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Occlusal interference during mastication can cause pathological tooth mobility

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Background and Objective: Despite little evidence regarding the relationship between tooth mobility and nonworking contact, the evaluation of occlusion is performed mainly by the detection of premature and/or nonworking contacts during tapping movements and lateral excursion. The hypothesis of this study is that occlusal contact during mastication is potentially traumatic to periodontal tissue. It clarifies the relationship between chewing patterns and the status of periodontal tissue.

Material and Methods: Subjects included 73 adults, 20–29 years of age (39 men and 34 women), with complete sets of teeth and no history of orthodontic treatment or periodontal disease. The closing chewing patterns of each subject were classified into three groups by the Masticatory Deviation Index, which depicts the deviation from the normal chewing patterns within 5 mm from the intercuspal position. Periotest® was used to diagnose teeth mobility and the values were compared among the three groups.

Results: The present study indicates that the chewing movements which deviated from the normal chewing movements increased the mobility of specific types of teeth.

Conclusion: The results of this study imply a relationship between chewing movements and tooth mobility and indicate that functional evaluation of occlusion is necessary for the examination of periodontal tissue. Occlusal evaluation with border and tapping movements might be insufficient, and functional occlusal evaluation during chewing movements can be clinically useful for using to evaluate periodontal tissue.

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Mastication is one of the most important functions of the stomatognathic system. A report on normal physiological mastication (1) revealed that masticatory movements were more regular and consistent in form with less individual variation. In the absence of systematic classification methods, only the most commonly observed forms of chewing have been described. The use of different, non-standarized test foods has often led to contradictory statements on ideal chewing movements (2).

Chewing patterns have been proposed as a parameter for objectively evaluating the chewing function (3). Occlusal contact occurs in mastication (4), and disturbances in the periodontal sensory function associated with malocclusion might also be a factor in the development of irregular movement patterns (5). For this reason, chewing patterns are thought to be affected by occlusal contact.

Although the authors have already reported no significant relationships between tooth mobility and nonworking contact, occlusal evaluation has mainly been performed by the detection of premature and nonworking contacts during tapping movements and lateral excursions in general practice. The hypothesis of this study is that occlusal contact during mastication is potentially traumatic to periodontal tissue. This study clarifies the relationship between closing chewing patterns and tooth mobility.

Material and methods

The present study was conducted in accordance with the Declaration of Helsinki (World Medical Association 1964), and informed consent was obtained from all subjects. The subjects comprised 73 adults (39 men and 34 women), selected from the students and staff at the Osaka University School of Dentistry, with the following inclusion criteria: (i) no missing teeth; (ii) no history of orthodontic treatment; (iii) 20–29 years old; (iv) no teeth with probing depths of 4 mm or deeper; and (v) no bleeding during probing.

The periodontal status of all teeth was evaluated by tooth mobility. The tooth mobility of each subject was measured using Periotest® (Gulden-Medizintechnik, Bensheim, Germany).

Subjects were instructed to chew a piece of commercial chewing gum (Freezone; Lotte Co., Ltd, Tokyo) as a testing food on a designated side of their mouth. The movement of the mandible was recorded using the Sirognathograph Analyzing System III (Canopus, Kobe, and Todent, Tokyo, Japan). The final closing phase of 10 chewing cycles 5 s after the start of the recording were analyzed. The mode of both sides of the Masticatory Deviation Index (MDI) of 10 patterns was summed as a representative value for each subject. For all subjects, an average pattern and its standard deviation were calculated using coordinates recorded at 100 Hz. In the space enclosed with the average pattern and its standard deviation (Fig. 1A), T1, T2, T3, T4, and T5 were defined as reference areas on that space and the curve surface of five spheres which were located 1, 2, 3, 4, and 5 mm from the origin (intercuspal position), respectively (Fig. 1B). The number of areas through which the pattern did not pass were counted as the MDI. Each pattern's MDI, which counted how many areas the pattern did not pass, was defined. Then, the mode was picked up from the 10 chewing pattern scores on both chewing sides. The modes of left and right chewing sides were totalled as representative values of each subject. Subjects were classified into the following three groups by representative values: (i) group A, representative value 0; (ii)

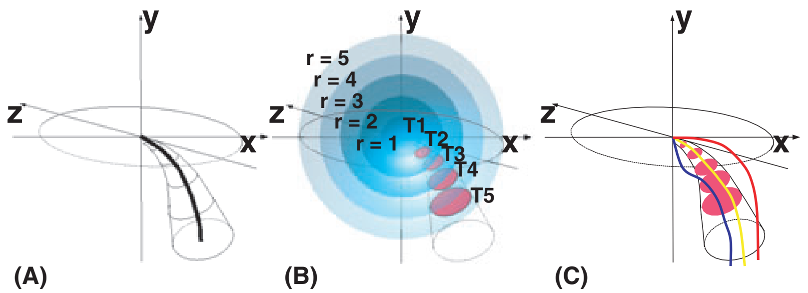

Fig. 1. Schematic drawings of the classification of closing chewing movements. The space (Fig. 1A) was enclosed by average pattern of all subjects and its standard deviation. Five spheres represented the areas that were 1, 2, 3, 4, and 5 mm distant from the origin (intercuspal position). T1, T2, T3, T4, and T5 were defined as areas on that space and the curve surface of five spheres (Fig. 1B). The number of areas that the pattern did not pass through was counted as the Masticatory Deviation Index (MDI) value. Yellow, blue and red curves represent the pattern of MDI values 0, 3 and 5

Table 1 . Distribution of closing chewing patterns

Group	Men	Women	Total
A	7	7	14
B	15	18	33
C	17	9	26

Values represent the number of subjects.

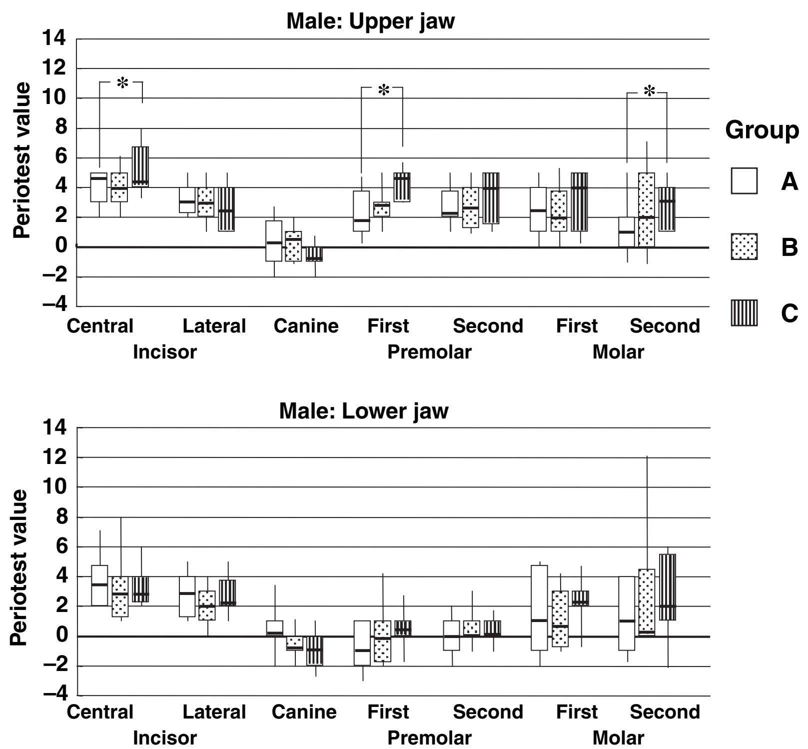

Fig. 2. Comparisons of the Periotest® values among groups A, B and C in men (n = 39). The Periotest values of the central incisor, and of the first and the second premolars of the upper jaw (Fig. 2A), were significantly different between groups A and C. There was no significant difference in the Periotest value, among groups A, B and C, in the lower jaw (Fig. 2B). $^*p < 0.05$ (Kruskal–Wallis test).

group B, representative value 1–9; and (iii) group C, representative value 10.

Periotest values were statistically compared, using the Kruskal–Wallis test, to verify differences among the three groups.

Results

Group A comprised 14 subjects (seven men and seven women), group B comprised 33 subjects (15 men and 18 women), and group C comprised 26 subjects (17 men and 9 women) (Table 1). In men the Periotest values of the central incisor and the first and the second premolars of the upper jaw were significantly different between groups A and C (Fig. 2). In women the Periotest values of the upper and the lower incisors were significantly different between groups A and B (Fig. 3). The Periotest values of the upper and the lower incisors, the lower canine, the upper and lower first premolars, and the upper and lower second molars were also significantly different between groups A and C in women (Fig. 3).

Discussion

For years, studies have attempted to objectively evaluate the chewing movement. Chewing patterns are influenced by various factors, such as food texture (2), the temporomandibular joint (6), jaw and facial muscles (7), and dental anatomy (1,2,5,8–11). Yet, there is still no systematical classification or agreement of the ideal chewing pattern. One experimental definition was that chewing patterns around the intercuspal position depended on occlusal forms (7,12), and chewing patterns in the closing phase were associated with dental occlusion (9). Therefore, it is appropriate that chewing patterns in the closing phase should be analyzed to detect the relationship between occlusal contact and periodontal tissue during mastication.

Group A subjects showed the average chewing pattern in the closing phase on both chewing sides. The average chewing pattern is approximately a 'teardrop shape', which is often observed in normal occlusion (1). Subjects in group B showed a closing chewing pattern that changed rapidly in the closing phase. Subjects in group C showed a chewing pattern that was completely different from the average chewing pattern on both chewing sides. As the alteration of tooth contact affects the closing chewing patterns, this classification distinguished the direction and the amount of force loaded on the teeth during chewing.

In this study, we found significant differences between groups A and B and/or between groups A and C in certain types of teeth, especially in the first premolar and the second molar, because the first premolar is the most anterior tooth that has the lingual cusp in normal dentition. During mastication, as the mandible approaches from posterior to anterior, the lingual cusp of the upper first premolar tends to contact the lower canine and/or the lower first premolar to affect tooth mobility. The second molars were related to the chewing movements because they tend to erupt in transposition. Generally, the first molar, the second premolar, the first premolar and the canine erupt, in this order, in the upper jaw in individuals from about 6 years of age. Then, those teeth together guide the lower teeth during lateral excursion according to the internal surfaces of the buccal cusps. Finally, after the canine have led the lower teeth in lateral excursion, the second molars start to erupt, tending to erupt in transposition and irregularly come into contact with antagonists. During mastication, the second molar tends to receive more interference with antagonists on the non-working side than other teeth on the nonworking side (4). Therefore, in transposition the second molars may longitudinally provide so-called 'misdirected occlusal forces' that produce chronic occlusal trauma and increased tooth mobility.

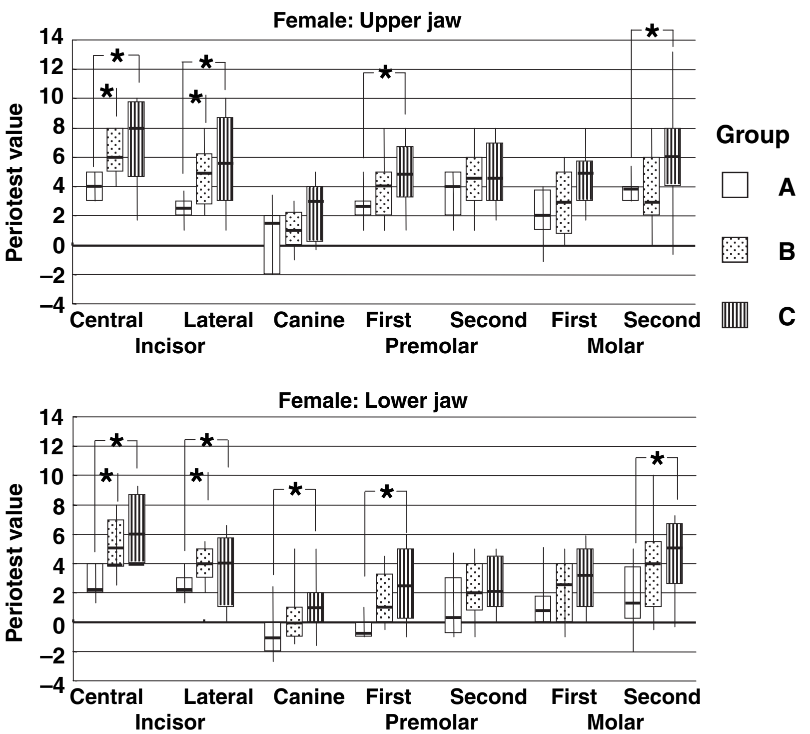

Fig. 3. Comparisons of the Periotest® values among groups A, B and C in women ($n = 34$). The Periotest values were significantly different between groups A and B in incisors, and between groups A and C in incisors, in the first premolar and in the second molar of upper jaw (Fig. 3A). The Periotest values were significantly different between groups A and B in the incisors, and between groups A and C in the incisors, canine, first premolar and second molar of the upper jaw (Fig. 3B). $*p < 0.05$ (Kruskal–Wallis test).

The present study indicates that chewing patterns induced the adaptation of periodontal tissue through occlusal contact. Moreover, the chewing movements that deviated from the normal chewing movements increased the mobility of specific types of teeth. This implies that occlusal evaluation with border and tapping movements might be insufficient and that functional occlusal evaluation during chewing movements is necessary to evaluate periodontal tissue. The method used in this study can be applied to examine mandibular deviations in patients with varying degrees of periodontal inflammation in a future study. Demonstrating the relationship between periodontal attachment/bone loss and occlusal trauma may provide important information regarding the central dilemma of occlusal trauma and periodontal disease.

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