Mastication is managed by cooperative movements of the jaw, lip, tongue, and buccal mucosa. Evaluating this process using soft tissue morphology, muscle mass, or muscular strength is important. Sarcopenia of the perioral muscle might cause a disorder of the cooperative movements of the muscles and tissues during mastication, as well as a decline in masticatory ability. The suprahyoid muscles, particularly the geniohyoid (GH), mainly assist in opening the jaw during mastication and play a critical role in controlling the position of the hyoid bone according to tongue movements.

This study aimed to clarify the effect of GH muscle morphology and related function on masticatory ability by using a decision-tree analysis and to examine whether evaluation of the GH muscle is an effective factor for evaluating masticatory function.

Purpose: To clarify the effect of geniohyoid (GH) muscle morphology and related function on masticatory ability using a decision-tree analysis. Materials and Methods: A total of 103 participants were enrolled. A cross-sectional area (CSA) of the GH muscle, neck circumference, body mass index, tongue pressure, jaw opening strength, and masticatory ability score were measured. The CSA of the GH muscle was selected as an independent variable for the first layer of the decision tree, with masticatory score as the dependent variable. Results and Conclusion: These data suggest that the CSA of the GH muscle may have a large impact on the masticatory ability score when evaluating masticatory ability. Int J Prosthodont 2018;31:569–572. doi: 10.11607/ijp.5862

Materials and Methods

The 103 participants (57 women and 46 men, mean age ± standard deviation [SD] 59.4 ± 19.5 years) included in this study were the same as in a previous study showing the relationship between the GH muscle and swallowing function. The same common data were used for analyses, but the data on masticatory function are original. This study was approved by the ethics committee of the Tokushima University Hospital (no. 2225).

A cross-sectional area (CSA) of the GH muscle was measured using an ultrasonic device (Fig 1). The masticatory score, used to assess masticatory ability, was obtained with a food-intake questionnaire consisting of 25 food items. Measurements of physical status included neck circumference and body mass index, and measurements of oral function included tongue pressure and jaw opening strength.

A decision-tree analysis with classification and regression tree algorithms was used to assess the influence of the GH muscle on masticatory ability. The masticatory score was the dependent variable, divided into two groups (best and good) based on the median value.

Results

Men showed significantly higher values than women in height, weight, neck circumference, tongue pressure, jaw opening strength, and CSA of the GH muscle (Table 1). Significant positive correlations were found between masticatory score and tongue pressure; jaw opening strength; and CSA of the GH muscle (Table 2).
Geniohyoid Muscle Directly Affects Masticatory Function

The CSA of the GH muscle was selected as the independent variable for the first layer of the decision tree (Fig 2). In the group with a CSA > 165.5 mm², the best masticatory score group included 22 (88.0%) participants. The second layer was divided into two groups, with a tongue pressure of 30.6 kPa as the threshold. In the group with a tongue pressure > 30.6 kPa, all participants belonged to the best group, with a masticatory score of 100. In the group with a CSA < 165.5 mm², the second layer was categorized into two groups, with a jaw opening strength of 3.2 kg as the threshold.

**Discussion**

To summarize the relationship model, the size of the CSA of the GH muscle had the greatest influence, and the masticatory score was high when the CSA of the...
GH muscle was large. The present authors previously reported that the CSA of the GH muscle influences jaw opening strength and tongue pressure. The GH muscle plays a critical role in fixing the hyoid bone during tongue pressure generation. Based on previous reports, it was speculated that a decrease in GH muscle mass would make the hyoid bone unstable and lead to a decline in tongue pressure. However, the results of this study suggest that a decrease in the muscle mass of GH may be a critical factor in decreasing the masticatory score and tongue pressure, rather than the decrease of tongue pressure causing a decrease in masticatory score.

Because the duration of the swallowing sound is also directly influenced by the CSA of the GH muscle without the direct concerns of tongue pressure and jaw opening strength, the CSA of the GH muscle is speculated to be an important factor for mastication and swallowing. While tongue pressure and jaw opening strength are determined by self-reliant efforts, the CSA of the GH muscle could be a more effective and objective gnathologic assessment with less variation.

This preliminary study is based on a limited sample size of 103 participants with a wide age distribution and a comparatively good median masticatory score. Thus, these results should be interpreted with caution because of potential sampling biases and the limitations inherent in cross-sectional study designs. The number of remaining teeth also influences masticatory score. Future studies are needed to investigate the role of the GH muscles on masticatory ability, considering also the roles of other muscles and gnathologic factors.
Conclusions

This study suggests that the CSA of the GH muscle may have a large influence on the masticatory score when evaluating masticatory ability.

Acknowledgments

The authors report no conflicts of interest.

References


Literature Abstract

Retrospective 2- to 7-Year Follow-Up Study of 20 Double Full-Arch Implant-Supported Monolithic Zirconia Fixed Prostheses: Measurements and Recommendations for Optimal Design

The objective of this study was to measure the extension of cantilever lengths, thicknesses, and heights of zirconia prostheses in the lingual and facial areas of the distal screw access openings and to evaluate the clinical performance regarding chipping or fracture of the distal cantilevered sections of double, full-arch, computer-aided design/computer-assisted manufacturing (CAD/CAM), screw-retained, stained, monolithic zirconia, gingival-colored, ceramic implant-supported fixed prostheses (MZ-FPs). Ten edentulous patients were provided with 20 CAD/CAM double full-arch MZ-FPs. The zirconia thicknesses around distal screw access openings at three different levels (crown height space, screw access opening lengths, and dimensions of the cantilevered segments) were measured in the resin prototypes. Patients were evaluated clinically (visually) without magnification, with intraoral digital photography, and radiologically by the author approximately every 6 months. A total of 10 patients with 20 MZ-FPs were evaluated, and 20 resin prototypes with 35 cantilevered segments (15 maxillary, 20 mandibular) were measured. The lingual and facial thicknesses of the resin frameworks and the crown height spaces of 35 distal access openings were measured. The average extension of the maxillary cantilever segments was 7.72 mm, and the mandibular cantilever average was 13.72 mm. The average crown height space for maxillary prostheses was 13.27 mm, and for the mandibular prostheses 11.89 mm. Zirconia thicknesses around distal screw access openings at the middle of the crowns, the margins, and the middle of the gingival areas (buccal side of maxillary prostheses) were 4.29, 3.79, and 3.87 mm, respectively. On the lingual sides, the thicknesses were 3.13, 2.85, and 3.15 mm, respectively. For mandibular prostheses, the thicknesses were 3.56, 3.08, and 3.15 mm, respectively, on the buccal sides, and were 2.07, 2.00, and 2.99 mm, respectively, on the lingual sides. No implant failure or changes in the occlusal surface, chipping of the cuspid or incisal edges, or prosthesis distal extension fractures were observed during follow-up periods ranging from 2 to 7 years. The survival rate was 100% for implants and prostheses. In one of the patients, chipping of the pink ceramic was noted in the maxillary prosthesis 36 months after placement. The results of this study indicated that full-arch MZ-FPs without cutback, or with partial digital cutback and veneering ceramic, were a therapeutic option. Recommendations regarding the thickness of zirconia at the level of the distal screw access openings, the crown height spaces, and the lengths of the cantilever segments were recorded. Additional in vitro and clinical studies will be required for more scientific analysis of the criteria for design of this type of prosthesis to minimize prosthetic complications. Long-term and multicenter studies are needed to corroborate the findings discussed in this report.