論 文 要 旨

**Clinical study on fistula closure and speech outcomes
in patients with cleft palate
- An attempt at speech visualization using novel neural networks –**

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Objective: To confirm the validity of the NN-based analysis system (NN-system) by analyzing speech data from patients with cleft palate (CP) who underwent palatal fistular closure and examining the relationship between the analysis results by NN-system and perceptual assessment.

Patients: For comparison of the surgical techniques, a total of 31 patients, 21 in the hinge-flap group and 10 in the sliding-flap group were included. And for speech analysis using the NN-system, ten longitudinal patients from the hinge-flap group were enrolled. Three healthy Japanese infants, matched for age, were used as controls.

Main Outcome Measures: First, postoperative outcomes, such as recurrence rate of palatal fistula and the speech outcomes including hypernasality, nasalance scores, and articulation performance, were compared between the hinge- and sliding-flap groups. Second, to examine the reliability of the NN-system, an open test was conducted to detect the identification rate of three NNs (sounds source, articulation manner, articulation place). Next, 10 patients in the hinge-flap group were subjected to perceptual speech analysis and NN-based analysis. Furthermore, patients with CP who showed backed cleft type characteristics (CTCs: palatalization/palatal and backed to velar/uvular) were additionally assessed for the 17 task words containing [s] and [t] over time (at

pre-fistula closure, post-fistula closure, and post-speech therapy) by NN-system. The correlation between perceptual assessment by a SLT and the NN-based assessment was then examined.

Results: The fistula recurrence rate in the hinge-flap group (0%) was significantly lower than that in the sliding-flap group (30.0%) (P = 0.027). In the speech assessment, hypernasality and nasalance scores decreased post-operatively in both groups and significance was observed in the hinge-flap group (P = 0.013, P < 0.001, respectively). Articulation disorders were significantly improved in the hinge-flap group (P = 0.001). The results of open test showed that the mean frame and category identification rates were 77% or higher. Perceptual assessment of the 10 patients in the hinge-flap group showed a decrease in nasal airflow and CTCs, postoperatively and after speech therapy, respectively. And the analysis of the NN-system showed that there was a significant difference when observing the mean value of the output alveolar during pronunciation of [s] and [t] by the six participants with backed CTCs. Neither [s] nor [t] showed any significant differences between the post-speech therapy and control groups. In the relationship between the perceptual and NN-system assessment, a moderate positive correlation was observed for [s] with a correlation coefficient of 0.6676, p=0.003. For [t], no correlation was observed with a correlation coefficient of 0.4351, p=0.0711.

Conclusions: This study showed that the single hinge-flap method with double-breasted mattress suture should be preferred whenever appropriate. The novel neural network-based speech analysis system was shown to be reliable and valid.