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Comparison of Solid Swallowing Parameters in Healthy Individuals with Different Oropharyngeal Aperture Degrees

Farklı Orofaringeal Açıklık Derecelerine Sahip Sağlıklı Bireylerde Katı Yutma Parametrelerinin Karşılaştırılması

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Abstract

Objective: Individuals with a narrow oropharyngeal aperture may experience difficulty swallowing solid food. The purpose of the present study was to investigate the relationship between the oropharyngeal aperture degrees and solid food swallowing performance parameters.

Materials and Methods: The oropharyngeal aperture degree of the individuals was evaluated using the Mallampati classification. Based on this classification, the individuals were divided into four classes. Solid-food swallowing performance was evaluated using the Test of Masticating and Swallowing Solids. The number of bites, chews, and swallows, and the total eating time were recorded while individuals were eating the cracker.

Result: A total of 176 individuals (96 females, 80 males) aged 18-65 years and without a complaint of swallowing difficulties, were included in the study. A difference was found among the classes in the number of bites during solid-food swallowing performance ($p = 0.047$). There was a difference between Class-I and Class-III ($p = 0.018$) and between Class-II and Class-III ($p = 0.026$). No difference was found among the classes regarding the number of chewing cycles, the number of swallows, and the total eating time ($p = 0.108$; $p = 0.768$; $p = 0.256$, respectively).

Conclusion: The oropharyngeal aperture degrees do not affect solid food swallowing parameters. It is generally accepted that eating habits, rather than the oropharyngeal opening, influence the time required to eat solid foods in individuals without dysphagia.

Keywords: Mallampati, oropharyngeal aperture, solid food swallowing performance, swallowing disorder

Öz

Amaç: Orofarebgeal açıklığı dar olan bireyler katı besinleri yutmada zorluk yaşayabilirler. Bu çalışmada amaç, orofarengeal açıklık derecesi ile katı besin yutma performans parametreleri arasındaki ilişkiyi incelemektir.

Materyal ve Metot: Bireylerin orofarengeal açıklık derecesi "Mallampati Sınıflaması" ile değerlendirildi. Bireyler, bu sınıflandırmaya göre dört gruba ayrıldı. Katı besin yutma performansı "Katıları Çiğneme ve Yutma Testi" kullanılarak değerlendirildi. Bireylerin krakeri yedikleri esnada ısırma, çiğneme ve yutkunma sayıları ile toplam yeme süreleri kaydedildi.

Bulgular: Çalışmaya 18-65 yaş aralığında, yutma güçlüğü şikâyeti olmayan toplam 176 birey (96 kadın, 80 erkek) dahil edildi. Katı besin yutma performans parametreleri arasında ısırma sayısı açısından sınıflar arasında fark vardı ($p = 0.047$). Sınıf I ile III ve Sınıf II ile III arasında fark vardı ($p = 0.018$; $p = 0.026$, sırasıyla). Çiğneme sayısı, yutkunma sayısı ve toplam yeme süresi açısından sınıflar arasında fark yoktu ($p = 0.108$; $p = 0.768$; $p = 0.256$, sırasıyla).

Sonuç: Orofarengeal açıklık derecesi katı besin yutma parametreleri etkilememektedir. Yutma bozukluğu olmayan bireylerde katı besin yeme sürelerini orofarengeal açıklıktan daha çok yeme alışkanlıklarının etkilediği düşünülmektedir.

Anahtar Kelimeler: Katı besin yutma performansı, mallampati sınıflandırması, orofarengeal açıklık derecesi, yutma bozukluğu

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INTRODUCTION

Both voluntary and involuntary sensorimotor systems work together during swallowing, a process that is investigated in four stages. The oral propulsion phase, which involves moving the bolus toward the throat to start the swallowing reflex, comes after the preparatory phase, which starts with the proper preparation of the meal in the oral cavity.[1] To ensure that the bolus is safely delivered from the mouth to the esophagus without escaping into the airway, the pharynx quickly reorganizes from its primary respiratory configuration to a temporary swallowing configuration during each swallowing action. Multiple muscles are sequentially contracted and relaxed during this procedure.[2,3] In order to ensure safe swallowing, oropharyngeal passage management is crucial.

Oropharyngeal structures such the palatum molle, radix linguae, pharyngeal wall, and epiglottis are crucial structural components for safe swallowing, according to studies on swallowing function. The coordinated and appropriate functioning of breathing, chewing, and swallowing depends on these oropharyngeal structural features.[4-6] It is stated that the close positioning of the palatum molle and radix linguae during swallowing facilitates the propulsion of the bolus through the oropharynx while also maintaining airway patency.[7] The Passavant ridge, found in 11–30% of people and located on the posterior pharyngeal wall, assists in closing the velopharyngeal sphincter and facilitates safe swallowing.[8] Another study by Radhakrishnan et al.[9] reported that individuals with narrower oral cavities are more likely to experience difficulty swallowing pills.

The Mallampati classification was developed to determine the degree of narrowing of the oropharyngeal anatomic structures preoperatively and to estimate the difficulty of endotracheal intubation.[10] This classification is frequently used in the clinic to simply and noninvasively assess the degree of narrowing of the oropharyngeal anatomic structures.[11] There are a limited number of studies examining the relationship between the oropharyngeal aperture degrees and swallowing function. A study by Liu et al.[12] reported that elderly individuals with Class-I oropharyngeal aperture according to the Mallampati classification had a higher rate of aspiration during saliva swallowing. Swallowing biomechanics significantly influences the velocity of the bolus passing through the oropharyngeal structures, the tongue base-pharyngeal wall contact, and the amount of hyolaryngeal elevation, depending on the bolus volume, viscosity, and rigidity.[13,14] Especially during the swallowing of solid foods, the relative narrowness or wideness of the oropharyngeal space is considered a critical anatomical factor determining bolus control, breakdown time, and coordination of pharyngeal passage.[15] However, studies directly examining the effect of oropharyngeal patency on solid food swallowing parameters in healthy individuals are quite limited in the current literature. The literature suggests that the close proximity of oropharyngeal structures to one another can provide both advantages[7,8] and disadvantages.[9]

This study was designed to compare solid-food swallowing parameters in healthy individuals with varying degrees of oropharyngeal aperture, enabling clinicians to predict solid-food swallowing ability during evaluation.

MATERIALS AND METHODS

Ethics Committee Approval: After the individuals were informed of the scope and procedures of the present study, they signed informed consent forms. The present study was conducted in accordance with the ethical guidelines and principles of the Declaration of Helsinki. The Bursa Uludag University Noninvasive Clinical Research Ethics Committee approved the study (Date:16.07.2025, Decision No:2025/13/8).

A total of 176 individuals (96 females, 80 males) participated in the present study. The individuals were divided into four classes according to the Mallampati classification (Class-I, Class-II, Class-III and Class-IV). The study included healthy individuals aged 18 to 65 years without difficulty or fear of swallowing and with a Body Mass Index (BMI) ranging from 18 to 29.9 kg/m^2. The exclusion criteria for this study were individuals with neurological or cognitive impairment, pill swallowing difficulty, a history of neck malignanity, a history of head and neck surgerie, a history of prior intubation or tracheostomy, swelling of the tonsils, acute upper respiratory tract infections, a diagnosis or subjective complaint of bruxism, current use of orthodontic appliances (braces), or existing temporomandibular joint pain.

Evaluation: Demographic information, oropharyngeal aperture, and solid-food swallowing performance of the individuals participating in the study were evaluated by the same researcher, respectively.

Evaluation of Oropharyngeal Aperture: The Mallampati Classification was used to assess the oropharyngeal aperture. The Mallampati Classification used today was developed by Samsoon[16] and differs from the original Mallampati Classification in terms of class and number of anatomical reference points. The anatomical structures of the upper airway are classified into 4 different grades based on their visibility. The classification is based on

whether the soft palate, uvula, and pharyngeal pillars are fully visible (Class-1), whether the soft palate, uvula, and pharynx are visible (Class-2), whether the soft palate and uvula base are visible (Class-3), and whether only the hard palate is visible but the soft palate is not visible (Class-4) (Fig. 1).[16] During the evaluation, individuals were asked to sit upright and protrude their tongue by opening their mouths wide.[17]

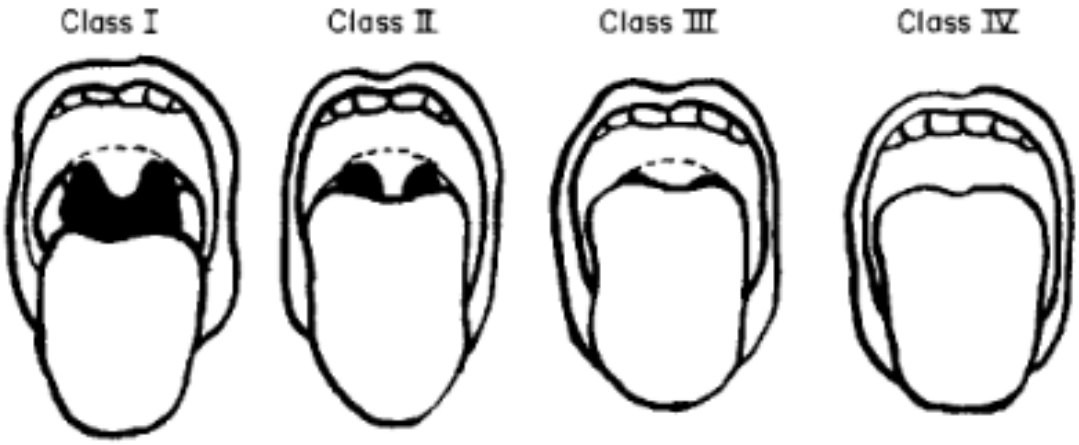

Fig. 1: Mallampati classification. A: Class-I; B: Class-II; C: Class-III; D: Class-IV.[16]

The Test of Masticating and Swallowing Solids: The Test of Masticating and Swallowing Solids, which has been validated and is reliable, was used to assess solid food swallowing performance parameters (number of bites, chews, swallows, and total eating time).[18] A standard cracker was used during this test (Taç Kraker, Ülker, Türkiye). Individuals were instructed to eat the cracker as fast as they could. To guarantee accurate analysis of the evaluation parameters, the test procedure was videotaped. The participant's total number of bites, chews, swallows, and total time to finish the cracker were all noted during the analysis. When the cracker was fully consumed, the participant was asked to state "done," and the assessor verified this by opening their lips.[15] In the study conducted by Kavakcı et al.[19] on healthy adult individuals in Türkiye, normative data were obtained for the TOMASS, and it was shown that the test was valid and usable for the population of our country.

Statistical Analysis: The IBM SPSS for Windows version 25 software (IBM Corp., Armonk, NY, USA) was used to analyses. Descriptive statistics were given as mean ± standard deviation for numerical data. The Shapiro–Wilk test was used to determine the normal distribution of the obtained numerical variables. Age, Body Mass Index, Solid Chewing and Swallowing Test Parameters (Number of Bites, Chews, Swallow, and Total Eating Time) were observed to be nonnormally. For descriptive statistics of variables that do not follow a normal distribution, median, min-max, and IQR values were used. The Kruskal-Wallis test was used to assess differences in age, BMI, number of bites, number of chews, number of swallows, and total eating time across oropharyngeal aperture degrees. If the Kruskal-Wallis test is statistically significant, a post hoc test is performed to determine which group or groups are responsible for the difference. A post-hoc test was used to determine which oropharyngeal aperture was responsible for the significant difference in the number of bites observed between the oropharyngeal apertures. The Pearson Chi-Square Test was used to determine whether there was a difference in gender between the classes. The significance level was accepted as $p<0.05$.

RESULT

A total of 176 individuals participated in the study. The individuals were classified into four classes based on their oropharyngeal aperture degrees (Class-I, n:44; Class-II, n:47; Class-III, n:40; Class-IV, n:45). There was no difference between the classes in terms of gender, age, BMI, number of chews, number of swallows and total eating time ($p = 0.968$; $p = 0.054$; $p = 0.198$; $p = 0.108$; $p = 0.768$; $p = 0.256$, respectively) (Table 1).

Table 1. Investigation of the difference between oropharyngeal aperture degrees and solid food swallowing performance parameters.

		Class I (n: 44)	**Class II** (n: 47)	**Class III** (n: 40)	**Class IV** (n: 45)	**p**
Sex, n (%)	Female	24 (54.45)	27 (57.44)	21 (52.5)	24 (53.33)	0.968*
	Male	20 (45.45)	20 (42.56)	19 (47.5)	21 (46.66)	
Age (year), Median (Min-Max) (IQR)		26.00 (18-64) (13.75)	22.00 (18-60) (7.00)	31.00 (18-65) (32.75)	23.00 (18-65) (18.00)	0.054++
BMI (kg/m²), Median (Min-Max) (IQR)		24.35 (18.52-29.60) (5.22)	22.95 (18.20-29.30) (6.55)	25.60 (18.07-29.91) (7.59)	25.10 (18.65-29.52) (6.95)	0.141++
Solid Chewing and Swallowing Test Parameters, Median (Min-Max) (IQR)	The Number of Bites	2.00 (1-4) (2.00)	2.00 (1-4) (1.00)	2.00 (1-6) (1.00)	2.36 (1-6) (1.50)	**0.047**++
	The Number of Chews	29.50 (14-66) (16.50)	29.00 (19-48) (11.00)	33.00 (18-79) (14.75)	34.00 (16-85) (18.00)	0.108++
	The Number of Swallows	2.00 (1-5) (1.00)	2.00 (1-3) (1.00)	2.00 (1-4) (1.75)	2.00 (1-4) (1.00)	0.768++
	Total Eating Time (sn)	23.89 (12.53-59.84) (13.48)	25.09 (11.72-41.53) (9.50)	28.21 (13.45-57.41) (17.11)	26.58 (11.38-83.24) (13.94)	0.256++

BMI: Body Mass Index; *: Pearson; ++: Kruskal Wallis Test; p<0.05.

There was a difference between the classes in the number of bites during solid-food swallowing performance parameters (p = 0.047). Pairwise comparisons revealed a difference between Class-I and Class-III (p = 0.018) and between Class-II and Class-III (p = 0.026). Individuals in Class-III had a higher number of bites. There was a difference between Class-I and Class-II (p = 0.863), Class-I and Class-IV (p = 0.100), Class-II and Class-IV (p = 0.134), and Class-III and Class-IV (p = 0.440). The relevant values are presented in Table 2.

Table 2. Results of a post-hoc test between oropharyngeal aperture degrees and the number of bites.

Oropharyngeal Aperture Degrees	**p**
Class I – Class II	0.863
Class I – Class III	**0.018**
Class I– Class IV	0.100
Class II – Class III	**0.026**
Class II – Class IV	0.134
Class III – Class IV	0.440

A Post-Hoc Test; p<0.05.

DISCUSSION AND CONCLUSION

No study was found in the literature examining the relationship between the degree of oropharyngeal aperture and solid food swallowing performance parameters (number of bites, chews, swallows, and total eating time). When the results were examined, a difference was found only in the number of bites among the classes within the solid food swallowing parameters, while no difference was found in terms of the number of chews, the number of swallows, and the total eating time. In the study, the number of bites in Class III individuals was higher than in other classes. This study was designed to compare solid food swallowing performance parameters in healthy individuals with different degrees of oropharyngeal aperture.

The Mallampati classification, used to classify oropharyngeal aperture, is particularly used in anesthesiology to predict intubation difficulty. This classification classifies oropharyngeal aperture based on the size of the tongue base and the oropharyngeal cavity, as well as the visibility of upper respiratory tract structures.[16] There are limited studies in the literature examining the relationship between the oropharyngeal aperture degrees and swallowing function. Liu et al.[12] examined the relationship between oropharyngeal aperture degree and the risk of aspiration pneumonia and reported a higher risk in geriatric individuals with lower oropharyngeal aperture degrees (Class I).

They interpreted the higher incidence of pneumonia in these individuals as reflecting the tongue base's lesser effect on closing the oropharynx, which may have increased the risk of aspiration pneumonia. However, the absence of a significant relationship between oropharyngeal aperture degrees and the repetitive saliva swallowing test (RSST) suggests that upper airway anatomy may be a more effective in risk of community-acquired pneumonia than a direct indicator of swallowing performance. Oropharyngeal aperture is more closely related to solid foods than liquids. Liquid foods lack the oral preparation and oral phase stages of solid foods, and they trigger swallowing directly.[20] A narrow oropharyngeal opening might be thought to negatively affect the duration of solid food consumption and the number of swallows. However, in light of the data obtained from this study, no differences were found in solid food swallowing parameters other than the number of bites in individuals with different oropharyngeal openings.

The literature indicates that boluses with high viscosity generate greater oropharyngeal pressure and slow bolus passage.[21] The palatum molle and radix linguae play a significant role in determining the degree of oropharyngeal opening. They approach each other during swallowing to push the bolus towards the oropharynx and, at the same time, maintain airway aperture, a critical function in ensuring safe swallowing.[7] It has been stated that in individuals with a large tongue volume, a flat or low palate, or more cheek tissue, solid foods may come into contact with more sensory receptors due to the reduced oropharyngeal aperture, which may trigger chewing or gag reflexes and cause delayed swallowing.[9] Contrary to the literature, this study determined that there was no difference in the time it takes to eat and swallow solid food between healthy individuals with narrow or wide oropharyngeal openings. However, in individuals with heightened sensory sensitivity, a narrow oropharyngeal opening may negatively affect the swallowing of solid foods.

The number of bites used during chewing and swallowing solid foods is considered a key parameter in performance-based assessment methods, such as TOMASS. TOMASS objectively measures chewing and swallowing performance during solid-food consumption, showing that not only anatomical factors but also behavioral and strategic differences can affect this performance.[18] In this study, there was a difference between individuals clinically classified as Class III and those in Class I and II. We believe this difference is not due to oropharyngeal opening but rather to individuals preferring to consume solid foods by dividing them into smaller pieces and adopting a more controlled eating strategy. The literature reports that chewing and swallowing performance is affected by anatomical factors such as mouth opening, morphology of oropharyngeal structures, and dental occlusion, as well as individual eating habits and learned behaviors. Particularly in healthy individuals, the use of different chewing strategies during the consumption of solid foods can lead to significant variations in chewing cycle and bite count.[22] Our observation that some participants consumed crackers whole, while others preferred taking small, frequent bites, supports this finding.

This study has some limitations. The primary limitation is the absence of instrumental swallowing assessment methods. This would allow a clearer demonstration of the effects of anatomical differences on solid-food swallowing performance parameters. The second limitation is that the malocclusal status and the history of wisdom tooth extraction were not evaluated. Another limitation is that although the crackers used in the TOMASS test have similar technical specifications in national and international reference articles, they are from different brands. This situation may limit the direct comparability of universal normative data. Finally limitation is that all participants were healthy individuals without a complaint of dysphagia. The oropharyngeal aperture angle may significantly affect solid-food swallowing parameters in patients with swallowing difficulty.

In conclusion, this is the first study to examine the relationship between the oropharyngeal aperture and solid-food swallowing performance in healthy individuals. Based on the findings, a difference in the number of bites among study participants was observed according to their oropharyngeal aperture degree. It has been observed that individuals with a Class-III oropharyngeal aperture degree have a higher number of bites than those with other degrees. However, no difference was found in the number of chews, swallows, or total eating time. These results suggest that individual eating habits are more important than oropharyngeal aperture degree for solid-food swallowing performance parameters in healthy individuals. Further investigation is needed into the negative effects of age on anatomical structures related to swallowing. Studies using instrumental methods can shed light on this field.

Ethics Committee Approval: The authors confirm that this study complies with the Declaration of Helsinki and that, following local ethical approval, all subjects provided written informed consent. The Bursa Uludag University

Noninvasive Clinical Research Ethics Committee approved the study protocol (Date:16.07.2025; Decision No: 2025/13/8).

Conflict of interest: All authors have no conflicts of interest regarding the data collected and procedures used in this study.

Author contributions: Concept – CS, EU; Supervision – CS, EU, OO; Materials – CS, EU; Data Collection and/or Processing – EU; Analysis and/or Interpretation – CS; Writing –CS, EU.

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REFERANCES

1. Logemann JA. Dysphagia: Evaluation and treatment. Folia Phoniatrica et Logopaedica. 1995;47(3):140–164. doi:10.1159/000266348
2. Jean A. Brain stem control of swallowing: Neuronal network and cellular mechanisms. Physiological Reviews. 2001;81(2):929–969. doi: 10.1152/physrev.2001.81.2.929
3. Ertekin C, Aydogdu I. Neurophysiology of swallowing. Clinical Neurophysiology. 2003;114(12):2226–2244. doi:10.1016/s1388-2457(03)00237-2
4. Dodds WJ. Radiologicassessment of abnormal oral and pharyngeal phases of swal-lowing. AJR. American Journal of Roentgenology, 1990;154:965–974. doi:10.2214/ajr.154.5.2108570
5. Matsuo K, Palmer, JB. Anatomy and physiology of feedingand swallowing: Normal and abnormal. Physical Medicine and Rehabilitation Clinics of North America. 2008;19, 691–707. doi:10.1016/j.pmr.2008.06.001
6. Matsuo K, Palmer, JB. Video fluoroscopic techniquesfor the study of Oral food processing. Current Opinion in FoodScience. 2016;9, 1–10. doi:10.1016/j.cofs.2016.03.004
7. Rosero Salazar DH, Honnlee L, Nguyen PH, Willis E, Liu ZJ. Spatial relationships of oropharyngeal structures during respiration, chewing, and swallowing. The Anatomical Record. 2024 Dec 2. doi:10.1002/ar.25605
8. Finkelstein Y, Lerner MA, Ophir D, Nachmani A, Hauben DJ, Zohar Y. Nasopharyngeal profile and velopharyngeal valve mechanism. Plastic and Reconstructive Surgery. 1993;92(4):603–614. doi:10.1097/00006534-199309001-00008
9. Radhakrishnan C, Sefidani Forough A, Cichero JAY, et al. A difficult pill to swallow: An investigation of the factors associated with medication swallowing difficulties. Patient Preference and Adherence. 2021;15:29–40. doi:10.2147/PPA.S277238
10. Mallampati SR, Gatt SP, Gugino LD, et al. A clinical sign to predict difficult tracheal intubation: A prospective study. Canadian Anaesthetists' Society Journal. 1985;32(4):429–434. doi:10.1007/BF03011357
11. Lesavoy B, Lumsden C, Grunstein E, Yoon R. Mallampati and Brodsky classification and children's risk for sleep related breathing disorder. Journal of Clinical Pediatric Dentistry. 2022;46(4):280–286. doi:10.22514/1053-4625-46.4.4
12. Liu J, Fukuda H, Kondo E, Sakai Y, Sakai H, Kurita H. Screening of aspiration pneumonia using the modified Mallampati classification tool in older adults. PLOS ONE. 2024;19(5):e0302384. doi:10.1371/journal.pone.0302384
13. Steele CM, Miller AJ. Sensory input pathways and mechanisms in swallowing: a review. Dysphagia. 2010;25(4):323-333. doi:10.1007/s00455-010-9301-5
14. Logemann JA, Pauloski BR, Rademaker AW, Kahrilas PJ. Oropharyngeal swallow in younger and older women: videofluoroscopic analysis. J Speech Lang Hear Res. 2002;45(3):434-445. doi:10.1044/1092-4388(2002/034)
15. Palmer JB, Rudin NJ, Lara G, Crompton AW. Coordination of mastication and swallowing. Dysphagia. 1992;7(4):187-200. doi:10.1007/BF02493469
16. Samsoon GL, Young JR. Difficult tracheal intubation: A retrospective study. Anaesthesia. 1987;42(5):487–490. doi:10.1111/j.1365-2044.1987.tb04039.x
17. Jackson JS, Rondeau B. Mallampati Score. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. https://www.ncbi.nlm.nih.gov/books/NBK585119/. Accessed December 8, 2025.
18. Huckabee ML, McIntosh T, Fuller L, et al. The Test of Masticating and Swallowing Solids (TOMASS): Reliability, validity and international normative data. International Journal of Language & Communication Disorders. 2018;53(1):144–156. doi:10.1111/1460-6984.12332

19. Kavakcı M, Ozdemir S, Aras B, Kuruoğlu E. Turkish normative data for the Test of Masticating and Swallowing Solids (TOMASS). Çukurova Medical Journal. 2021;46(3):920–926.
20. Todaro F, Pizzorni N, Scarponi L, Ronzoni C, Huckabee ML, Schindler A. The Test of Masticating and Swallowing Solids (TOMASS): Reliability and validity in patients with dysphagia. International Journal of Language & Communication Disorders. 2021;56(3):558–566. doi:10.1111/1460-6984.12613
21. Omari T, Ross A, Schar M, et al. Effect of thickened fluids on swallowing function in oropharyngeal dysphagia: Impact of shear rheology and disorder subtype. Neurogastroenterology & Motility. 2025;37(4):e15003. doi:10.1111/nmo.15003
22. Peyron MA, Lassauzay C, Woda A. Effects of increased hardness on jaw movement and muscle activity during chewing of viscoelastic model foods. Experimental Brain Research. 2004;154(1):41-51.