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Original article

Gender differences in masticatory movement path and rhythm in dentate adults

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ABSTRACT

Purpose: The purpose of this study was to clarify whether there might be a gender difference in masticatory movement path and rhythm in dentate adults.
Methods: Thirty healthy males and 30 healthy females were asked to chew softened chewing gum on their habitual chewing side for 20 sec, and the movement of the mandibular incisal point was recorded using mandibular kinesiograph. For 10 cycles from the fifth cycle, the spatial and temporal parameters (spatial: amounts of vertical and lateral movements; temporal: opening, closing, occluding, and cycle times) of masticatory movement path and rhythm and the parameters representing the stability of masticatory movement path and rhythm were calculated and compared between males and females.
Results: The values of the spatial parameters were significantly greater for males than for females. The values of the temporal parameters were smaller for males than for females, and significant differences were found in all parameters except occluding time. However, there was no statistically significant difference in the parameters representing the stability of masticatory movement path and rhythm.
Conclusion: From these results it was suggested that although there were no differences in the stability of masticatory movement path and rhythm between genders, there were gender differences in the spatial and temporal parameters of masticatory movement path and rhythm.

1. Introduction

One of the main purposes of dental practice is to restore and maintain masticatory function. In order to objectively evaluate masticatory function, many attempts have been made to investigate parameters such as occlusal force [1–3], masticatory performance [3–5], muscular activity [6,7], and masticatory movement [2–4,8–13] and so on. Among these analyses, investigation of masticatory movement could be expected to be useful for quantitatively and objectively evaluating masticatory function. Therefore, several attempts have been made to analyze the amounts of vertical and lateral movements [6,7,14–19] and the rhythm [6,7,12–20], velocity [14–16,19–21], variances [21,22], and patterns of masticatory movements [23–25].

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It is necessary to clarify the presence of gender differences in masticatory movement for evaluating masticatory function using different parameters. However, gender differences in the amount and rhythm of masticatory movement have not been elucidated till date. In addition, gender differences in the stability of masticatory movement have also not been investigated.

Masticatory movement may be affected by exogenous factors [9,20,26,27], such as test food, chewing methods, and section selected for analysis, and can vary, even among healthy subjects. Therefore, when evaluating masticatory movement, it is necessary to minimize the intra-individual variations arising from these factors. It is necessary to study this further by focusing on the masticatory condition and gender differences.

Therefore, this study aimed to clarify the presence of gender differences in masticatory movement by investigating quantitative parameters of masticatory movement in healthy males and females.

2. Materials and methods

2.1. Subjects

Thirty healthy males (age range, 20–34 years; average age, 27.8 years) and thirty healthy females (age range, 20–35 years; average age, 27.6 years) participated in this study. None of the subjects had any clinical abnormalities in the masticatory system. The following selection criteria were used for inclusion: absence of complaints regarding bite; presence of a full set of teeth, excluding the third molars; absence of major dental restorations; and no history of orthodontic treatment.

All experimental procedures were approved by the Ethics Committee of the Nippon Dental University (NDU-T2012-29). Informed consent was obtained from all subjects after they were provided with an explanation of the general nature of the study.

2.2. Test food

A piece of chewing gum (Trident®, USA) was used as the test food, which weighed approximately 2 g. The chewing gum was sufficiently softened before recording masticatory movement.

2.3. Recording of masticatory movement

The subjects were asked to sit in a chair so that their Frankfurt plane was parallel to the floor with the head not fixed in a relaxed state, and were asked to chew softened chewing gum on their habitual chewing side for 20 sec. Incisal point movement during mastication was recorded by mandibular kinesiograph (K6I, Myotronics, USA) using a data recorder (XR-5000, TEAC, Tokyo).

2.4. Spatial parameters and parameters representing stability of masticatory movement

The analog signals from the data recorder were converted to digital signals (sampling number: 2000; sampling time: 10 msec). Then after all masticatory cycles recorded were separated into individual cycles, for 10 cycles from the fifth cycle, the spatial and temporal parameters (spatial: amounts of vertical and lateral movements; temporal: opening, closing, occluding, and cycle times) and the parameters representing the stability of masticatory movement path and rhythm were calculated.

2.4.1. Spatial and temporal parameters and parameters representing stability of masticatory movement path

Using the centric occlusion (CO) position in each cycle from the fifth cycle to the fourteenth cycle as a standard, the coordinates for each cycle were determined by vertically dividing the opening and closing paths into 10 equally spaced sections in the frontal view (Fig. 1A–C). From these coordinates, the average path and standard deviation (SD) were calculated (Fig. 1D and E). The opening distance (OD, amount of vertical movement) and masticatory width (amount of lateral movement) were the indicators representing the amount of masticatory movement (Fig. 1F). The masticatory width was applied to the average of width from level 1 to 9 (Table 1). The SDs of lateral opening, lateral closing, and vertical components were calculated as indicators representing variations of the masticatory path. The averages of 11 SDs from level 0 to 10 in the horizontal direction during opening movement, in the horizontal direction during closing movement, and in the vertical direction were taken as the lateral opening component, lateral closing component, and vertical component, respectively (Table 1). These values were then divided by the opening distance, and the value (SD/OD) was used as the index representing the stability of masticatory movement path.

2.4.2. Temporal parameters and parameters representing stability of masticatory movement rhythm

As to masticatory rhythm, each starting point of the opening phase, closing phase and occluding phase of each cycle were first identified using our own method [9].

Next, for 10 cycles from the fifth cycle, the opening time, the closing time and the occluding time, and the sum of all the three times were calculated. And then the coefficient of variations (CVs) were obtained from the mean time of the ten cycles and its standard deviation (Table 2), and the mean values were used as temporal parameters, and the CVs were used to represent the stability of masticatory movement rhythm.

2.5. Analyzing method

The spatial and temporal parameters, and the parameters representing the stability of masticatory movement path and rhythm were compared between males and females using statistical software (SPSS for Windows 10.0J, SPSS, Chicago, IL, USA). The comparison was investigated by an independent *t*-test. A P value of <0.05 was considered statistically significant. The Levene test was used to test for equality of variance.

3. Results

The values of the spatial parameters were greater for males than for females, with statistically significant differences