



## Nature of Occlusion during Eccentric Mandibular Movements in Young Adults

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### ABSTRACT

**Aim:** The aim of this study was to find out the nature of occlusion and tooth contact during various eccentric mandibular movements in young adults with class I occlusion.

**Materials and methods:** The sample consisted of 100 young adults with class I occlusion with full complement of teeth.

Anterior disclusion in centric occlusion was demonstrated using a shim stock interposed between the upper and lower anteriors. Disclusion of posteriors was ascertained during 1.5 mm straight protrusion and in edge-to-edge protrusion, visually as well as using a silk floss method. Posterior disclusion was also verified during lateroprotrusion and crossover. Besides these occlusal wear of teeth also were observed.

**Results:** The results of this study showed that the anterior disclusion is seen only in one-fourth of the subjects compared to almost three-fourth showing posterior disclusion. Mutually protected occlusion was also seen only in one-fourth of the subjects. Canine protective mechanism is seen in a relatively large number of subjects, but it was not overwhelmingly predominant. No correlation could be established between cuspid wear and the type of occlusion. A relatively high percentage of subjects showed wear on posterior teeth when there was no posterior disclusion.

**Conclusion:** From the above study it is seen that posterior disclusion is acknowledged as a common factor except when a bilateral balance is present. Since bilateral balance is harmful, the ideal occlusal relationship in eccentric movements is in favor of posterior disclusion. Posterior disclusion is easily obtainable when restorations are planned.

**Clinical significance:** From the findings and results it has been possible to make some contributions on the nature of tooth contacts and disclusion during various eccentric movements and compare it with the requirements of ideal occlusion.

**Keywords:** Disclusion, Lateroprotrusion, Crossover, Canine protected occlusion, Mutually protected occlusion, Group function, Balanced occlusion.

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### INTRODUCTION

Numerous studies have been done in the past to investigate the occlusal relationship of upper and lower teeth during protrusive and lateral excursive movements. Based on these, various theories and concepts have been introduced. These are the concepts of balanced occlusion, group function cuspid protection and mutually protected occlusion. There are proponents and opponents for each of them, each claiming their own views.

Among these the earliest was the concept of balanced occlusion which aims in obtaining contact between upper and lower teeth in various excursive movements of the mandible. The proponents<sup>2,12,18,20</sup> of this theory claimed that it produced a stable occlusion. However, presently this claim is not only refuted but also believed that balancing contacts are a serious threat to the functioning of the stomatognathic system resulting in temporomandibular joint dysfunction, periodontal problems and occlusal wear. Balanced occlusion is no more valid for natural teeth. Balanced occlusion is restricted only in complete dentures to obtain occlusion during eccentric movements. The concept of cuspid protection which is diametrically opposed to balanced occlusion became popular after the extensive work of D' Amico in 1958. Since then, cuspid protective theory has gained the support of many<sup>5,8,19,21</sup> and has been the forerunner of mutually protected occlusion concept. This theory suggests that the only tooth contact in all positions of the mandible except centric relation and straight protrusion should be between maxillary cuspids and mandibular cuspids or first premolars, and that the cuspids should not be in contact when the mandible is in centric relation.

The advocates<sup>3,4,9-11</sup> of group function believe that groups of teeth either anterior or posterior on one side take up the occlusal load relieving the rest of the teeth from

occlusal trauma. During posterior group function the upper buccal cusps contact the lower buccal cusps on the functional side without separation, thereby.

The force of occlusion are evenly distributed on the working cusps during lateral movements.

In mutually protected occlusion,<sup>5,8,16,19,21</sup> the anterior teeth protect the posterior teeth during excursive movements in the form of anterior guidance or canine protected occlusion, and the posterior teeth protect the anterior teeth during centric closure. There is minimal space present between the upper and lower incisors and canines in centric occlusion.

Keeping this in mind as well as the several concepts of occlusion a study was conducted to find out the pattern of tooth contacts in natural dentition during the following eccentric mandibular positions in young adults with class I occlusion:

1. Straight protrusive
2. Lateroprotrusive
3. Lateral
4. Crossover

## MATERIALS AND METHODS

The subjects for this study comprised of 100 dental students with a mean age 22 years within the age range of 17 to 28 years comprising of both sexes. The present investigation was planned in the following manner:

1. Selection of subjects
2. Recording the nature of occlusion and tooth contact in the following eccentric mandibular positions;
  - Straight protrusive
  - Lateroprotrusive
  - Lateral
  - Crossover
3. Observation of disclusion during various eccentric mandibular positions.
4. Observation of occlusal wear facets.

## SELECTION OF SUBJECTS

The following criteria were followed during the selection of the subjects:

1. Full compliment of teeth were present. Third molars were not taken into consideration.
2. No supernumerary, peg-shaped teeth, no median diastema present.
3. No untreated carious cavities present.
4. No crowns or large restorations involving the occlusion of cuspids.
5. No previous orthodontic correction of teeth.
6. Subjects were screened for malaligned teeth.

7. No midline deviation.
8. No deviation of the mandible on mouth opening.
9. All subjects were having Angle's class I occlusal relationship.

## RECORDING OF THE NATURE OF OCCLUSION AND TOOTH CONTACT IN VARIOUS ECCENTRIC MANDIBULAR POSITIONS

### Disclusion in Centric Occlusion

The subjects were instructed to close and tap on the back teeth to bring the teeth in centric occlusion. When any of the subjects had difficulty in bringing the teeth in centric occlusion, they were manually assisted to take the mandible to centric occlusion. Before the commencement of recording it was made sure that the subject closed in centric occlusion. The test was repeated till successive closures were identical. Then the test was carried out as follows.

A shimstock of eight micron thickness was placed in between the upper and lower anteriors, to find whether or not the anteriors made contact in centric occlusion. If the shimstock was held in place it was interpreted as anteriors having contact and *vice versa* (Fig. 1).

### Straight Protrusive Movements

Tooth contacts were recorded in two different straight protrusive positions of the mandible, such as in 1.5 mm protrusion and in edge-to-edge protrusion.

- i. *1.5 mm from the intercuspal position:* Subjects were instructed to close on the back teeth. Using a sharp indelible pencil, a straight line was drawn vertically from the cusp tip of the lower first premolar on the buccal surface till its middle third. Another straight vertical line was drawn on the buccal surface of the opposing upper canine tooth 1.5 mm mesial from the cusp tip of the lower first premolar, which has a vertical line marked on it. In this manner a horizontal distance of 1.5 mm



**Fig. 1:** Anterior disclusion in centric occlusion detected with shim stock

was obtained between the premolar line and the canine line when the teeth were closed in centric occlusion. Then the subject was made to protrude the mandible till both the lines were aligned with each other to give 1.5 mm protrusion. During this protrusive position, the posterior teeth were observed for disclusion.

**Silk floss method to verify disclusion:** A waxed silk floss verify disclusion. The waxed silk floss was looped around the distal tooth on both the sides and it was withdrawn anteriorly holding the two ends of the floss, when the mandible was in 1.5 mm protrusive position. If the silk floss was held in place it indicated the absence of disclusion. In this manner any error in the visual judgment method is avoided (Fig. 2).

When there was no disclusion, the location of interfering contacts were then recorded using an articulating film of 8 micron thickness (Fig. 3).

- ii. **Edge-to-edge protrusion:** The subject was made to protrude the mandible till the upper and lower incisors reached an edge-to-edge position. With the jaw maintained at this position, the same procedure



**Fig. 2:** Posterior disclusion during protrusion detected by silk floss method



**Fig. 3:** Posterior disclusion during protrusion detected with articulating foil

mentioned above was repeated to find out the presence or absence of disclusion.

### Lateroprotrusive Movements

- i. Right lateroprotrusion
- ii. Left lateroprotrusion

From the intercuspatal position the subject was made to move the mandible to the right and left respectively till the lower central incisor, lateral incisors and cuspid contacted the upper central incisor, lateral incisor and cuspid. Disclusion of posterior teeth during this mandibular position was observed using the same procedure mentioned above.

### Lateral Movements

- i. Right lateral
- ii. Left lateral

Lateral excursive movements were studied in two positions:

- **Canine cusp tip to cusp tip position:** The subject was made to move the mandible laterally on one side without any protrusive component till the cusp tip of lower canine contacted the cusp tip of upper canine. At this position it was observed whether, the cuspids discluded all the other teeth in the entire arch. This was seen visually, as well as eliciting information from the subjects. An articulating film was interposed to confirm any occlusal contacts. In the absence of contact between the upper and lower canines, contact between the upper and lower posterior teeth on the movement side was noticed. The nature of this contact whether it was (a) cross tooth balance or (b) cross arch balance was recorded, cross arch balancing contacts were elicited by silk floss method.
- **Three millimeter lateral position along canine guidance:** Tooth contacts were recorded in 3 mm lateral position as measured at the mandibular midline. This was done by the following method. A line was drawn vertically on the labial surface of both the upper central incisors with a sharp indelible pencil 3 mm on both sides of the midline. The subjects were made to move the mandible laterally with canine guidance till the mandibular midline approximated with the line drawn on the labial surface of upper central incisors. This was done both left and right sides. Presence or absence of disclusion was observed during these movements. Using the silk floss method the interfering contacts were noted.

### Crossover

- i. Right crossover
- ii. Left crossover

The subjects were asked to move the mandible further laterally till the lower canine passed over the upper canine. At this time the anteriors should remain in contact on their incisal edges and not be separated by any posterior tooth contacts either on the working or balancing sides. Presence or absence of disclusion was observed either clinically by the articulating film or silk floss method.

### Observation of Occlusal Wear Facets

The occlusal wear facets if any were visualized, and its location was noted in each quadrant.

In this manner the various excursive movements, such as straight protrusion, lateroprotrusion, lateral and lateral crossover were performed to elicit the nature of occlusal relationship, such as canine-protected occlusion, group function, balanced occlusion and mutually protected occlusion and for the presence of disclusion. The data thus obtained from the subjects were evaluated.

### RESULTS

The basic data of the study are analyzed and presented in Tables 1 to 5.

Table 1 shows anterior disclusion in centric occlusion in 100 subjects, incisor disclusion was seen in 45% of the subjects studied and 55% did not have incisor disclusion. Canine disclusion was present in 30% of the subjects in centric occlusion. Rest of the 70% had contact of upper canine to the lower canine, out of which 10% had unilateral contact and 60% had bilateral contact.

Table 2 shows posterior disclusion during straight protrusive movement. Eighty-three percent of the subjects had disclusion of posteriors in 1.5 mm protrusion compared to 87% in edge-to-edge protrusion. There was no posterior disclusion in 17% of the subjects in 1.5 mm protrusion and 13% in edge-to-edge protrusion.

Table 3 shows posterior disclusion during lateroprotrusion. On the right lateroprotrusion 75% of the subjects showed posterior disclusion and 73% showed disclusion of posteriors during left lateroprotrusion.

Table 4 shows the type of occlusion during lateral movements to the right and left sides. In both the positions (canine cusp tip to cusp tip and 3 mm canine guidance) to the right side, canine protection was seen in 63% of the

subjects, followed by 31% group function and 6% balanced occlusion. The left side showed 64% canine protection, 32% group function and 4% who had balancing contacts.

Table 5 shows posterior disclusion during crossover. Sixty-nine percent of the subjects showed disclusion of posteriors during both right and left crossover and 31% did not show disclusion.

### DISCUSSION

Occlusion plays a dominant role in the various disciplines of dentistry because of its direct influence on three structures namely the teeth, periodontal membrane and alveolar bone and the temporomandibular joint. A healthy occlusion promotes the maintenance of physiological functioning of these three structures and *vice versa*. For example, an unfavorable occlusion can produce occlusal wear, over stress on the periodontal ligament leading to its destruction and alveolar bone resorption. By passing these two, unfavorable occlusion can also lead to altered muscle activity and temporomandibular dysfunction.<sup>1,6,17</sup> Today there is no debate on these facts. However, as regard to various theories of occlusion, there are many concepts, controversies, propounded by various research workers from time to time. Some of the old concepts have become obsolete in favor of newer concepts.

**Table 1:** Anterior disclusion in centric occlusion in 100 subjects

	Absent	Present
Incisor disclusion	55%	45%
Canine disclusion		
• Unilateral	10%	
• Bilateral	60%	30%

**Table 2:** Posterior disclusion during straight protrusive movement

Protrusive range	Disclusion of posteriors	No disclusion
1.5 mm	83%	17%
Edge-to-edge	87%	13%

**Table 3:** Posterior disclusion during lateroprotrusion

	Disclusion	No disclusion
Right side	75%	25%
Left side	73%	27%

**Table 4:** Type of occlusion during lateral movements

	Range	Canine protection	Group function	Balanced occlusion
Right side	Canine cusp tip to cusp tip	63%	31%	6%
	3 mm canine guidance	63%	31%	6%
Left side	Canine cusp tip to cusp tip	64%	32%	4%
	3 mm canine guidance	64%	32%	4%

**Table 5:** Posterior disclusion during crossover

	Posterior disclusion	No disclusion
Right crossover	69%	31%
Left crossover	69%	31%

Two aspects of occlusion should be kept in mind before one attempts to relate its influence on dental structures. These are when the upper and lower teeth meet in centric occlusion and when the teeth move from centric occlusion to its protrusive and lateral excursive movements. Both these phases of occlusion are important to the well-being of stomatognathic system.

The nature of occlusal contacts in these movements have been described as mutually protected occlusion, canine protected occlusion, group function, unilateral balance and bilateral balance. Whatever, may be the concept, in principle it should be agreed that during centric occlusion, the teeth should meet each other with multiple pin-point contacts and these contacts should be separated during lateral movements to have contacts in anterior group, canine and groups of posterior teeth on one side. At this time there should not be contact in remaining teeth. In this manner the deleterious effects of lateral forces on the teeth are avoided. In other words, as recommended by gnathology school, there should be anterior disclusion in centric and posterior disclusion during eccentric movements.

This study was planned with two objectives. Firstly, to know the nature of occlusion during various excursive movements and secondly, to identify the presence or absence of disclusion during these movements. The investigation was done on young students between the age of 17 and 28 years who had class I occlusion.

This study showed that the anterior disclusion was present in only 26% of the subjects. This is not a favorable situation, if one believes in anterior disclusion theory which protects the anterior teeth from horizontal force.

As regards the posterior disclusion; during the incisal edge-to-edge protrusion 87% showed posterior disclusion while, in 1.5 mm protrusive range 83% showed posterior disclusion. It is significant that even in 1.5 mm protrusive range there was posterior disclusion in 83% of the subjects.

Bilateral canine protected occlusion was seen in only 58% of the subjects and 8% of the subjects showed unilateral canine protection. This of course is a sound principle which should be strictly followed while providing restorations or implant prosthesis. This study concurred with the finding of Scafe<sup>15</sup> (1969) where bilateral cuspid protective mechanism was observed in 57% and unilateral in 16%.

There is a general tendency for males to show canine protected occlusion. This is a significant observation during

canine protection all the posterior teeth were discluded during lateral eccentric movement except the canines on functional side; the upper and lower canines hold the jaw in lateral excursive movements. At this time considerable occlusal load is taken up by canine teeth. Canines are capable to withstand it without showing any signs of strain. This is because of (1) the buttressing nature of bone around the canine, (2) good crown—root ratio, (3) favorable root length, (4) the position of canine in dental arch and (5) the area of periodontal support.

## CONCLUSION

From the results of the study the following conclusions have been drawn:

1. In centric occlusion, anterior disclusion was present in 26% of the subjects.
2. On straight edge-to-edge protrusion, 87% of the subjects showed posterior disclusion while in the 1.5 mm protrusive range 83% showed posterior disclusion.
3. Mutually protected occlusion was seen during anterior guidance in 25% of the subjects.
4. Disclusion was seen in 74% of the subjects during lateroprotrusion showing equal distribution in both the sides.
5. Unilateral canine protected occlusion was seen in 8% and bilateral canine protected occlusion was seen in 58%, while unilateral group function was seen in 6% and bilateral group function in 28% of the subjects.
6. There was a general tendency for males to show canine protected occlusion and for females to show group function occlusion.
7. Cross tooth balance was observed only in 4% and crossarch balance was seen in only 7% of the subject.
8. During crossover 69% showed disclusion of posteriors on both the sides.
9. There is no significant difference in the incidence of cuspid wear when canine protected occlusion and group function was present.
10. There was a significant incidence of molar wear (39.33%) when there was no posterior disclusion as compared to 24% with posterior disclusion.

## CLINICAL SIGNIFICANCE

From the findings and results of this and many other studies<sup>7,13-15,22</sup> it has been possible to make some contribution on the nature of tooth contact and disclusion of teeth during various excursive movements and compare it with the requirements of ideal occlusion.

The evaluation of occlusion is important in prosthodontics and restorative dentistry because the occlusal

surface of teeth to be restored must be functional units of the patients stomatognathic system. Restored teeth should not interfere with mandibular function in mastication, speech and swallowing nor should they transmit excessive force to the attachment apparatus or temporomandibular joint either in the centric or eccentric jaw positions or during movements.

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