

Pattern of Occlusal Contacts in Eccentric Mandibular Positions in Dental Students

Fereidoun Parnia^{1*} • Elnaz Moslehi Fard¹ • Katayoun Sadr¹ • Negar Motiaghney²

¹Assistant Professor, Department of Prosthodontics, Faculty of Dentistry, Tabriz University of Medical Sciences, Tabriz, Iran

²Post-graduate student, Department of Anesthesiology, Faculty of Medicine, Tabriz University of Medical Science, Tabriz, Iran

*Corresponding author; E-mail: parniaf@tbzmed.ac.ir

Abstract

Background and aims. This study observed occlusal contacts and their area on the teeth during lateral mandibular movements. The percentage of each occlusal pattern was determined.

Materials and methods. Fifty subjects (male: 27, female: 23), aged 20-29 years, were included in the study. The criteria for selection were as follow: all subjects (i) were in their twenties; (ii) had normal occlusal alignment, no temporomandibular signs and symptoms with Angle's Class I relationship; (iii) had full dentition except for third molars; (iv) had no history of orthodontic therapy; and (v) had no restorations involving a cusp. The occlusal contacts were recorded with occlusion foil in three lateral excursions: 1, 2 and 3 mm from the maximum intercuspation. Data were analyzed with chi-square test.

Results. Most of working-side contact patterns were classified as group function (60%). Canine protection was rare (17%). Contact patterns other than canine protection and group function were found in 23% of the contact patterns on the right side. On the left side, group function was seen in 51%, canine protection in 21% and others patterns in 28% of the studied subjects.

Conclusion. On laterotrusion, most subjects had group function on the working side but canine protection was rare.

Key words: border movement, eccentric, mandibular movement, non-working side, working side.

Introduction

The collective arrangement of the teeth in function is quite important and has been subjected to a great deal of analysis and discussion over the years. As the mandible moves laterally, the lower posterior teeth leave their centric contact with the upper teeth and travel sideways down a path dictated by the condyles in the back and by the lateral anterior guidance in the front. In the diversified literature on occlusion and its role for functional patterns of the masticatory system,¹ two concepts stand out: (1) Canine protection as described by D'Amico² is said to favor a vertical chewing pattern and to prevent wear of teeth, as in lateral occlusion where the canine guides the mandibular movement directly through contact or indirectly through periodontal receptors. (2) Group function as described by Beyron³ following his observations on Australian Aborigines implies contact and stress on several teeth in lat-

eral occlusion and indicates abrasion as a positive and inevitable adjustment.

The reason for bringing any teeth into lateral function is to distribute stress and wear over more teeth. Group function occlusion, which is also commonly known as unilateral balanced occlusion, is a widely accepted and used method of tooth arrangement in restorative dental procedures today. The group function of the teeth on the working side distributes the occlusal load. The obvious advantage is the maintenance of the occlusion. In group function occlusion, the contacting inclines must be perfectly harmonized to border movements of the condyles and the anterior guidance. Kleinberg⁴ has pointed out the importance of the feedback mechanism between mechanoreceptors in the temporomandibular joint and the functional mandibular movement pattern.

In addition, a probable change in the input sig-

nals from the periodontal receptors after occlusal adjustment seems to affect the functional movement of the mandible.⁴ Ingervall⁵ recorded tooth contact patterns in laterotrusion, protrusion of the mandible, and in the retruded position in young men with varying types of occlusion. On protrusion, most subjects had contacts only on anterior teeth. Protrusive contacts were rare only on posterior teeth. On laterotrusion, most subjects had group function on the functional side. Contact on the nonfunctional side was found in half of the subjects in a 1.5-mm laterotrusive position and in one third of them in a 3-mm laterotrusive position. No correlation between the types of tooth contacts and mandibular dysfunction was found.⁵ Yaffe & Ehrlich⁶ recorded the dynamic contact pattern of teeth in lateral glide movement in 72 individuals, 19 to 35 years of age, with normal tooth alignment and Angle's Class I molar and canine relationship. The lateral glide movement was divided into three stages to simulate the total range of events in lateral glide movement naturally demonstrated by the patient. This study has shown that lateral glide movement is a complex movement in which the nature of tooth contact is altering in location, direction, and number of teeth participating. Consequently the restoration of an occlusion in accordance with a given concept does not always apply to all patients.⁶ The present study was designed to evaluate the incidence of occlusal patterns in a group of dental students.

Materials and Methods

Fifty subjects (male: 27, female: 23) aged 20–29 years (mean, 24.1 years) were included in the study. They were selected from a group of 225 undergraduate students of the Faculty of Dentistry, Tabriz University of Medical Sciences. The Research and Ethics Committee approved the study protocol and informed consent was obtained from the subjects after they were provided an explanation of the general nature of the study. The criteria for selection were as follow: all subjects (i) were in their twenties; (ii) had normal occlusal alignment, no temporomandibular signs and symptoms with Angle's Class I relationship; (iii) had full dentition except for third molars; (iv) had no history of orthodontic therapy; and (v) had no restorations involving a cusp.

The occlusal contacts were recorded with occlusion foil (8 µm thick, Occlusions Pruf-Folie, GHM, Germany) in three lateral excursions, after laterally sliding the mandibular incisal point on both sides, 1, 2 and 3 mm from the maximum intercuspation (MI). When recording the occlusal contacts, each patient was instructed to close in

the intercuspatal position and to slide the mandible laterally to the right and left side performing the three lateral excursive movements designed as lateral 1 (1 mm from MI), lateral 2 (2 mm from MI), and lateral 3 (3 mm from MI) on each side. Each subject was required to sit upright in a dental chair with the Frankfort plane almost horizontal. The subject's head was not fixed. To control lateral position, marks were made on the upper central incisors with a sharp black water-resistant pencil from the mandibular midline. Three lines were marked on the maxillary incisor. In case of deviation of mandibular midline, a reference line was traced at the labial surface of the mandibular incisor in the intercuspatal position to serve as a guide for the measurement. The blue occlusion foil was placed on the occlusal surface of the left-side most posterior mandibular molar, and the subject was requested to close his/her mandible to the MI. While a constant pulling force was maintained on the occlusion foil, red occlusion foil was put and the subject was requested to perform gliding movement to the right with the teeth in light contact. When the subject's mandible moved 1 mm right from the intercuspatal position, the presence or absence of an occlusal contact was examined. Only the red marks on teeth were considered to indicate occlusal contact. To prevent movement with mandibular opening or movement without occlusal contact and lateral-protrusive excursion, the movement was observed closely, and occasionally the subject was instructed to correct the movement. The movement was performed by the subject without any help from the examiner. When the subject could not perform the movement voluntarily, he or she was asked to practice with the use of a hand mirror. The examination was continued from the left-side most posterior molar to the left-side central incisor sequentially. For examination of the molars, the occlusion foil was placed on both the mesial and distal sides of the occlusal surface. The same procedure was performed for the 1, 2 and 3 mm right positions and also for the 1, 2 and 3 mm left positions. In addition, the working-side occlusal contacts were recorded in the same manner. All recordings were performed by the same examiner and were repeated. In the case of differing results, the existence of occlusal contact was re-examined and verified. All recordings were made between 10 o'clock in the morning and 4 o'clock in the afternoon to avoid possible diurnal variations.⁷

Working-side occlusal contact patterns were determined for the total range of lateral positions and classified into three groups: canine protection, group function or others (occlusal patterns other than those described). Canine protection was de-

defined as the contact of only working-side maxillary and mandibular canines in the total range of lateral positions from 1 to 3 mm. Group function was defined as the contacts of two or more working-side teeth in at least one lateral position, and/or as single tooth contacts on the working-side in different lateral positions, e.g. the contact of only first molars in the 1 mm position followed by the contact of only canines in the 2 and 3 mm positions. The others type was identified when a contact pattern other than those described above was observed, e.g. contact of only first premolars throughout the lateral positions or contact patterns with no working-side contacts. Data were analyzed with SPSS 15 statistical software. The differences between patterns were evaluated using chi-square test.

Results

Figure 1 shows the number of working occlusal contacts recorded for each dental unit on right and left sides. The contact frequencies varied with the lateral position and with the tooth type. The work-

ing-side occlusal contacts were mostly on the first premolar in R1 (right 1 mm) followed by canine; but in L1 (left 1 mm), the percentage of contacts on canine and first premolar were the same. The frequency of contact on premolars decreased gradually from the 1 to 3 on both sides. In all lateral positions, the frequency of contact decreased from the canine to the first molar as the tooth type became located posteriorly. However, the contact on the first molar almost was as prevalent as that on the second premolar. The frequency of the working-side canine contact increased from the 1 to the 3 mm position.

Figure 2 presents the number of non-working occlusal contacts recorded for each dental unit on right and left sides. The non-working-side contacts primarily involved the first and second molars, most frequently the second molar. The prevalence of non-working-side contacts decreased as the mandible moved from the 1 to 3 mm position on the premolars and molars.

Table 1 shows the percentage of occlusal patterns in mandibular lateral movement on the right

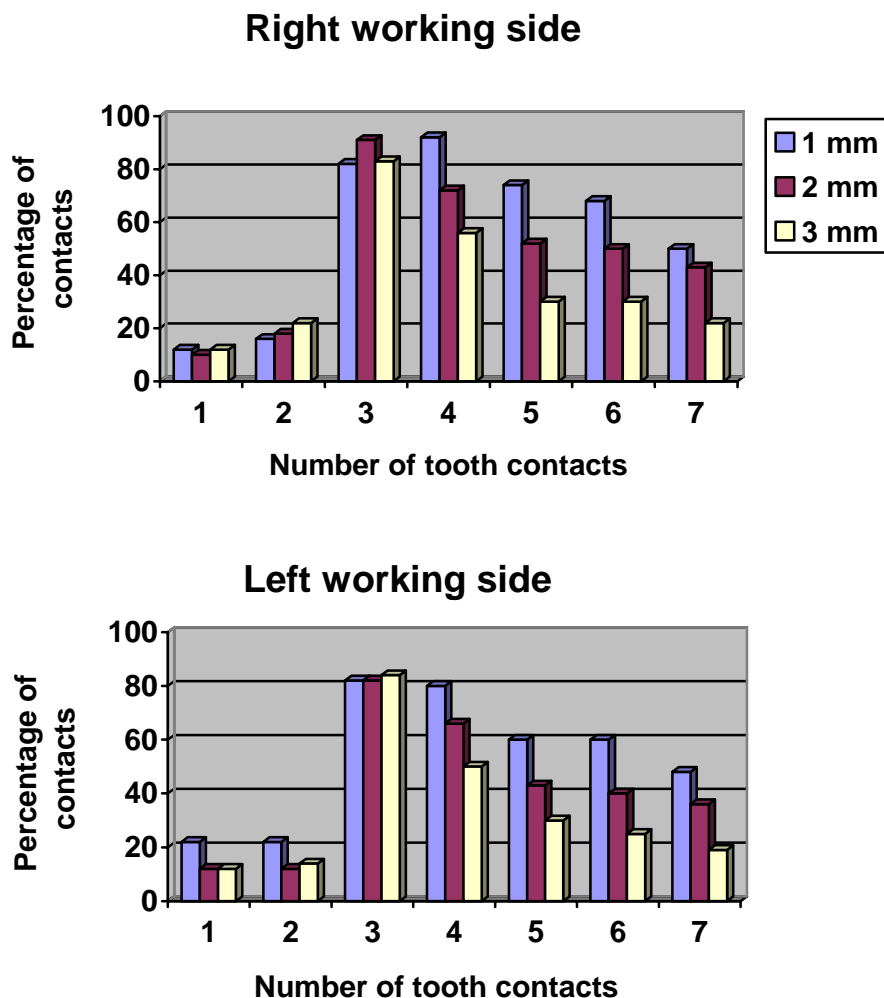


Figure 1. Distribution of occlusal contacts on the right and left working sides in various lateral positions.



Figure 2. Distribution of occlusal contacts on the right and left non-working sides in various lateral positions.

and left sides. Most of working-side contact patterns were classified as group function (60%); canine protection was rare (17.3%), and contact patterns other than canine protection and group function were found in 23.7% of the contact patterns on the right side. On the left side, group function was found in 51.3%, canine protection in 20.7% and others in 28% of the contact patterns. Most of the subjects (66%) had the same pattern

Table 1. The percentage of occlusal patterns in lateral mandibular movements on right and left sides

Lateral movement	Canine protection	Group function	Other
Right side			
1 mm	2%	66%	32%
2 mm	20%	60%	20%
3 mm	30%	54%	16%
Mean	17.3%	60%	23.7%
Left side			
1 mm	8%	58%	34%
2 mm	20%	50%	30%
3 mm	34%	46%	20%
Mean	20.7%	51.3%	28%

on both sides: 42% group function, 8% canine protection, and 16% others.

Discussion

This study demonstrated that the occlusal contact pattern during lateral movement differs between 1 mm, 2 mm and 3 mm. In the position close to the maximum intercuspation, canine protection was seen to be the lowest.

The occlusal contact pattern varying with lateral positions should be a critical factor on diagnosis and treatment of occlusal disharmonies. The marked difference in the pattern of occlusal contacts between the 1, 2 and 3 mm positions, suggests that the contact pattern in the 1 mm position reflects a pattern of occlusal contact distinct from that commonly observed during lateral excursion.

In a study analyzing two working-side inter-occlusal contacts, a large number of subjects presented unclassified patterns of articulations.⁸ More individuals had canine guidance on the left side, whereas the most frequent pattern on the right side was group function.⁸ Another study on occlusal contact areas using a 3-D digitization measurement system found that, at intercuspal position, estimated occlusal contact areas were 12.6 mm².⁹ However, after 3.0 mm of lateral excursion, their areas were sharply reduced to 2.2 mm².

Ogawa et al¹⁰⁻¹² found most contact patterns belonged to group function and a few to canine protection. They also found the presence of occlusal contacts in different lateral positions may have different effects on biomechanics of the related teeth. For instance, the force on individual teeth may be more traumatic in the more lateral positions because of the increased vector of the force. Occlusal force is transmitted to the teeth during four functional and parafunctional stages: mastication, swallowing, clenching and grinding. The occlusal contact during mastication and swallowing is suggested to occur mainly in lateral positions close to the MI, i.e. within 1 mm of the MI.¹⁰⁻¹² In addition, forces during these two functional movements are relatively low and their durations are short. Taking into consideration these various factors, the biomechanical significance of non-working-side occlusal contact may increase over the non-functional range of lateral movement corresponding to the 3 mm position. In the present study, incidence of non-working-side occlusal contact decreased from 1 to 3 mm; so it does not seem appropriate to deduce that contact in this position produces harmful force to the teeth or periodontal structures. However, this does not exclude the possibility that the non-working-side contacts in the position close to the MI may be important in masticatory function.¹³

Conclusion

Most of working-side contact patterns were classified as group function. Canine protection was rare. Contact patterns other than canine protection and group function were found in 23% of the contact patterns on the right side. On the left side, group function was seen in 51%, canine protection in 21% and others patterns in 28% of the studied subjects. On laterotrusion, most subjects had group function on the working side but canine protection was rare.

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