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CLINICAL RESEARCH

Influence of masticatory side switch frequency on masticatory mixing ability and sensory perception in adults with healthy dentitions: A randomized crossover trial

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ABSTRACT

Statement of problem. The advantages and disadvantages of frequently changing sides while masticating remain unclear.

Purpose. The purpose of this clinical study was to determine the effect of varying the frequency of masticatory side switches on masticatory mixing ability and sensory perception in dentate adults.

Material and methods. This nonblinded, randomized 12-period crossover study, conducted at Barcelona Dental School from January to March 2022, included 36 healthy adults with natural dentitions (median age, 23.5 years; 26 women). Participants were randomly allocated to 12 sequences and performed 12 masticatory assays masticating a 2-colored gum for 40 cycles each using the following masticatory styles as interventions: freestyle, unilateral right, unilateral left, and switching sides 5%, 15%, and 25%. The primary outcome was the mixing ability index (MAI), defined as the standard deviation of the red channel intensity of the masticated gum in the color-histogram plugin of the ImageJ software program. Participants also rated the perceived flavor intensity and salivary flow on a visual analog scale. Data were analyzed by repeated measures analysis of variance (α=.05).

Results. The MAI was similar for all masticatory styles (P=.63). Participants perceived greater flavor intensity (mean difference: 8%, 95% CI: 1% to 15%) and salivary flow (mean difference: 11%, 95% CI: 0% to 21%) with 25% side switching compared with freestyle or unilateral mastication.

Conclusions. Frequently switching the masticatory side while masticating gum does not alter the mixing ability, but it appears to enhance salivary flow and flavor intensity. (J Prosthet Dent 2024;131:1093-103)

Prosthodontic treatment aims to restore or improve the masticatory function of the oral system. Masticatory function can be evaluated subjectively by questionnaires or objectively by masticatory assays.[1] Objective masticatory performance, for example, can be assessed by quantifying the degree of comminution of a test food after a certain number of masticatory strokes and by quantifying the ability to mix a 2-color chewing gum.[2-8] Masticatory function can also be assessed indirectly by masticatory rhythm and masticatory laterality analyses.[9-14] Indicators of good masticatory health include high masticatory performance, a normal and consistent masticatory rhythm, and a low level of unilateral mastication.[15-20]

An aspect of masticatory laterality is the number of masticatory side changes,[16,21] also known as masticatory side switch (MSS) frequency.[22,23] The normal MSS frequency seems to be between 5% and 32% of the maximum switches possible, depending on the dental state and food type.[15,21-25] In addition to this large

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Clinical Implications

In dentate adults, increasing the frequency of masticatory side switching to 25% does not impair mixing, but it may improve salivary production and flavor intensity. Dental personnel could counsel patients to masticate slowly and symmetrically and by changing their masticatory side every 4 to 8 cycles.

interindividual variability, and contrasting with other aspects of the masticatory function, MSS frequency has been reported to have high intraindividual variability while masticating biscuits, bread, or bagged silicone.[21,23] However, the advantages and disadvantages of frequently changing sides while masticating remain unclear. Patients missing 3 unilateral posterior teeth have been reported to show fewer side switches than dentate controls and recover normal MSS frequency after treatment with implant-supported, fixed partial prostheses.[25] Recently, increases in MSS frequency have been reported to reduce the masticatory rhythm but not the masticatory performance when assessed by the comminution of bagged silicone.[23] If simultaneous bilateral mastication provides increased flavor intensity and enhanced saliva production compared with consistent unilateral mastication,[16] alternating unilateral mastication or frequently changing sides should also provide these sensory perception benefits. Flavor integrates taste, aroma, and texture sensations and contributes to the enjoyment of eating.[26,27] Several associations have been reported between some aspects of the masticatory pattern and aroma release or flavor perception.[28-31] Moreover, alternating sides 10 times when masticating model custards was reported to produce higher flavor intensity and persistence than freestyle mastication, though the authors allowed only 5 seconds for freestyle mastication compared with 15 seconds for the alternating masticatory style.[32] Because the time from baseline to swallowing is a limiting factor for volatile flavor release, whether these flavor variations are attributable to the time or the MSS frequency is difficult to determine.

Certain aspects of the eating process are related to well-being and health.[33-38] Elucidating the effects of MSS frequency on mixing ability and sensory perception might provide novel insights into the physiology of mastication. Dentists could use this knowledge to advise patients how frequently they need to change the masticatory side. The purpose of this clinical study was to determine whether different side switch frequencies alter the masticatory mixing ability in healthy dentate adults. The secondary aims were to assess how variations in side switch frequency affected the sensory perception and masticatory rhythm and to explore the interindividual relationship between sensory perceptions and masticatory function during freestyle mastication. The null hypothesis was that mastication at different MSS frequencies would not affect the mixing ability.

MATERIAL AND METHODS

In this randomized crossover trial, 6 interventions (masticatory styles) through 12 periods of approximately 1 minute were assessed, allowing washout intervals of 2 to 5 minutes between periods. The crossover design was chosen because interindividual variability is higher than intraindividual variability for mastication and because no carry-over effect was expected. The number of sequences was chosen to reduce the bias in the order of performing each masticatory style. One researcher (I.M.T.) randomly assigned each participant to a sequence arm by using a software program (Research Randomizer; https://www.randomizer.org) with permuted blocks to achieve an equal participant number per arm (Fig. 1). The intervention sequence, allocation, and outcome assessment were not subjected to blinding, and no significant modifications to the study design were made after it had started.

The study protocol was approved by the local Ethics Committee (Barcelona University Dental Hospital, number #2021/044) and was registered at clinicaltrials.gov (NCT05173259). All procedures were carried out in accordance with the principles of the Helsinki Declaration. This report follows the guidance of the consolidated standards of reporting trials (CONSORT) extension for randomized crossover trials.[39]

A sample size of 36 was needed to detect a statistically significant difference of $\geq$2 units on the mixing ability index (MAI), given a standard deviation (SD) of 4.2 units and 2-sided alpha and beta risks of .05 and .2, respectively.[3] The requisite number of volunteers was recruited from students at the University of Barcelona Dental School (Catalonia, Spain) from January to March 2022. For inclusion, participants had to be between 18 to 40 years, in good general health, and to have at least 24 natural teeth without edentulous spaces. Those with severe malocclusion, active orthodontic treatment, orofacial pain, or other conditions that could affect masticatory function were excluded. All participants provided written consent before the study began.

Participant age and sex were obtained by interview and details of the dentition (including number of teeth and Angle classification) by clinical examination. Vertical and horizontal overlaps were measured with digital calipers (Absolute; Vogel).[40]

Participants were exposed to 6 interventions by applying 1 of 6 masticatory styles during an assay of 40 masticatory cycles. Because each masticatory style was

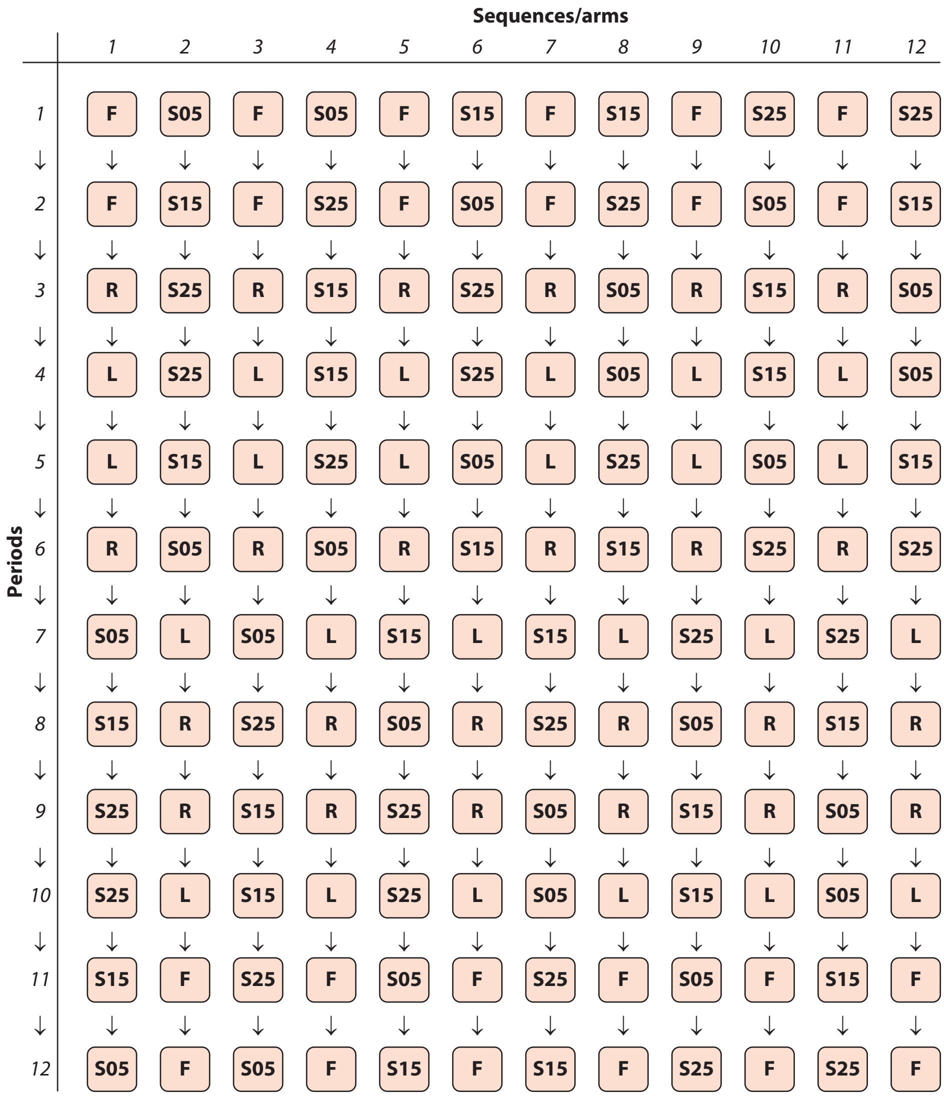

Figure 1. Study design. freestyle mastication (F), without imposing a masticatory side; unilateral left mastication (L); unilateral right mastication (R); S05, S15, and S25, side switching frequencies of 5%, 15%, and 25% per trial of 40 masticatory cycles, respectively; "↓" = Washout period of 2 to 5 minutes. F, freestyle mastication; L, unilateral left mastication; R, unilateral right mastication; S05, switching frequencies of 5%; S15, switching frequencies of 15%; and S25, switching frequencies of 25%.

performed twice, each participant completed 12 masticatory assays following a predetermined sequence (Fig. 1).

The test food was a sugar-free 2-colored chewing gum assembled from a spearmint flavor gum (Green, "Hierbabuena," 5; Mars Wrigley) and a cool berry flavor gum (Red, "Frutos rojos," 5; Mars Wrigley). The 2-colored chewing gum (3×20×37.5 mm; 2.5 g) was obtained by sealing a half of a strip of one flavor to another half of the other flavor with a drop of distilled water (Fig. 2). The 6 masticatory styles were as follows: Freestyle (F)=masticating naturally, following no specific pattern; unilateral right (R)=masticating using only the right side; unilateral left (L), masticating using only the left side; MSS 5% (S05)=changing sides twice (in the cycles 11 and 31); MSS 15% (S15)=changing sides 5 times (in the cycles 5, 13, 21, 29, and 37); and MSS 25% (S25)=changing sides 10 times (in the cycles 3, 7, 11, 15, 19, 23, 27, 31, 35, and 39).

Participants were seated in an upright position and the 40 masticatory cycles were counted by an examiner (I.M.T.) while each masticatory assay was video recorded using a smartphone (P30 lite, Huawei). The gum was retrieved from the mouth after completing the 40 cycles, excess saliva was removed, and the gum was placed into a transparent plastic bag and coded. The chewing gum was flattened to a thickness of 1.5 mm using 2 glass plates. Each side of the gum was then scanned at a resolution of 300 dpi and saved in Joint Photographic Experts Group (JPEG) format.

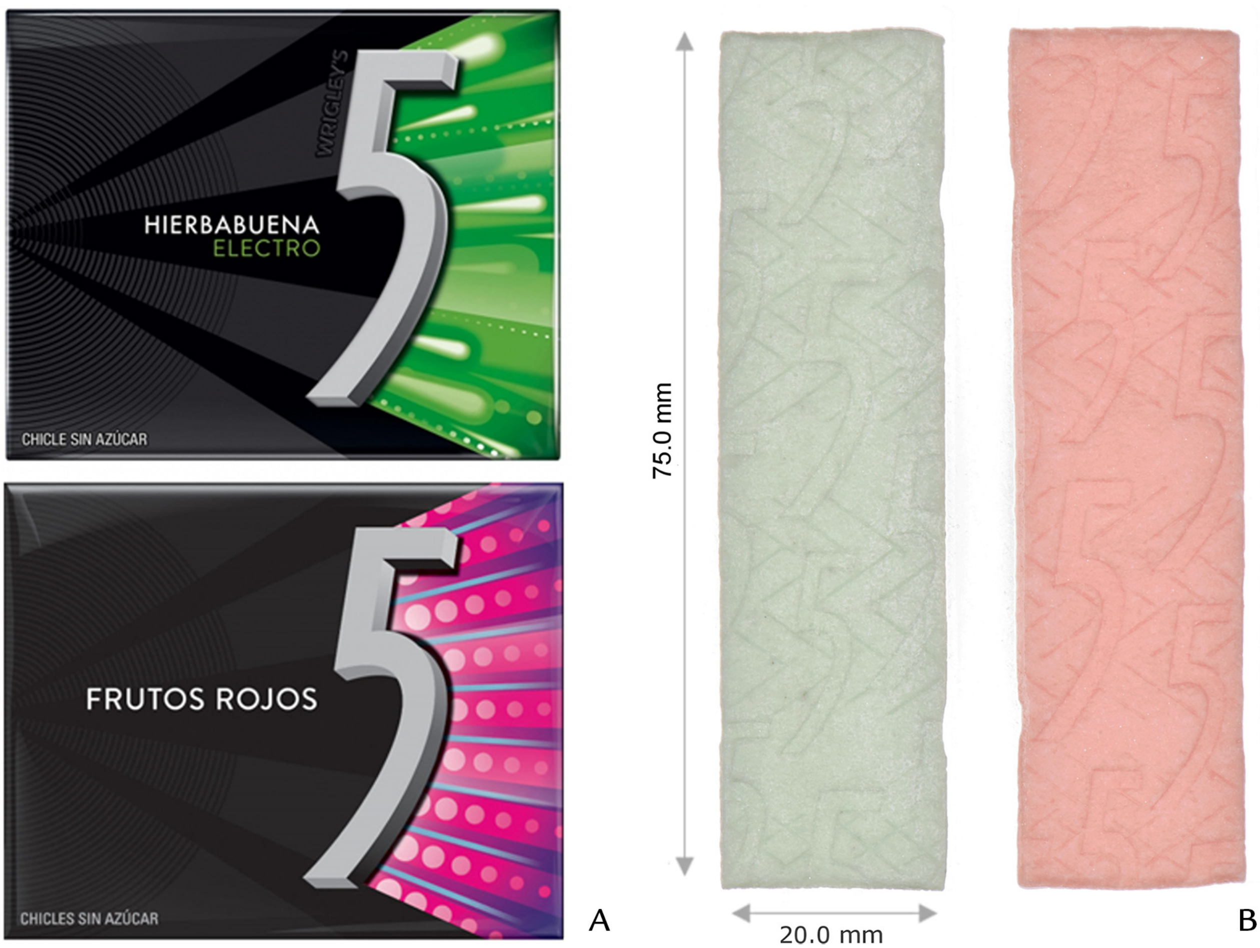

Figure 2. Test food preparation. A, Sugar-free chewing gum 5 (Wrigley; "Hierbabuena"=*green*, "Frutos rojos"=*red*). B, Dimensions of original chewing gum strip. C, Dimensions of halved chewing gum strip. D, Thickness of 2 halves of chewing gum sealed with droplet of distilled water.

Immediately after each masticatory assay, participants were asked to rate 2 sensory attributes experienced during the masticatory test: the perceived flavor intensity ("During this masticatory test, what flavor intensity did you notice?") and the perceived salivary flow ("How much saliva do you think you produced?"). Each response was marked as a vertical line on a 100-mm visual analog scale from "not at all" (left end) to "very much" (right end).

The number of masticatory cycles, the gum colors to be combined, the scanning resolution, and the color channel were chosen based on the higher intraclass correlation coefficient (ICC) values determined from a preliminary study of reliability compared with other chewing gum colors, 5 or 20 masticatory cycles, a 600 dpi resolution, and analyzing the green or blue channel. All chewing gum images were analyzed according to the method described by van de Bilt et al[3] using the color-histogram plugin of a software program (ImageJ; National Institutes of Health) (Fig. 3). The color-histogram software program also determined the SD of the red color intensity from all pixels, which in turn reflected the degree of mixing between these 2 colors. Therefore, using the SD of red intensity as the MAI, a higher mixing index indicates poorer mixing capacity and vice versa. To assess interrater agreement, 2 operators (I.M.T., M.G.J.) determined the MAI for each masticatory style.

A single operator (I.M.T.) watched the video recordings in slow-speed playback to assess the masticatory rhythm as masticatory cycle duration (MCD), the unilateral masticatory index (UMI), and masticatory side switch index (MSSI), as described elsewhere.[23] Briefly, the time needed to complete the 40 cycles of each masticatory assay was determined, averaged for each masticatory style, and expressed as milliseconds per cycle.[11] For each masticatory cycle of the 2 freestyle masticatory assays, the same operator observed the chin and recorded where the jaw closed at the intercuspal position ("+1" if right, "−1" if left, and "0" if neither). The asymmetry index was determined as follows: ([number of right strokes] − [number of left strokes]) ÷ ([number of right strokes] + [number of left strokes]).[12,41,42] The UMI was established as the absolute asymmetry index and expressed the degree of unilateral mastication, regardless

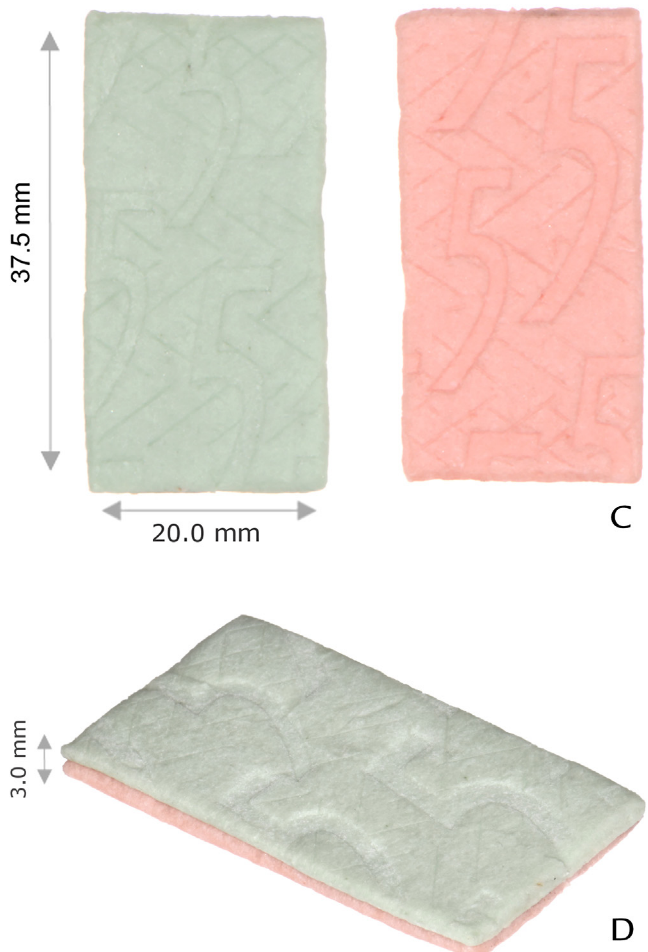

Figure 2. (*Continued*). C, Dimensions of halved chewing gum strip. D, Thickness of 2 halves of chewing gum sealed with droplet of distilled water.

of the side.[18] Finally, to calculate the MSSI, the same operator revised the sides where the jaw closed during the 40 cycles of each freestyle masticatory assay and scored as follows: 1 point per masticatory switch between right and left, 0.5 points per masticatory switch between either side and the center, and 0 points for no masticatory switch. The total number of points was divided by the maximum number of possible switches (39 in this study) and recorded as the MSSI.[23,25]

To assess reproducibility, the masticatory tests were repeated 2 to 4 weeks after the initial testing in 24 participants (18 women, 6 men), chosen by convenience. Test-retest reliability and interrater agreement were assessed by the ICC for average measurements using a 2-way random effects model and absolute agreement.

Data obtained from the first sessions were used to test the study hypotheses. The MAI was analyzed from data obtained from a single operator (I.M.T.). Data for right- and left unilateral mastication were averaged and grouped as unilateral mastication. The Shapiro–Wilk test revealed nonnormal data for age and vertical overlap. The interindividual relationship between different masticatory parameters and sensory perception during freestyle mastication was assessed with Pearson correlation coefficients. The intraindividual effect of MSS frequency on the MAI, MCD, flavor intensity, and salivary flow were assessed by repeated measures ANOVA, with pairwise comparisons adjusted by Bonferroni correction for multiple tests. All analyses were conducted with a statistical software program (IBM SPSS Statistics, v27; IBM Corp) (α=.05).

RESULTS

The CONSORT study flow diagram is shown in Figure 4. Of the 39 volunteers who met the inclusion criteria, 2 men who did not follow the instructions during some masticatory trials and 1 woman who did not tolerate masticating the gum for the required time were excluded. No participant reported any side effects or adverse events due to the masticatory tests. The remaining 36 participants (26 women and 10 men; age range: 21.0 to 36.6) had a median of 28 natural teeth (range, 26 to 32) (Table 1). Depending on the masticatory style, the ICC values ranged from 0.69 to 0.86 for the MAI and from 0.73 to 0.95 for sensory perception (Table 2). Using a freestyle masticatory pattern, ICC values for the MSSI and UMI were 0.79 and 0.54, respectively. The MAI had an excellent interrater agreement, with high ICC values ranging from 0.997 (95% CI: 0.990 to 0.999) for the S25 masticatory style to 0.998 (95% CI: 0.994 to 0.999) for the unilateral and S15 masticatory styles.

Table 3 shows the results for mixing ability, masticatory rhythm, and sensory perception by style during the masticatory tests. Repeated measures ANOVA revealed no differences in the MAI between the masticatory styles (P>.05). Pairwise comparison revealed that the MCD tended to increase with the amount of switching (that is, unilateral<freestyle=S05<S15<S25). The S25 style required 141 milliseconds (95% CI: 97 to 185) and 159 milliseconds (95% CI: 121 to 198) more time per cycle compared with freestyle or unilateral styles, respectively.

Differences in perception were found among the masticatory styles for flavor intensity and salivary flow. The S05 and S25 styles were associated with an 8% (95% CI: 1% to 15%) perceived increase in flavor intensity compared with unilateral style (P<.05), though no significant differences existed between freestyle mastication and any switching frequency (S05, S15, and S25) (P>.05). Compared with freestyle mastication, the S15 and S25 styles increased perceived salivary flow by 12% (95% CI: 2% to 22%) and 11% (95% CI: 0% to 21%), respectively.

For freestyle mastication, the mean MSSI was 0.081 (SD=0.03, 95% CI: 0.069 to 0.092) and the mean UMI was 0.13 (SD=0.09, 95% CI: 0.10 to 0.16). Table 4 shows the Pearson correlation coefficients between variables related to masticatory function and sensory perception

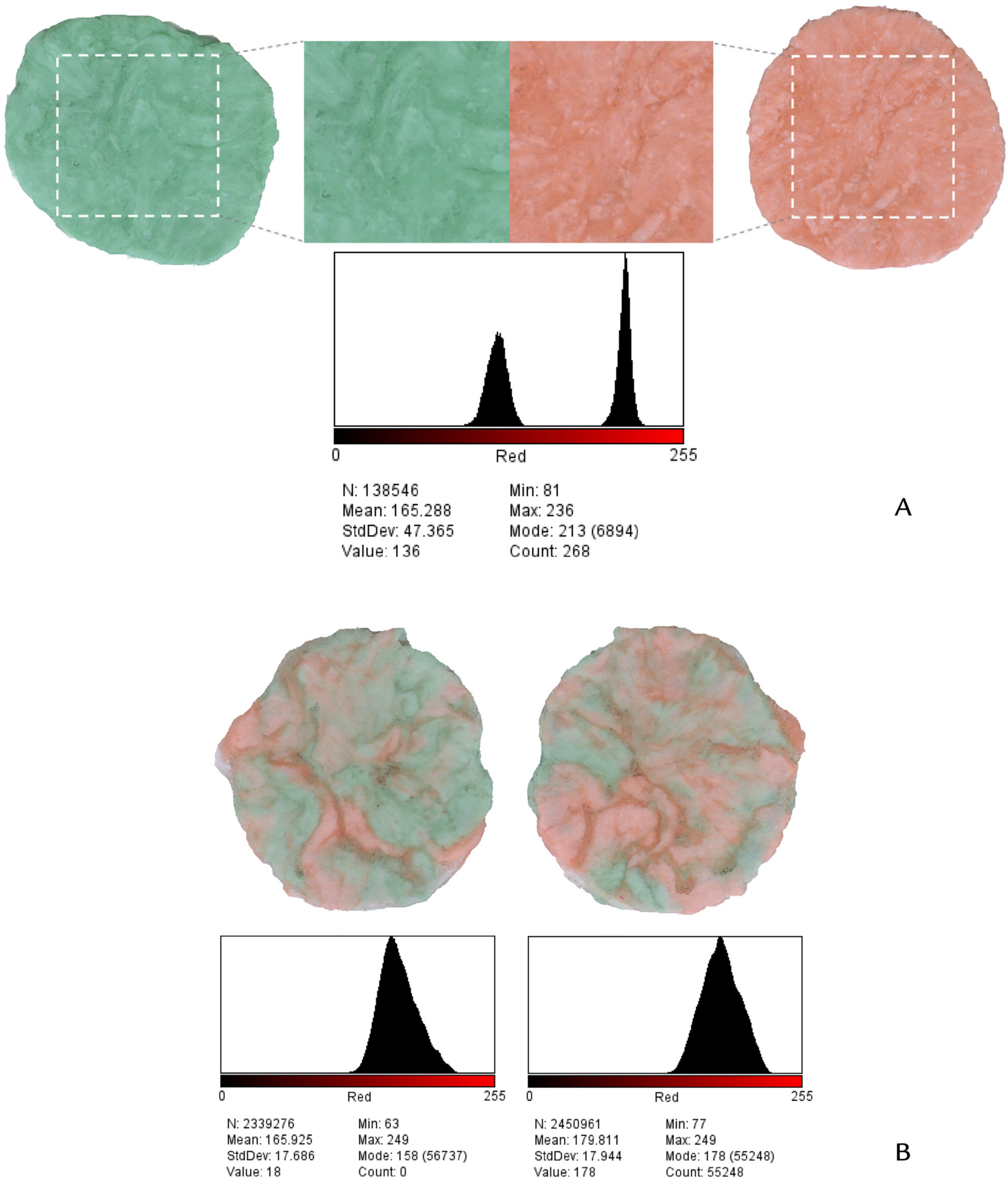

Figure 3. Test food analysis before study. A, *Green* and *red* sugar-free chewing gum 5 (Wrigley; "Hierbabuena"=*green*, "Frutos rojos"=*red*) masticated, but not mixed, and scanned in ImageJ software program. Central rectangular sections analyzed, giving 2 separate peaks in red channel of histogram. B, C, and D, Mixture of two-color chewing gum specimen shown over 5 cycles, 20 cycles, and 40 cycles, respectively. Images scanned on both sides and analyzed with Color-Histogram plugin in ImageJ software program. C, cycles. StdDev, standard deviation.

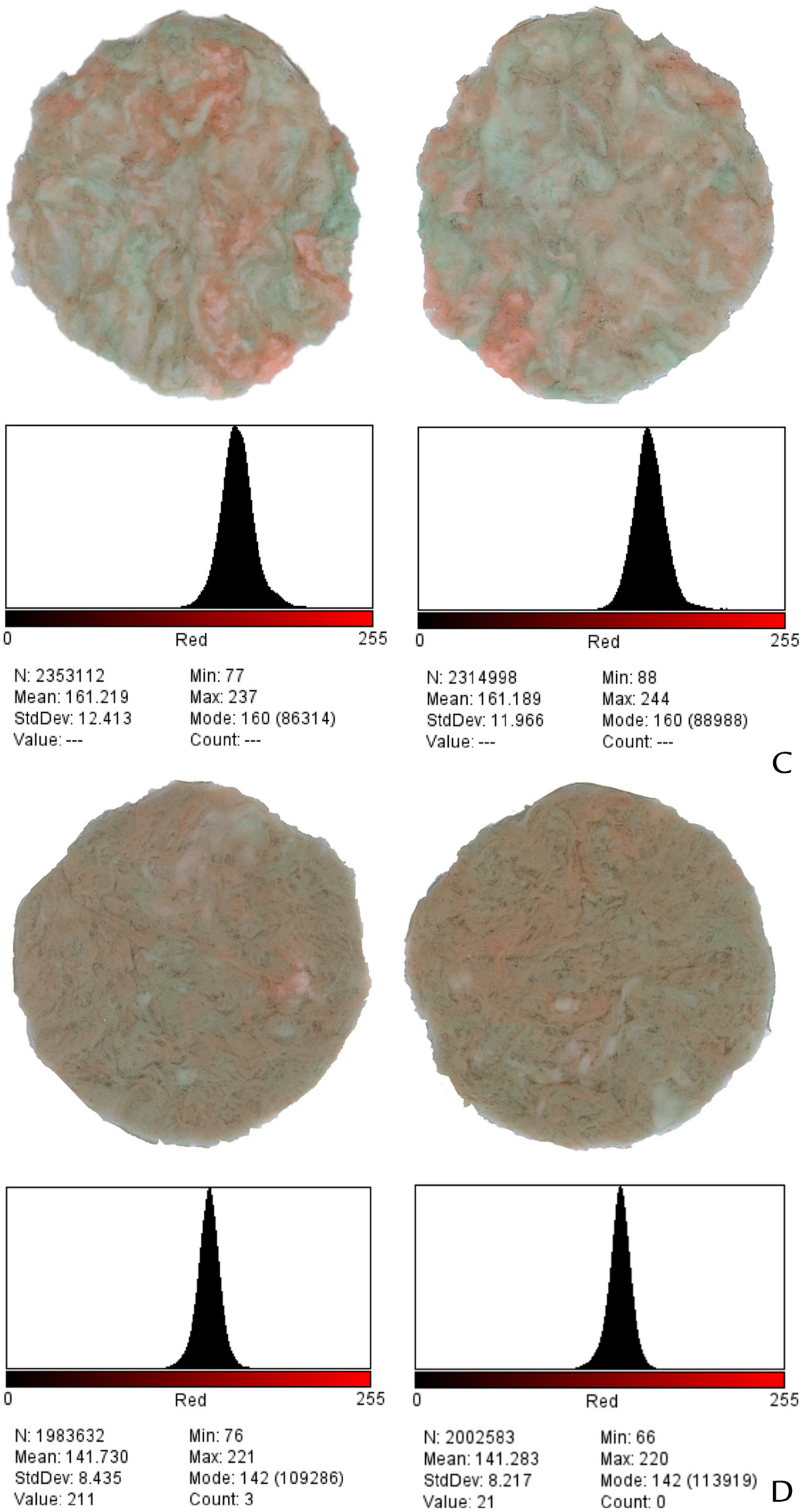

Figure 3. (*Continued*)

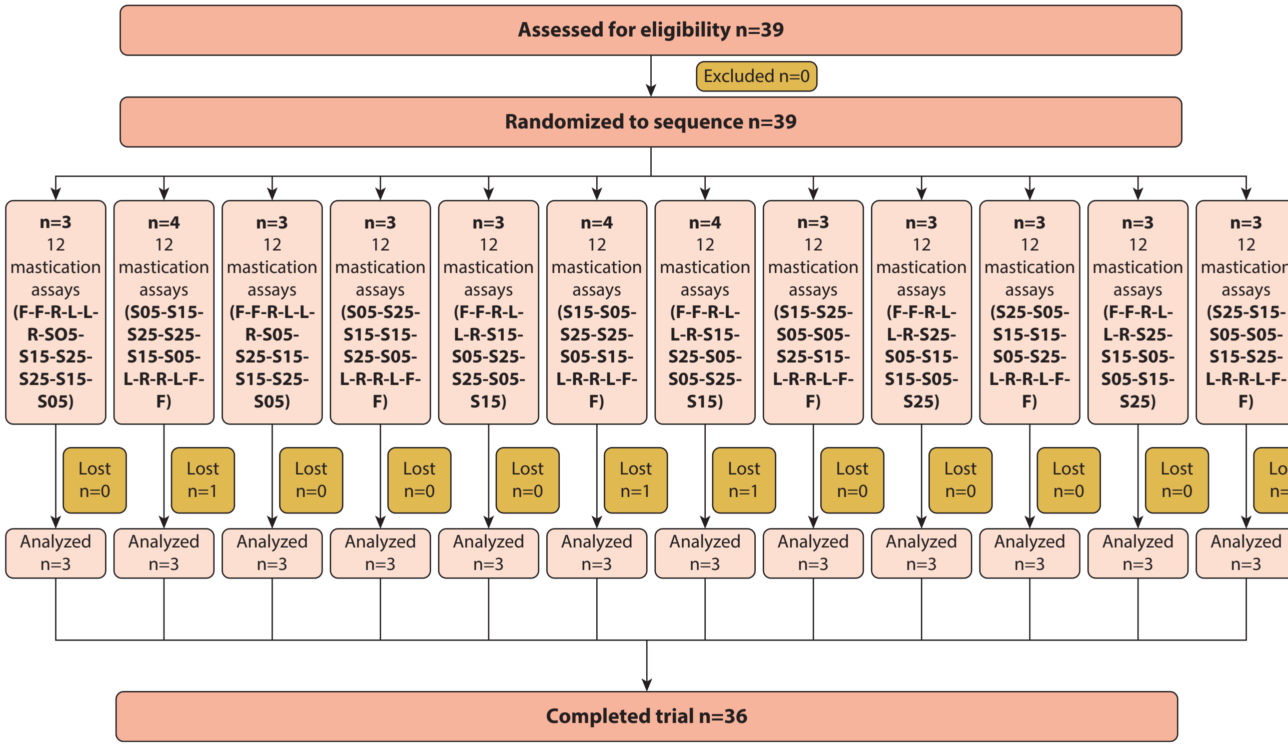

Figure 4. CONSORT flow diagram of study. F, freestyle mastication; L, unilateral left mastication; R, unilateral right mastication; S05, switching frequencies of 5%; S15, switching frequencies of 15%; and S25, switching frequencies of 25%.

Table 1. Participant characteristics and dental occlusion according to sex

Parameter	Women (n=26)	Men (n=10)	Total (n=36)
Age, mean (95% CI)	24.5 (23 to 26)	25.5 (23 to 28)	24.8 (24 to 26)
Number of teeth, mean (95%CI)	28.6 (28 to 29)	28.9 (28 to 30)	28.7 (28 to 29)
Vertical overlap in mm, mean (95% CI)	2.0 (1.3 to 2.7)	3.1 (2.4 to 3.9)	2.3 (1.8 to 2.8)
Horizontal overlap in mm, mean (95% CI)	3.1 (2.4 to 3.8)	2.7 (1.9 to 3.4)	3.0 (2.4 to 3.5)
Angle Class I Bilateral, n (%)*	21 (81%)	9 (90%)	30 (83%)

CI, Confidence interval. *Four participants had unilateral Class I and Class II, 1 had bilateral Class II, and 1 had bilateral Class III.

during freestyle mastication. As shown, correlations were found between the MSSI and UMI (r=−0.37, 95% CI: −0.62 to −0.04; *P*=.029) and between perceived salivary flow and flavor intensity (r=0.55, 95% CI: 0.26 to 0.74; *P*=.001) (Fig. 5).

DISCUSSION

The results of the present study in healthy dentate adults led to acceptance of the null hypothesis that increasing the MSS frequency does not affect the ability to mix when masticating. The findings were consistent with a recent report that changing the mastication side more often does not impair the ability to comminute food.[23] Therefore, both aspects of masticatory performance remained unchanged, even when switching the mastication side more often. Although some correlation exists between the comminution and mixing abilities in a heterogeneous population,[4,5] they correlated more weakly in young healthy dentate adults.[3] Given that fragmenting food depends more on the occlusal force and dental status,[2] whereas mixing food to form a bolus depends more on tongue and jaw movements, these aspects should be considered as complementary factors.[6]

Increased MSS frequency was associated with longer MCD, consistent with evidence from masticating silicone pieces.[23] Interestingly, only the freestyle and S05 styles masticated at a similar rhythm, probably because the mean MSSI during freestyle mastication was 0.081, which is close to that for 5% side switches. Despite a lack of agreement on an optimal masticatory rhythm,[1] eating speed has been associated with obesity indicators; therefore, eating slowly with a large MCD may be a good strategy to use in multidimensional approaches to the treatment of obesity and diabetes.[33-35] Furthermore, the high intraindividual stability of mastication rhythm could indicate good masticatory function.[1,16,19] The present test-retest results suggested that the S25 style exhibits equal or higher reproducibility compared with freestyle mastication. Frequent MSS could introduce nutritional benefits by slowing and stabilizing the mastication

Table 2. Test-retest reliability scores for masticatory function and sensory perception (n=24). Intraclass correlation coefficient with 95% confidence interval

Masticatory Style	MAI	MCD	Flavor Intensity	Salivary Flow	MSSI	UMI
Freestyle	0.86 0.67; 0.94)	0.85 (0.59; 0.94)	0.87 (0.70; 0.94)	0.79 (0.51; 0.91)	0.79 (0.52; 0.91)	0.54 (−0.07; 0.80)
Unilateral	0.72 (0.35; 0.88)	0.87 (0.67; 0.95)	0.85 (0.64; 0.93)	0.89 (0.75; 0.95)	–	–
Switching S05	0.80 (0.53; 0.91)	0.85 (0.61; 0.94)	0.78 (0.49; 0.90)	0.73 (0.39; 0.88)	–	–
Switching S15	0.81 (0.56; 0.92)	0.82 (0.49; 0.93)	0.83 (0.61; 0.93)	0.73 (0.39; 0.88)	–	–
Switching S25	0.69 (0.27; 0.87)	0.90 (0.77; 0.96)	0.83 (0.61; 0.93)	0.73 (0.38; 0.89)	–	–

MAI, mixing ability index; MCD, masticatory cycle duration; MSSI, masticatory side switching index; UMI, unilateral masticatory index. S05, S15, and S25 indicate respective side switching frequencies of 5%, 15%, and 25% per trial of 40 masticatory cycles.

Table 3. Mixing Ability Index, masticatory cycle duration, perceived flavor intensity, and salivary flow by mastication style

Masticatory Style	MAI Mean (95% CI)	MCD Mean (95% CI) (ms)	Flavor Intensity Mean (95% CI)	Salivary Flow Mean (95% CI)
Freestyle	9.22 (8.7-9.7)	766 (732-801)^{b}	7.55 (7.0-8.1)^{ab}	7.07(6.4-7.7)^{a}
Unilateral	9.10 (8.7-9.5)	748 (716-780)^{a}	7.47 (7.0-8.0)^{a}	7.26 (9.7-7.8)^{ab}
Switching S05	9.29 (8.8-9.7)	780 (748-812)^{b}	8.03 (7.6-8.5)^{b}	7.70 (7.3-8.1)^{abc}
Switching S15	9.16 (8.7-9.6)	826 (794-858)^{c}	7.91 (7.4-8.4)^{ab}	7.93 (7.5-8.3)^{cd}
Switching S25	9.25 (8.8-9.7)	907 (869-945)^{d}	8.07 (7.6-8.5)^{b}	7.82 (7.4-8.3)^{bcd}
P value	.627	.001	.002	.001

ANOVA, analysis of variance; MAI, mixing ability index; MCD, masticatory cycle duration; ms, milliseconds; CI, Confidence interval. Analyzed by repeated measures ANOVA (Greenhouse–Geisser). Different superscript letters within column indicate significant differences ($P<.05$ adjusted by Bonferroni correction for multiple tests). S05, S15, and S25 indicate respective side switching frequencies of 5%, 15%, and 25% per trial of 40 masticatory cycles.

Table 4. Pearson correlation coefficient matrix for masticatory parameters and sensory perception during freestyle mastication

Parameter	MSSI	MAI	MCD	UMI	Flavor Intensity	Salivary Flow
MSSI	1	–	–	–	–	–
MAI	−0.08	1	–	–	–	–
MCD, ms/cycle	0.09	−0.28	1	–	–	–
UMI	−0.3*	0.03	0.08	1	–	–
Flavor intensity	0.22	0.01	0.04	0.11	1	–
Salivary flow	0.32	−0.17	0.13	0.11	0.55**	1

MAI, mixing ability index; MCD, masticatory cycle duration; MSSI, masticatory side switching index; UMI, unilateral masticatory index. $^{*}P<.05$. $^{**}P\leq.001$.

rhythm, though prospective research should seek to identify the presence of a direct cause-effect relationship.

The results of the present study indicate that individuals with natural dentitions can perceive 1% to 15% more flavor intensity by increasing their MSS frequency to 25%, as compared with unilateral mastication. This finding was consistent with that of Aprea et al,[32] who reported the higher intensity and persistence of strawberry flavor release from custards when comparing freestyle mastication with MSS at a frequency of 10 switches during a 15-second masticatory trial. In addition, Mioche et al[15] reported that bilateral mastication could enhance flavor release by increasing the surface area of food in contact with the gustatory and oral mucosa. A similar mechanism could explain the increase in flavor intensity when the mastication side is changed more often. Flavor is a function of retronasal olfaction, texture, and taste following the release of volatile compounds in food. Therefore, the perceived increase in flavor may result from greater volatile compound release as food moves between sides in the oral cavity or from more volatile compounds reaching the retronasal space as the velum-tongue border opens.[26,28] The lack of a significant linear relationship between MSS frequency and perceived flavor intensity (Pearson r=0.22; *P*=.190) prevents the attribution of a cause-and-effect relationship.

Alternating the mastication side every 4 to 8 cycles (that is, S15 and S25) also increased the perceived

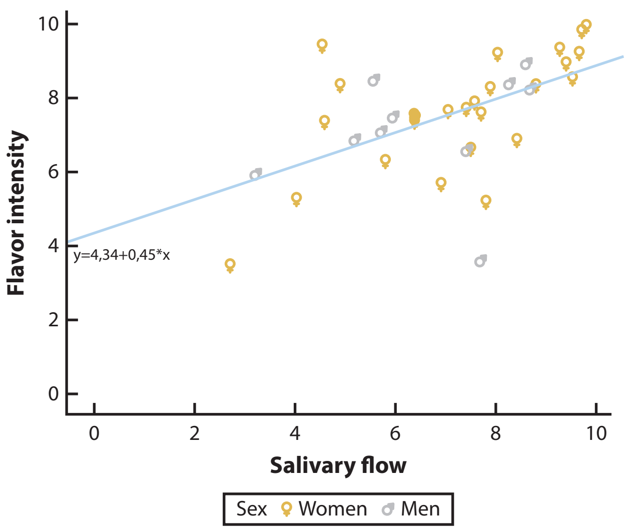

Figure 5. Scatterplot of perceived flavor intensity and salivary flow.

amount of saliva by 12% compared with freestyle mastication. Bilateral mastication may enhance the rate of saliva production, because the parotid secretion is related to muscle activity and the ipsilateral occlusal load.[15] Furthermore, those who perceived high flavor intensity also perceived a greater saliva secretion when masticating gum freestyle. Although salivary characteristics such as flow rate, composition, and buffer capacity modulate flavor perception through different mechanisms, the flavor stimulus itself can also regulate salivary flow and composition.[27,31] In addition, high interindividual and intraindividual variability exists in masticatory laterality, flavor perception, and salivary flow because many factors alter these behaviors and sensations.[26] For example, a positive correlation between salivary flow and time to maximum flavor intensity has been reported while masticating gum but not while eating a vanilla custard dessert.[37] By controlling for most of these factors with a randomized crossover design, the use of a stable and noncommittable test food, and ensuring an equal number of masticatory cycles, the present results provide new insights into the relationship between MSS frequency, salivary flow, and flavor intensity.

Test-retest results revealed that the UMI had weak reliability for chewing gum (ICC, 0.54), with this value notably lower compared with the use of Optosil silicone pieces in a similar population (ICC, 0.77) and significantly lower compared with the use of Optozeta test food in a more heterogeneous population (ICC, 0.90).[7,42] These results were consistent with the low reliability of methods using chewing gum to assess mastication side preference, suggesting that harder foods are more appropriate when assessing masticatory laterality.[12,13,41] However, using chewing gum as a test food benefits from being familiar to most young adults in Western countries, providing high reproducibility of mandibular movements,[10] and being used as the test food in most studies assessing the masticatory mixing ability.[1] It also produces an aroma that allows individuals to perceive flavor in a similar way to natural food.

The authors are unaware of a previous well-controlled study that demonstrated an intraindividual effect of high MSS frequency on the perception of salivary flow and flavor intensity. Alternating the side more often while masticating could provide these benefits in addition to those already established for eating slowly[23] and, in turn, increase the pleasure of eating. Modern living is characterized by fast eating of attractive, readily available, and energy-dense foods, necessitating conscious decisions to adjust masticating behavior, and improve health while eating with maximum pleasure.[38] Dental personnel could stimulate these changes by counseling patients to masticate slowly and symmetrically and by changing their mastication side every 4 to 8 cycles.[15,19,20,23,25,34]

A strength of the present study is the application of a randomized crossover design, with each participant acting as their own control, and with sufficient power to detect intraindividual differences with little bias. However, limitations of the study included that, despite the type of 2-colored chewing gum meeting all 11 criteria for an ideal test food,[8] it has not been used in any other research to date. Nevertheless, the test-retest results indicated an acceptable level of reproducibility and ability to discriminate among individuals. Although several authors recommend that the analysis of chewing gum requires 20 masticatory cycles,[1,4,8] it is difficult to know if mixing ability differences had been detected among masticatory styles after 20 masticatory cycles. In addition, the lack of blinding might have influenced the results of subjectively assessed outcomes. Finally, because only 1 test food was used in individuals with healthy dentitions, these results may not be applicable to settings with natural foods that have different textures or to populations with compromised mastication.

CONCLUSIONS

Based on the findings of this clinical study, the following conclusions were drawn:

1. Variations in MSS frequency did not alter mixing in healthy dentate adults.
2. Increasing the MSS frequency up to 25% enhanced the perceived flavor intensity and salivary flow, possibly because more frequent changes in the masticatory side were associated with slower eating and a longer masticatory cycle duration.

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