8, 11 and 12 were most suitable for the detection of swallowing sounds compared with other sites. Among these sites, site 11, located at the inferior border of the mandible just above the sternocleidomastoid muscle, was the most optimal site for the detection of swallowing sound in the present study. Site 8, located at the position over the lateral border of the trachea immediately inferior to the cricoid cartilage, was also optimal for detecting swallowing sound.

These findings were not fully consistent with the previous study. This inconsistency might be caused by differences in recording methodology: sound microphone versus accelerometer. On the other hand, methodology for neck surface electromyography (N-EMG) for evaluating posterior tongue-lifting activity non-invasively was reported recently; the location of the surface electrode used to record N-EMG was almost identical to site 11 in the current study.

In addition, the site 11 spectrogram was revealed to contain a greater quantity of high-frequency components compared with site 8. Considering the fact that higher frequency signals are more easily dampened during transmission in viscoelastic material, it suggests that swallowing sound recorded at site 11 contains more functional information from high-frequency signals compared with the sound recorded at site 8.

### **Conclusion**

These results indicate that the region on the wrinkle line through the hyoid bone inferior to the anterior border of the sternocleidomastoid muscle is the optimal site to evaluate swallowing sound with regard to the magnitude and spectrogram measurements.

