

Different occlusal schemes in eccentric mandibular positions

Pratik Manandhar^{1*}, Sapna Laxmi Tuladhar¹, Neeta Thapa¹, Rebicca Ranjit²

¹Department of Prosthodontics and Maxillofacial Prosthetics,

²Department of Periodontics and Oral Implantology, Gandaki Medical College Teaching Hospital and Research Centre, Nepal

ABSTRACT

Introduction: The alignment of teeth and their occlusal relationship in the arch plays an important role in mandibular movements during static and dynamic positions. Harmonious and synchronized mandibular movements is important for the physiological occlusion during lateral excursions of the mandible. Hence, the present study was designed to determine the different occlusal schemes in eccentric mandibular positions and the frequency percentage of each occlusal pattern was determined. **Methods:** This cross-sectional study was conducted among 64 undergraduate students of Gandaki Medical College aged from 18 to 30 years, where, a convenience sampling technique was used for data collection. The occlusal contacts were recorded in 1, 2, and 3 mm from the maximum intercuspal position on both the working and non-working sides. Working side occlusal contacts were determined for the total range of lateral positions and classified into: canine protection, group functions, or others (occlusal patterns other than those described). **Results:** Most of the working side contact patterns were classified as group function (66.15%) followed by canine-guided occlusion (18.75%); while contact patterns other than canine protection and group function were found in 15.10% of the contact patterns on the right side. On the left side, group function was found in 62.50%, canine protection in 9.33% and others in 14.67% of the contact patterns. **Conclusions:** On laterotrusion, most subjects had group function on the working side but canine protection was found to be rare.

Keywords: Canine-guided occlusion, group function, non-working side, occlusal schemes, working side.

*Correspondence:

Dr. Pratik Manandhar
Department of Prosthodontics and
Maxillofacial Prosthetics
Gandaki Medical College Teaching Hospital
and Research Centre, Nepal.
Email: pratikmanandhar27@gmail.com
ORCID iD: <https://orcid.org/0000-0002-8294-7147>

Submitted: May 31, 2024

Accepted: June 17, 2024

To cite: Manandhar P, Tuladhar SL, Thapa N Ranjit R. Different occlusal schemes in eccentric mandibular positions. JGMC Nepal. 2024;17(1):17-21.

DOI: 10.3126/jgmcn.v17i1.66311

INTRODUCTION

The alignment of teeth and their occlusal relationship in the arch plays an important role in the harmonious and synchronized mandibular movements during static and dynamic positions.¹ 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.²

Mainly, two concepts of occlusal schemes have been used for the classification of the patterns of occlusal contacts during lateral excursions in natural dentition: (1) Canine protection (canine-guided occlusion) as described by D'Amico³ where the canine guides the mandibular movement directly through contact or indirectly through periodontal receptors and protects the posterior teeth from overload during lateral movement.^{4,5} (2) Group function / unilateral balanced occlusion as described by Beyron⁶ that implies contact and stress on several teeth in lateral occlusion and indicates abrasion as a positive and inevitable adjustment.⁵ The absence of contact on non-working side prevents those teeth from being subjected to the destructive obliquely directed forces found in non-working interferences. It also saves the centric holding cusps i.e. the mandibular buccal cusps and maxillary lingual cusps from excessive wear. The reason

for bringing any teeth into lateral function is to distribute stress and wear over more teeth. The obvious advantage is the maintenance of the occlusion.⁷ When a part of occlusion needs restoration, it must be consistent with already existing occlusal schemes. In restorative dentistry, when the whole dentition needs rehabilitation there is a need to choose the occlusal schemes and that could be done based on epidemiological data combined with the knowledge of the masticatory system.

The studies on such topics are scarce in our country.^{1,7} The primary hypothesis advanced in this study was that the contact pattern varies with the mandibular position and thus, the influence of the mandibular position on occlusal contacts should be defined. Unless lateral positions are studied, future advancement in understanding the roles of occlusal contacts in mandibular function and dental diseases is limited. So, the purpose of the study was to determine the different occlusal schemes in eccentric mandibular positions. This would help in designing the best occlusal scheme in patients who have lost the anatomical details of dentition and need full mouth rehabilitation.

METHODS

This cross-sectional study was conducted from March 6 to May 27, 2024 among the undergraduate students (first, second, third, and fourth year and interns) of Gandaki Medical College, Pokhara. The ethical clearance was obtained from the Institutional Review Committee, Gandaki Medical College (Ref. No. 052/2077/2078). A written informed consent was taken from all the participants prior to data collection. A convenience sampling technique was used to enroll the participants in the study. Based on a previous study,⁸ at 95% confidence interval and 60% prevalence, a sample size of 64 was calculated. Sample size (n) was calculated as:

$$n = z^2 p \times q / E^2, \text{ where } z=1.96 \text{ at } 95\% \text{ confidence interval} \\ = (1.96^2 \times 60 \times 40) / 12^2 \\ = 64.02 \cong 64$$

The willing complete dentate students aged 18 to 30 years, with Angle's Class I relationship and normal occlusal alignment, regardless of the presence or absence of third molars were included in the study. The subjects with any signs and symptoms of temporomandibular disorders or parafunctional habits, history of orthodontic therapy, subjects with a shift in the mandibular midline, presence of large restorations involving incisal edge and cusp tip, fractured teeth, presence of crown and bridge were excluded from the study. The oral examination of the subjects was carried out by a single examiner. The

armamentarium used for the data collection were (1) Shim stock occlusal registration strips of 12 μ m thick [Arti-Fol metallic articulating film—Dr. Jeau Bausc GmbH & Co. KG, Germany (2) graduated periodontal probe (3) CD marker pen (4) tweezer.

Each subject was seated in a dental chair in an upright position. The occlusal contacts were recorded in 1, 2, and 3 mm from the maximum intercuspation (MI). To control the lateral position, three lines or marks were made (one at each mm) on the upper central incisors with a sharp black water-resistant CD marker pen from the maxillary midline. A shimstock which doesn't disturb the proprioception mechanism, were placed between the occlusal surface of maxillary and mandibular teeth. When recording the occlusal contacts, each subject were asked to close the mandible in maximum intercuspation (MI) and then instructed to slide the mandible laterally to the right side performing three lateral excursions previously marked as: lateral 1 (1mm from MI), lateral 2 (2mm from MI), lateral 3 (3mm from MI). Occlusal contacts were then recorded on both the working and non-working sides. The same procedure was carried out with the subject gliding the mandible on the opposite (left) side. Working side occlusal contacts were determined for the total range of lateral positions and classified into: canine protection, group functions, or others (occlusal patterns other than those described).

(1) Canine-protection (canine-guided occlusion) as described by D'Amico³ is a form of mutually protected articulation in which canines of maxilla and mandible contact with each other during lateral mandible movement in such a way that all posterior teeth are out of occlusion.^{4,9} In this occlusion, the canine guides the mandibular movement directly through contact or indirectly through periodontal receptors. It has been speculated that this occlusion type protects the posterior teeth from overloading during lateral movement.^{4,5} Canines' location, anatomy, and strong proprioceptive abilities well tolerate the occlusal loads.⁵

(2) Group function / unilateral balanced occlusion as described by Beyron⁶ implies the multiple contact relations between the maxillary and mandibular teeth in lateral movements on the working side and indicates abrasion as a positive and inevitable adjustment. Multiple teeth come in contact between the maxilla and mandible during lateral movements on the working side (the side towards which the mandible moves) and no contact of teeth on the balancing side (the side of an arch from where the mandible moves away).¹⁰ Groups of teeth on the working side take up the occlusal load and thus relieve the rest of the teeth from occlusal trauma.^{5,11}

Canine protection was 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 other 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.² The obtained data were entered in a Microsoft Excel sheet and the statistical analysis was done using Statistical Package on Social Sciences (SPSS) version 16.0.

RESULTS

Out of 64 subjects, the majority 42(65.63%) were females. The subjects with the age group 18 to 30 years were taken into the study where the mean age group was found to be 22.81±3.202 years.

Table 1 shows the frequency of occlusal patterns in mandibular lateral movement on the right and left sides. Most of the working-side contact patterns were classified as: group function (66.15%) followed by canine-guided occlusion (18.75%); while contact patterns other than canine protection and group function were found in 15.10% of the contact patterns on the right side. On the left side, group function was found in 62.50%, canine protection in 9.33% and others in 14.67% of contact patterns.

Table 1: Frequency of occlusal patterns in lateral mandibular movements on right and left sides

Lateral movements	Group function n(%)	Canine-protection n(%)	Others n(%)
Right side			
1mm	47(73.44%)	8(12.50%)	9(14.06%)
2mm	43(67.19%)	14(21.88%)	7(10.94%)
3mm	37(57.81%)	14(21.88%)	13(20.31%)
Mean	66.15%	18.75%	15.10%
Left side			
1mm	46(71.88%)	5(7.81%)	13(20.31%)
2mm	38(59.38%)	12(18.75%)	14(21.88%)
3mm	36(56.25%)	11(17.19%)	17(26.56%)
Mean	62.50%	9.33%	14.67%

Figure 1 shows the number of working occlusal contacts recorded for each dental unit on right and left sides. The contact frequency varied with the lateral position and with the tooth type. The working side occlusal contacts were mostly on the canine 43(67.19%) in R1 (right 1mm) followed by lateral incisors 40(62.50%) and first premolars 37(57.81%). In all lateral positions, the frequency of contacts decreased from canine to molars. The frequency of working side canine contacts increased from 1 to 2 mm and then decreased from 2mm to 3 mm position.

Similarly, in left working side, the occlusal contacts were mostly on the lateral incisors 43(73.43%) in L1 (left 1 mm) followed by canine 36(56.25%). The frequency of contacts on lateral incisors, premolars and molars decreased gradually from 1 to 3 mm in both sides.

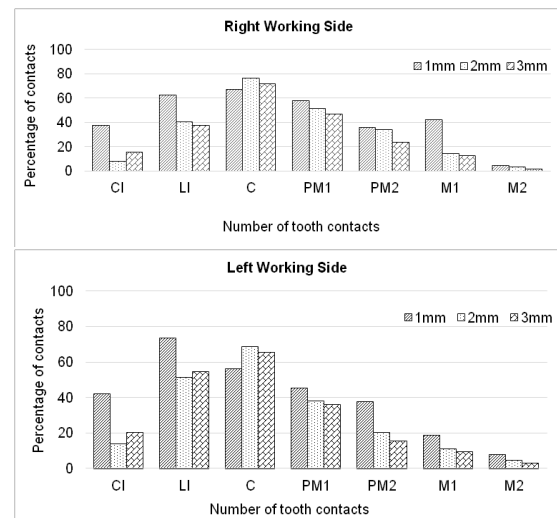


Figure 1: Distribution of occlusal contacts on the right and left working sides in various lateral positions

Figure 2 represents the number of non-working occlusal contacts recorded for each dental unit on right and left sides. The non-working side contacts primarily involved canines in right side 48(75%) in R1 (right 1mm) while lateral incisors in left sides 37(57.81%) in L1 (left 1mm).

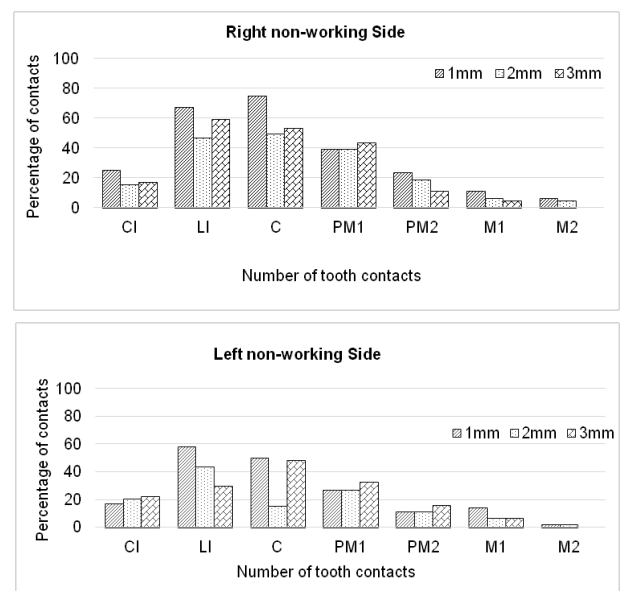


Figure 2: Distribution of occlusal contacts on the right and left non-working sides in various lateral positions

DISCUSSION

Occlusion has a vital role in various disciplines of dentistry. In full mouth rehabilitation cases, the dentists are at loss of selecting the best occlusal schemes for the patients.

The occlusal contact pattern varying with lateral positions should be a critical factor in the diagnosis and treatment of occlusal disharmonies. The marked 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. Group function and canine protection have been used as categories for the classification of the patterns of occlusal contacts in lateral excursions in natural dentition.^{8,12}

The age group included in this study was 18 to 30 years because the subjects in this age group are susceptible to negligible occlusal wear while the older subjects with greater occlusal wear could alter the outcome of the study. This study showed that most of the working-side contact patterns on the right side were found to be group function followed by canine-guided occlusion while the other patterns were found to be least prevalent. Similarly, on the left side, group function was found to be the predominant type of occlusion while canine-guided occlusion was found to be rare. These findings were in accordance with the studies by Shrestha et al.,¹ Parnia et al.,² Gupta et al.¹³ and Singh et al.¹² The prevalence of group function occlusion could be attributed to the shift from canine-guided occlusion to group function with the increase in age¹⁴ indicating abrasion as a positive and inevitable adjustment. Groups of teeth on the working side take up the occlusal load and thus relieve the rest of the teeth from occlusal trauma. However, this finding contradicts to few previous studies¹⁵⁻¹⁷ which state that the normal pattern that the majority of young people have canine-guided occlusion. These variations in occlusal patterns could be attributed to the difference in criteria used for sample selection, differences in daily dietary habits, cultures and influence of materials used to register contacts as well as differences in classification system which may be the auxiliary circumstance that contribute to the observed difference.¹⁸

On determining the number of working occlusal contacts for each dental unit on the right and left sides, it was found that the contact frequency varied with the lateral positions (1 to 3mm) and with the tooth type. The working side occlusal contacts were mostly on the canine in R1 (right 1mm) followed by lateral incisors and first premolars. The study by Parnia et al.² showed that most contacts were on first premolars followed by canines. However, in both studies, the frequency of contacts decreased from canine to molars in all lateral positions

Similarly, on the left working side, the occlusal contacts were mostly on the lateral incisors in L1 (left 1 mm) followed by canine. In contrast to this finding, the study by Parnia et al.² showed a similar percentage of contacts in canines and premolars with lesser contacts in lateral

incisors. The frequency of contacts on lateral incisors, premolars, and molars decreased gradually from 1 to 3 mm on both sides as the tooth type became located posteriorly. Thus, this study demonstrated that the occlusal contact pattern during lateral movement differs from 1mm, 2 mm, and 3 mm positions from maximum intercuspation. The occlusal contacts in different lateral positions may have different effects on the biomechanics of the related teeth. The force on the individual teeth may be more traumatic in the more lateral positions because of the increased vector of the force. 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 MI.⁸

This study bears some limitations like small sample size and intra-oral examination of canine guided and group function occlusion. The use of face bow records mounted on an adjustable articulator to determine the occlusion would have helped to get precise results. Furthermore, a multicentric study with a larger sample size could have helped to generalize the results of this study.

The rationale of this study was that the intercuspation of teeth plays an important role in restorative dentistry as the long-term success of any restoration is dependent on the maintenance of occlusal harmony. Unsteadiness and alterations of occlusal contacts may lead to non-equilibrium situations, determining muscular stresses that lead to pathological occlusion.¹⁹ Careful designing and rehabilitation of occlusal schemes in restoring lost dentition is required. But when the whole dentition needs rehabilitation due to attrition, erosion, and cusp fractures the choice of selecting the occlusal scheme should be carried out.

CONCLUSIONS

This study demonstrated that on laterotrusion, most subjects had group function on the working side but canine protection was found to be rare in both right and left sides. On determining the number of working occlusal contacts for each dental unit on the right and left sides, it was found that the contact frequency varied with the lateral positions (1 to 3mm) and with the tooth type.

ACKNOWLEDGEMENT

The authors would like to express their gratitude of thanks to all participants for their valuable time and information. We are also grateful to the Department of Prosthodontics and Maxillofacial Prosthetics, College of Dental Surgery (Gandaki Medical College Teaching Hospital & Research Pvt. Ltd., Pokhara) and GMC-IRC for support in conducting the research.

CONFLICTS OF INTEREST: None declared

SOURCE OF FUNDING: None

AUTHORS' CONTRIBUTION

PM designed the research, collected data, performed statistical analysis, and prepared the first draft of the manuscript, SLT, NT, and RR explained and interpreted the data and contributed to preparing the final draft of the manuscript. All authors read and approved the manuscript.

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