Chewing Side Continuity and Masticatory Performance

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Clinical significance

Chewing side continuity or the frequency with which the chewing side is changed during mastication has scarcely been studied until now. In this study, subjects with long chewing side continuity showed significantly better masticatory performance, suggesting the possibility that longer chewing side continuity might be a marker of good masticatory performance.

Abstract

Purpose: The aim of this study was to investigate the relationship between chewing side continuity and masticatory performance.

Methods: Twenty-two healthy subjects with normal occlusion who chewed alternately on both sides in a preliminary chewing task were selected for this study (15 males, 7 females; mean age, 25.9 years). To evaluate chewing side continuity, the subjects were asked to chew on one piece of gummy jelly for 20 seconds. This task was repeated three times, and the mean number of side-continuous strokes was calculated for each chewing side. The masticatory performance was determined by Manly’s sieving method. The results obtained were analyzed for each chewing side, and the subjects were divided into two groups according to the length of chewing side continuity: the long chewing side continuity group (mean number of side-continuous strokes ≥ median) and the short chewing side continuity group (mean number of side-continuous strokes < median). The masticatory performance was compared between the two groups using the t-test, with statistical significance being established at P<0.05.

Results: Among the 44 chewing sides, the most frequently encountered number of side continuous strokes was less than 4. The mean masticatory performance was 87.0% (SD, 7.5%). The long chewing continuity group showed significantly better masticatory performance than the shorter chewing continuity group (P=0.040).

Conclusion: Our results suggest that long chewing continuity could be a measure of better masticatory performance in healthy young dentate subjects who do not have a preferred chewing side.

Key words: mastication, masticatory performance, chewing side, chewing side continuity, preferred chewing side

Introduction

Mastication is usually accomplished by chewing on either the left or the right side, with the chewing side eventually changing from one side to the other. The chewing side continuity and the frequency of side changes have scarcely been studied until now. In our previous work,1,2 we assessed the chewing side continuity by counting the number of side-continuous chewing strokes on either chewing side during non-side designated chewing. We found that the chewing side continuity varied among healthy subjects, and that the subjects could be classified into three groups based on the chewing pattern. The first group almost always showed a preferred chewing side, with relatively stable chewing movements1 showing a wider trajectory pattern in the frontal plane. The masticatory performance in this group has been shown to be better on the preferred chewing side.1 The second group showed one preferred chewing side during any given test session, but often changed the preferred chewing side during other test sessions. Although they appeared at first to show strong chewing laterality, closer examination revealed that they actually showed no chewing laterality,2 that is, they had two preferred chewing sides or while they did show preference of chewing side, their preferred chewing side differed at different times. The third group, the focus of the present study, chewed on both sides alternately during the same test session. Unlike the first two groups who showed a pre-
ferred chewing side during any given session, this group showed no chewing side preference and chewed on both sides during the same test session. This may be possibly attributable to the presence of specific uncomfortable or annoying oral factors in the subjects. If this were actually the case, continuity of chewing could be a predictor of masticatory dysfunction, such as occlusal problems and muscle fatigue, that the individual might be unaware of. That is, such patients who frequently change their chewing side during a given test session might be in need of dental care, such as establishment of a more tightly occluded cuspal position or removal of occlusal interferences. The purpose of the present study was, therefore, to investigate the relationship between chewing side continuity and masticatory performance.

**Materials and methods**

Twenty-two healthy subjects with normal occlusion who chewed alternately on both sides in a preliminary task of non-side designated chewing were selected from among the students and staff of the Department of Fixed Prosthodontics, Osaka University Graduate School of Dentistry, Japan. Subjects who chewed on the same side for over 20 seconds of recording were excluded from this study. The enrolled subjects consisted of 15 males and 7 females with a mean age of 25.9 years (SD, 3.1 years). The inclusion criteria were: absence of missing teeth except for the third molar; no history of prosthetic treatment other than minor restorations. All the subjects were informed of the aim and methods employed in this research, and agreed to participate.

To evaluate chewing side continuity, the subjects were asked to chew one piece of gummy jelly (3.5 g, Kaju Gumi, Meiji, Tokyo) for 20 seconds. The chewing movements were recorded using the Sirognathograph Analyzing System (Canopus, Kobe and Todent, Tokyo, Japan). The gummy jelly chewing task was repeated three times, and the mean number of side-continuous strokes was computed for each side in all the subjects. Therefore, two mean values, one for the left and one for the right side, were obtained for each subject. Reference chewing records of side-designated chewing were used for determining the chewing side (Fig. 1).

The masticatory performance was measured by Manly’s sieving method. Briefly, the subjects were asked to chew on 3 g of peanuts sealed in a small latex bag over 20 strokes on the designated side. The bag was then opened and the pulverized peanuts were dried at room temperature before being sieved through a 10-mesh sieve and weighed using an electrical precision scale (EW-150i, A&D, Tokyo, Japan). The masticatory performance was expressed as the ratio of the weight of the sieved pulverized material to the total weight of the peanuts.

The results obtained were analyzed for each chewing side, and the subjects were divided into two groups according to the median number of side-continuous chewing strokes for the 44 chewing sides: the long chewing side continuity group (mean number of side-continuous strokes ≥ median) and the short chewing side continuity group (mean number of side-continuous strokes < median). Masticatory performance was compared between the two groups using the t-test, with sta-
Significance was established at $P<0.05$ (SPSS 12.0J) after the normality of the distribution was confirmed by the Kolmogorov-Smirnov test.

**Results**

The distribution of side-continuous chewing strokes is shown in Fig. 2 (median, 2.5). Among the 44 chewing sides (right and left sides in the 22 subjects), the most frequently encountered number of side-continuous strokes was less than 4. The distribution of the masticatory performance is shown in Fig. 3: the mean value was 87.0% (SD, 7.5%).

The scatter diagram illustrating the relation between the number side-continuous strokes and the masticatory performance is shown in Fig. 4.

When the subjects were divided into two groups according to the median number of side-continuous chewing strokes, the masticatory performance was significantly better in the long chewing side continuity group ($\geq 2.5$ continuous strokes) than in the short chewing side continuity group ($<2.5$ continuous strokes) ($P=0.040$, Fig. 5).

**Discussion**

Chewing in humans is performed half unconsciously, but it is an essential function of life and involves powerful, yet precisely controlled movements. The chewing side preference has been expressed as the ratio of the number of side-continuous strokes on one side to that on the other.
side, or the asymmetry index.\textsuperscript{6,7} The frequency of side changes during non-side designated chewing, however, has seldom been discussed.

In our previous studies on masticatory laterality,\textsuperscript{1,2} we identified three patterns: two of these were characterized by consistent use of one side (preferred chewing side). In both of these patterns, during any given test session, the subjects used only one side for chewing from the start to the end of the examination. The third pattern, defining the subjects of the present study, was characterized by frequent changes of the chewing side within the same test session. Tsubakimoto\textsuperscript{1} reported from his study of 50 young healthy subjects that 60\% showed the third of the above-described patterns of chewing, which he named the omni-lateral pattern. Interestingly, 80\% of the female subjects were included in this group. Susceptibility to muscle fatigue might be considered as underlying this pattern of chewing.

The distribution of side-continuous chewing strokes in the present study also revealed that side change occurred frequently in the subjects showing the omni-lateral type of chewing. In 37 of the 44 (84.1\%) sides, change of the chewing side occurred within 4 strokes, whereas subjects with a preferred chewing side often chew continuously on the same side for more than 20 strokes. No comparable reports discussing the number of side-continuous chewing strokes could be found in the literature.

In regard to the test food used to evaluate the number of side-continuous chewing strokes, gummy jelly was chosen, because as compared to other foods, the chewing side can be determined easily even after pulverization when this food is used.\textsuperscript{8} The masticatory performance was measured with peanuts as this is the long-accepted conventional method for this measurement.

The masticatory performance in this study was, in general, better as compared with that reported from a previous study on masticatory performance in seventy dentate subjects with full occlusal support (31 males, mean age 53.9 years, 39 females mean age 59.5 years), which reported an average of 75.8\%.\textsuperscript{9} In the present study, 37 of the 44 sides showed a masticatory performance of more than 80\% (84.1\%). Masticatory performance has been reported to decrease with age,\textsuperscript{10} and therefore, the observed high performance in our study is probably attributable to the subjects in our study being young and healthy and having normal dentition, and also to the methodological improvement of wrapping the test food in a latex bag, which prevents the loss of the pulverized nuts in the mouth.\textsuperscript{5}

Of the 44 chewing sides, 7 showed a mean of more than 4 side-continuous chewing strokes, and all showed a good masticatory performance of more than 80\%. In contrast, all of the 7 chewing sides which showed poorer masticatory performance than 80\% belonged to the short chewing side continuity group (Fig. 4). These results suggest that long side-continuous chewing side is preferable for superior masticatory performance. Since our subjects were all healthy young people, only a few chewing sides were found to show reduced masticatory performance, all of whom showed frequent changes of chewing side. The significant difference in masticatory performance found between the long chewing continuity group and short chewing continuity group is likely to be attributable to these less efficient chewing sides. Further investigations involving dental patients with compromised occlusion or muscle pain will be required to further elucidate the relationship between chewing continuity and masticatory performance.

**Conclusion**

Our results suggest that long chewing continuity could be a measure of good masticatory performance in healthy young dentate subjects who do not have a preferred chewing side.

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**References**


