The Effect of Some Parameters on Natural Occlusion in Different Ethnicities

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Abstract: - Natural occlusion is the resultant of many components, such as muscles, temporomandibular joints, teeth, and neuromuscular systems, and thus plays an essential role in any dental treatment. This research aims to analyze some important features of occlusion in Malaysians. A clinical examination was conducted on 120 students at MAHSA University. The sample was equally divided by gender and ethnicity (Malays, Chineses, and Indians), their age ranged between 18 to 25 years. Results showed that the incidence of canine guidance and group function occlusions was 36% and 64% respectively. Angle's classification analysis revealed that Class I included the highest ratio of group function, Class II, Division 1 incorporated more group function than canine protection, while class II division 2 had more canine protection. In Class III, the occurrence for both occlusal patterns was almost equal. Other findings were that subjects with reduced horizontal overlap (0-0.9mm.) showed a 45% group function occlusal pattern, while subjects with increased (7-8.9 mm.) horizontal overlap all had group function. On the other hand, when vertical overlap exceeds 3mm., the percentage of canine protection spikes sharply and it reaches more than 80% of the cases when vertical overlap stands out at 5mm. During edge-to-edge protrusion, 45 % of individuals had anterior and posterior teeth contact, while 55% had anterior teeth contact with posterior teeth disocclusion. Class II division 2 had only anterior teeth contact with posterior teeth disocclusion, while Class III had nearly only anterior teeth contact with posterior teeth contact. There was no statistical difference in types of occlusion among ethnic groups and genders. In conclusion, Angle's Classification, horizontal and vertical overlaps affect the occlusal pattern types during lateral excursion and protrusion. A simple formula is presented to predict the vertical and horizontal overlaps.

Key-Words: - Natural occlusion, eccentric occlusion, group function, canine protection, horizontal overlap, vertical overlap.

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1 Introduction

Dental occlusion or occlusion is the static relationship between the incising or masticating surfaces of maxillary and mandibular teeth or tooth. More technically, it is the relationship between the maxillary and mandibular teeth when they approach each other, as occurs during chewing or rest, [1], [2]. In conclusion, occlusion should include both dynamic and static inter and intra relationship of the teeth and their supporting structures during normal and pathological conditions as well. Occlusion has been described as the most important factor in dental health, [3].

It played a major role in the successful treatment of removable partial and complete denture patients. Many well-designed and skillfully fabricated dentures failed because of an adequate occlusal pattern was not developed during the treatment period, [4].

The knowledge of occlusion principles and the physiology of mandibular movements are prerequisites in single or multiple teeth reconstruction. Therefore, to prevent occlusal trauma, the occlusal pattern should be restored, [5]. A successful surgical correction of malocclusion caused by congenital or acquired disease requires a good knowledge of occlusion and its principles, [6].

The treatment of temporomandibular joint disorders (TMD) and myofascial pain depends on comprehensive knowledge of occlusion.

In periodontology, malocclusion had been reported as a predisposing factor in periodontal diseases in

the presence of dental plaque and inflammation. Therefore, a good occlusion leads to good periodontal health, [7].

The success of endodontic treatment of a tooth depends on many factors. Among these factors is the occlusal status of the treated teeth. Excessive occlusal forces on a tooth may cause root resorption and hypercementosis, [8].

Good prognosis for dental implants whether single or multiple depends on creating a good occlusal pattern. Due to the lack of the periodontal ligament, osseointegrated implants, unlike natural teeth, react biomechanically in a different fashion to occlusal force. It is therefore believed that dental implants may be more prone to occlusal overloading, which is often regarded as one of the potential causes for peri-implant bone loss and failure of the implant/implant prosthesis. Overloading factors that may negatively influence implant longevity include large cantilevers, parafunctions, improper occlusal designs, and premature contacts. Hence, it is important to control implant occlusion within physiologic limits and thus provide optimal implant load to ensure long-term implant success, [9].

The achievement of the ideal functional occlusion provided satisfactory stability after orthodontic treatment. Thus, the success of the orthodontic treatment depends on the establishment of static and dynamic criteria. This minimizes the orthodontic relapse and prevents the appearance of occlusal pathologies, [10].

1.1 Natural Occlusion Types

1.1.1 Centric Occlusion (CO)

It is the static maximum teeth intercuspation contacts, [2], [11]. It is also defined as the interocclusal dental position of the maxillary teeth relative to the mandibular teeth, [1].

1.1.2 Eccentric Occlusion (EOC)

It is defined as the dynamic mandibular and maxillary teeth relationship during lateral and protrusive movements of the mandible while the teeth are in contact, [12].
Eccentric occlusion is classified into two main types:

1.1.2.1 Group function occlusion concept (GF): This may be bilateral balanced occlusion (BBO), or unilateral working side occlusion (UWO) (Fig. 1).


Fig. 1: Unilateral working side occlusion

BBO is the simultaneous contacting of the upper and lower right and left anterior and posterior teeth, [1].

UGF is simultaneous contact of the upper and lower teeth on the working side during lateral excursive movements. The lateral limit of this movement is dictated by the cusp-to-cusp relationship of the opposing molars, [13].

1.1.2.2 Canine Protected Occlusion Concept (CP)
It may be unilateral or bilateral, and occurs on both sides of the arch during lateral movement of the mandible. (Fig. 2).


Fig. 2: Canine protected occlusion

In CP occlusion, the canines of the working side are in contact during a lateral excursion, [12]. It is postulated that the CP prevents injury to the buccal cusps of the posterior teeth during lateral and protrusive movements. It is also called mutual protection occlusion, [14].

1.2 Factors Affecting Natural Occlusion

The combined effects of several factors can influence the nature of the teeth contacts during

mandibular movements in natural dentition, [15]. The controlling factors may be classified into

1.2.1 Posterior Controlling Factors

They include

1.2.1.1 Condylar Guidance (CG)

It is provided by the two temporomandibular joints and is determined by the distal slope of the articular eminence. This factor is considered fixed. During protrusive movements, the separation between maxillary and mandibular molars is maintained by the protrusive condylar guidance which depends on the angulation of the articular eminence, [15]. If the eminence is very steep, the condyles will describe a steep vertical path. While if it is flatter, the condyles will have a less vertical path. This will give a flatter occlusal plane and compensating curves (Spee and Wilson curves), [13]. During lateral movements, the separation between the molars on the non-working side is maintained by the non-working side condylar guidance. This is also dependent on the angulation of the articular eminence and the angulation of the medial wall of the glenoid fossa of the non-working side, [16].

1.2.1.2 Bennett Movement (BM) and Angle (BA)

During the lateral excursion, the non-working condyle moves downward, forward, and inward in the mandibular fossa around axes located in the opposite condyle forming the Bennett angle (Fig. 3).

Bennett's movement influences the height of the cusps, the depth of the fossa, and the direction of the ridges and grooves of the occlusal surfaces of posterior teeth. The lesser the degree of lateral mandibular translation, the cusps are higher and the fossa deeper. Besides, the direction of lateral mandibular movement also influences the cusp height. The cusp is shorter if the Bennett's movement is immediate, [16].

1.2.1.3 The Intercondylar Distance

It is the distance between the centers of the condyles of the mandible (Fig.3). The more the intercondylar distance, the more will be the possibility of disocclusion during laterality.

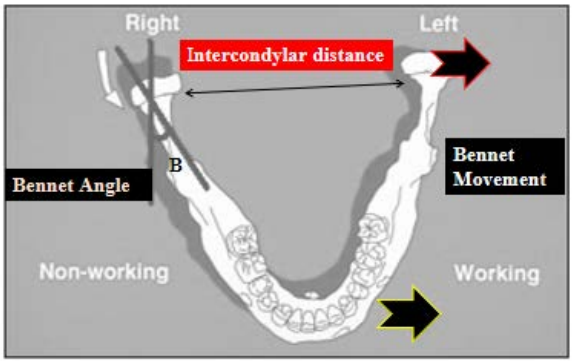

Fig. 3: Bennet movement and Bennet angle

1.2.2 The Anterior Controlling Factors

1.2.2.1 Anterior Guidance (AG)

There are two types of anterior guidance systems during mandible excursion;

-Group function (GF); occurs during lateral movement when the buccal cusps of the posterior teeth on the working side are in contact. There is no tooth contact on the non-working side.

-Canine protection (CP) takes place during the lateral excursion when only the upper and lower canine of the working side contact each other. There is no contact between the teeth on the non-working side and the other teeth on the working side. Thus, it protects other teeth from wearing off, [12], [11].

1.2.2.2 Incisal Guidance (Horizontal and Vertical Overlaps)

Incisal guidance (IG) is influenced by the vertical and horizontal overlap of the anterior teeth. Increase in vertical overlaps (VOL) resulting an increase in anterior guidance angle and large vertical component of the mandibular movement and a greater inclination of posterior cusps, posterior disocclusion space is larger and the cusp is higher.

A decrease of (VOL) will reduce the angle of anterior guidance, the posterior disocclusion space is lesser, hence, the cusp will be flatter, [17].

The more the (VOL) the more the possibility of canine guidance disocclusion during laterality. While the more the horizontal overlap (HOL) the more the group function incidence, [12], [18].

Much vertical overlap and little horizontal overlap of the anterior teeth (steep anterior guidance) will have the tendency to more easily disclude the posterior teeth during eccentric movement; thus the cusps will tend to remain high as attrition occurs. On the other hand, much (HOL) and little (VOL)

tend to flatten the cusps of the posterior teeth during eccentric movement, [12].

1.2.2.3 Plane of Occlusion (PO)
This is the imaginary plane that rests upon the tips of the lower canines, up to the distobuccal cusp tips of the lower second molars. The relationship of the plane of occlusion to the sagittal condylar guide influences the steepness of the cusps inclination and height of the cusps. When a plane of occlusion is steeply inclined, this will be associated with steep incisal guidance and condylar path. This should be reproduced in full mouth reconstruction to maintain the harmonious relationship between both incisal and condylar guidances, [13].

1.2.2.4 Compensating Curve (CC)
The Curve of Spee is the curve of the dental arches that extends from the tip of the lower canine along the buccal cusp tips of posterior teeth. The flat curve of Spee is associated with higher posterior cusps and deeper fossa, [15].

1.2.2.5 Cusp Height (CH)
The greater the height of the cusp, the more will be the vertical path of the anterior teeth during jaw closing. The higher the cusp, the disclusion space of the posterior and the angle of more incisal guidance are larger. While the flatter the posterior cusps, the plane of occlusion will be more parallel to the sagittal condylar guidance. The higher the posterior cusps, the flatter will be the curve of Spee, [2], [16].

1.2.3 Angle's Classification
This factor is shown to influence the incidence of certain types of eccentric occlusion. For example, in Class II Division 1, the horizontal overlap is high, thus, canine guidance incidence is reduced. While in Class II Division 2, canine-protected eccentric occlusion is occurring more. While in class III Angle's classification, where the horizontal and vertical overlaps are reduced, the incidence of group function occlusion is more noticeable, [12].

In a study conducted in 1989 on 500 Iraqi subjects regarding their eccentric occlusion. The researcher found that 41.3% of the subjects had bilateral canine protection occlusion and 46.3% were with bilateral group function occlusion. The other 12.4 % of the studied subjects had unilateral group function or canine protection occlusion.
The incidence of either type of occlusion was affected strongly by the amount of vertical and horizontal overlaps as well as the Angle's classification.
As the amount of vertical overlap increased, the incidence of canine protection increased and as the amount of horizontal overlap increased, the group function incidence increased.
Angle's Class I had almost the same incidence of both types of occlusion, while Class III subjects were with 91.5% group function occlusion.
Class II Div.1 they were mostly group function, and Class II Div. 2 had about 90% canine protection occlusion, [12].
A researcher found that 86.0% of their subjects were having group function occlusion, [19]. While others reported that canine protected occlusion was predominant in his sample (57%). During the lateral excursion, canine protected occlusion was predominant in class I (56%); class II Division 1 (67%), and Class II Division 2 (82%). In the Class III group function occlusion was predominant, [20].
It was found that at a 3 mm laterality position, 50% of the subjects had bilateral canine guidance, and only 8.5% had bilateral group function. Bilateral canine protected occlusion was predominant in Class I (53%) and also among both Class II, (70%). Bilateral canine protected occlusion was only 11% of the Class III subjects, [21].

2 Problem Formulation

Rehabilitation of the oral and dental structures is the main goal of restorative dentistry. Due to the presence of many hypotheses regarding the most biologically healthy solutions that respect the physiology and anatomy of oral structures, many opinions were introduced from time to time. However, the restoration of which occlusion is still argued among researchers and clinicians. We think that careful study of occlusal parameters and their interdependence enhance the reconstruction theories to their maximal benefits for the patients. Therefore, this study was designed to ameliorate our understanding of the interdependence among occlusal parameters in different ethnic groups of the population. The study involved the following parameters;
-The incidence of CG and GF occlusion in Malays, Chinese, and Indian individuals, aged from 18-25 years.
- The effect of the Angle's classification on the type of eccentric occlusion.
-The consequence of vertical and horizontal overlaps on occlusion.

-The length of the canines on eccentric occlusion occurrences. In addition to other relationships that may influence the occlusion rehabilitation of edentulous patients.

3 Materials and Methods

3.1 Data Collection

Data were collected from 120 volunteers. Their age group (18-25) years. The sample included nearly equal numbers of each gender (men and women) and ethnic groups (Malay, Chinese, and Indians).

The subjects were fully dentate and had normally aligned teeth. The examination of occlusion was performed by three examiners working independently to promote consistency of the results which was supported by high positive Inter and intra-examiner reliability tests Table 1 and Table 2.

Table 1. Intra-reliability of 2 examiners (high positive correlation at ρ<.01, 2-tailed)
Para; parameter, Ex; examiner, HO; horizontal overlap, VO; vertical overlap, URC; upper right canine, ULC; upper left canine, LRC; lower right canine, LLC; lower left canine.

Para.	1st Ex	1stEx	1stEx	2ndEx	2ndEx	2nd Ex
HO	.990	.918	.857	.986	.928	.878
VO	.994	.903	.868	.992	.921	.873
URC	.987	.951	.965	.991	.960	.966
ULC	.988	.925	.949	.989	.930	.949
LRC	.927	.937	.944	.989	.940	.944
LLC	.806	.936	.783	.970	.933	.937

Table.2 The inter-examiner reliability of measurements (high positive correlation at ρ.01, 2-tiled) Para; parameter, Ex; examiner, HOL; horizontal overlap, VOL; vertical overlap, URC; upper right canine, ULC; upper left canine, LRC; lower right canine, LLC; lower left canine

Para.	1st Ex	2ndEx	3rdEx
HOL	.990	.986	.989
VOL	.994	.992	.994
URC	.987	.991	.987
ULC	.988	.989	.988
LRC	.927	.989	.987
LLC	.806	.970	.971

The subject was seated in a dental chair in an upright position, with good illumination. A clear mouth mirror was used for examination. The individual was instructed to close in centric occlusion. Then Angle's class was identified, and the number of overlaps (horizontal and vertical) was measured in the region of central incisors (Fig. 4, Fig. 5).

The HOL was measured directly by placing the periodontal probe tip in contact with the labial surface of the lower central incisor and the incisal edge of the upper central incisor. The rubber stopper was moved toward the incisors until contacting the labial surface of the upper incisor. The length from the tip of the periodontal probe to the inner surface of the rubber stopper was measured using a steel ruler.

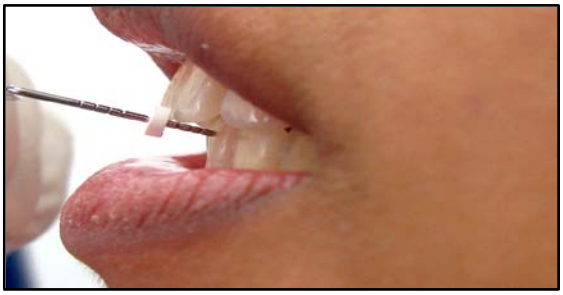

Fig. 4: Method of measuring the horizontal overlap

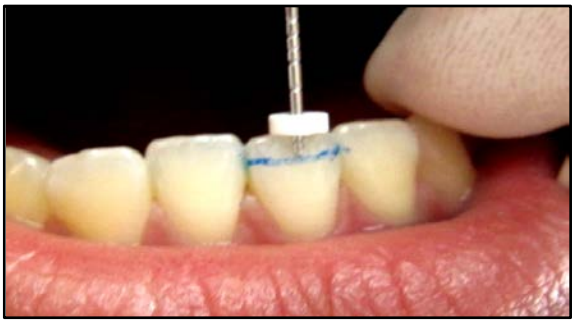

Fig. 5: Method of measuring the vertical overlap

The VOL was measured between a line mark and the incisal edge of the lower central incisors using the periodontal probe as mentioned previously (Fig. 5).

A dot was marked at the highest point of the labial surface at the visible cervical margin of the maxillary canine, whereas the dot was drawn at the lowest end of the labial surface at the cervical margin for the lower canine by an indelible pencil (Fig. 6).

Fig. 6: Marking the points of upper and lower canine length

Canine length was measured using a digital gauge (Fig. 7).

Fig. 7: Measuring the maxillary canine length

The records were repeated three times by each of the three examiners to calibrate the measurements. The other records were checking of the lateral occlusion type, checking of the protrusive occlusion types; if only 6 or less number of anterior teeth were in contact, it was considered as anterior teeth guidance, while if all the anterior and posterior teeth were in contact, this was considered as group function protrusive occlusion.

3.2 Statistical Analysis

The inter and intra-examiner reliability was done using Pearson correlation (significance level at ρ≤.01) Table 1 and Table 2 show records of consistency among investigators. The incidence of group function and canine protection occlusion in relation to the sample, ethnic groups, and gender was counted. The correlation between the incidence of occlusion type and the amplitude of HO and VO as well as its relation to Angle's classification and the length of the canines were analyzed.
The incidence of the protrusive contacts types in relation to Angle's classification was displayed.
The study analysis was done using IBM SPSS software and Microsoft Spreadsheets.

4 Results

4.1 The Composition of the Sample

The sample was composed of 120 individuals divided into 49.2% females and 50.8 % males. More information is presented in Table. 3. No statistical difference was estimated among the different variables (X^2=1.666, DF= 2, N = 120, p = .434). However, Malaysians represented the major composition of the sample followed by the Chinese and Indians Table 3.

Table 3. The ethnic groups forming the sample

Race	Male	%	Female	%	Total
Chinese	22	59.5	15	40.5	37
Indians	18	48.6	19	51.4	37
Malays	21	45.7	25	54.3	46
Total	61	50.8	59	49.2	120

Class I Angle's classification was the most represented in the sample followed by Class II Division 1, Division 2, and Class III respectively Table 4.

Table 4. Angle's classification in the sample

An. Cl	%	No.	%	Cumula.%
Cl1	56.7	68	56.7	56.7
Cl2D1	20.8	25	20.8	77.5
Cl2D2	13.3	16	13.3	90.8
Cl3	9.2	11	9.2	100.0
Total	100	120	100	

An.Cl; Angle classification, CI1; Class I, Cl2; Class II, Cl 3; Class III, D; division.

The types of teeth contacts found during protrusive movement of the mandible where either anterior contact only between anterior maxillary and mandibular teeth or anterior and posterior teeth simultaneously, the difference was not significant (X^2=2.39, DF= 1, N = 120, p = .122) Table 5.

Table 5. Types of contacts between upper and lower teeth during protrusion of the mandible

Type of contact	No.	%	Valid
Anterior	66	55.0	55.0
Anterior and posterior	54	45.0	45.0
Total	120	100.0	100.0

The incidence of eccentric right and left sides (GF and CP) occlusion and protrusion teeth contacts (anterior only or anterior and posterior simultaneously) in relation to Angle's classification is shown in Table 6.

Table 6. The frequency of eccentric occlusion during laterality and protrusion in relation to Angle's Classification

AngCl	R side lat.		L side lat.		Protrus. Co	
Exc.Occ.	GF	CP	GF	CP	A	AP
Cl I	49	19	53	15	30	38
Cl IID1	15	10	17	8	19	6
Cl IID2	4	12	2	14	16	0
Cl III	7	4	5	6	1	10

AngCl; Angle's class, R; right, lat.; laterality, L; left, Protrus. Co; protrusive teeth contacts

The difference among the above parameters was highly significant (X^2=68.512, DF= 15, p = .0000)

This finding is supported by other researchers who worked on an Iraqi population sample of 500. and 600 volunteers, [13], [18]. Our results support the importance of Angle's classes on eccentric occlusion generation in any rehabilitation procedures.

4.2 The Effect of HOL, VOL on the Sample Components

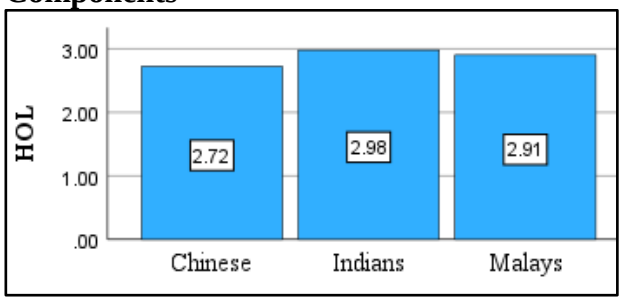

Fig. 8: The HOL mean in different ethnic groups

The difference between the means of HOL in the 3 ethnic groups is not significant using the ANOVA test (DF=2, F=.244, ρ =.794) (Fig. 8).

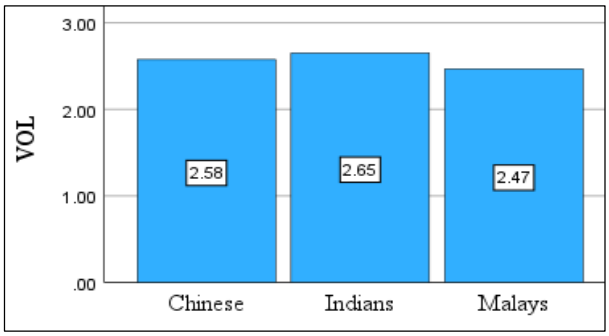

Fig.9: The VOL mean in 3 ethnic groups

No statistical difference is estimated in the 3 groups (DF= 2, F=.162, ρ =.851) (Fig.9).

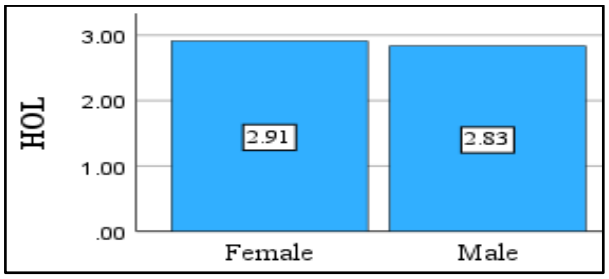

Fig. 10: The HOL mean in females and males

No statistical difference was estimated between males and females (DF=1, F= .067, ρ = .795) (Fig. 10).

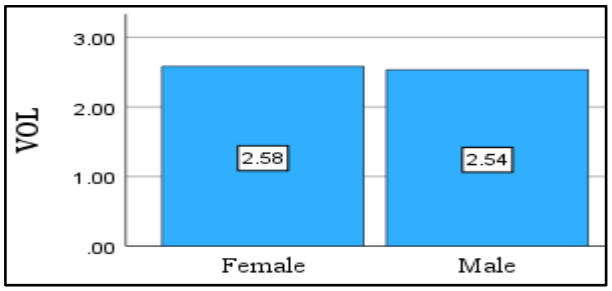

Fig. 11: The VOL mean in females and males

No statistical difference was estimated between males and females (DF=1, F=.027, ρ= .869) (Fig. 11).

Table 7. The means of HOL and VOL in angle's classes

AngCl		HOL	VOL
C1	Mean	2.3172	2.1452
	N	68	68
	Std. Deviation	.77477	.90934
C2D1	Mean	5.1086	3.4825
	N	25	25
	Std. Deviation	1.16115	1.35407
C2D2	Mean	3.5402	4.4961
	N	16	16
	Std. Deviation	.99008	.54221
C3	Mean	.2468	.1875
	N	11	11
	Std. Deviation	.46221	.35022
Total	Mean	2.8720	2.5578
	N	120	120
	Std. Deviation	1.63562	1.47787

The means of HOL and VOL are shown in Table.7. The differences are significant for HOL (DF=3, F= 99.0, ρ <.001) and for VOL (DF=3, F=57.0, ρ <.001) in all Angle's classes Table 11.

The plot of regression analysis of the HOL and VOL for the whole sample is shown in Fig. 12.

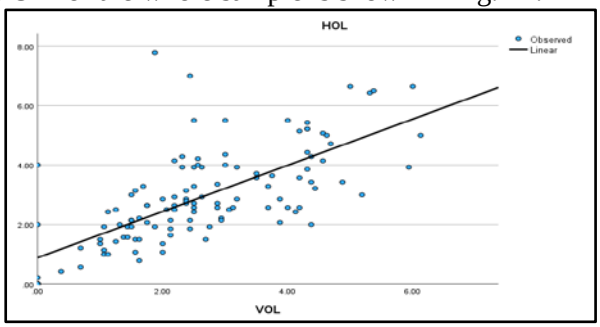

Fig. 12: Regression analysis and the line plot of the best curve fit between the two variables.

Table 8. The results of linear regression and correlation between the VOL and HOL

	Unstand Co.		StCo.		
	B	St E	Beta	t	Sig.
VOL	.777	.073	.702	10.697	<.001
(Constant)	.886	.214		4.135	<.001

Therefore, an equation was generated to predict the HOL when VOL is known as:

HOL= .886+ .777 (VOL) (1)

The plot between some selected range values of HOL with GF and CP eccentric occlusion occurrence is shown in Fig. 13. There is a close incidence between GF and CP when the HOL value is between 0-1 mm and this happens again when the horizontal overlap reaches slightly more than 5 mm and the next time when the values of overlaps reach 7mm. In the other situations, the two types of eccentric occlusion incidence become diverged widely from each other Fig. 13. This finding supports the hypothesis that increased HOL at a certain amplitude affects the type of eccentric occlusion to be generated in dental and oral rehabilitation. As increased horizontal overlap can cause an increase in the incidence of group function occlusion.

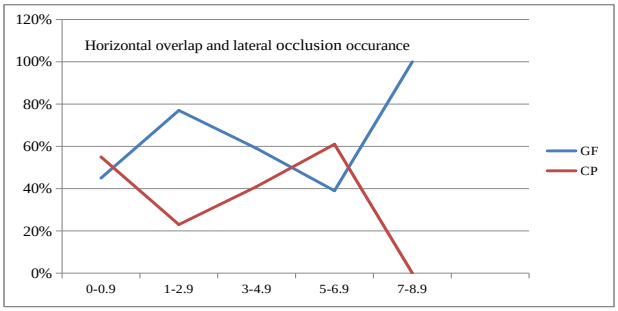

Fig. 13: The relation between the type of eccentric occlusion and the type of anterior teeth overlap

VOL also has an effect on the occurrence of the incidence of GF and CP. The plot in Fig. 14 shows that only at 4.5 mm of VOL, the GF and CP eccentric occlusion can occur simultaneously in natural dentition Fig. 14. However, increasing VOL induces augmented CP and reduced GF occurrence.

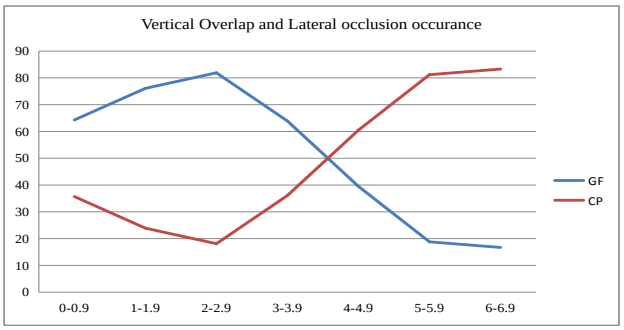

Fig. 14: Plot of the incidence of GF and CP in relation to VOL values.

The upper canine length (UCL) shows an unpredictable effect on the GF and CP eccentric occlusion. The inclusion of more factors may resolve this inconsistency Fig. 15.

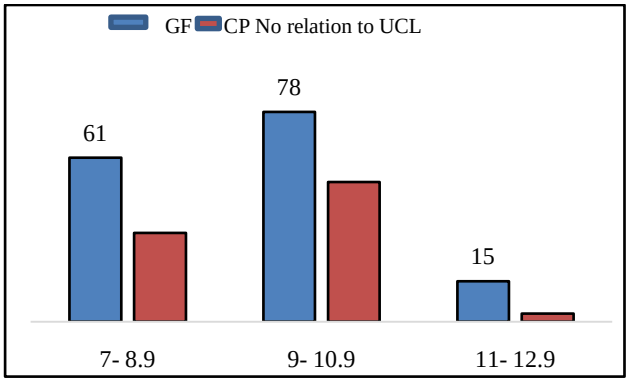

Fig. 15: The histogram of GF and CP against UCL

The lower canine length (LCL) shows an effect on the GF and CP eccentric occlusions. At 6-7.9 mm the two eccentric occlusions nearly occur similarly. However, at 8-9.9 mm the difference spikes in favor of GF. Again at 10-11.9, the incidence is reduced Fig. 16.

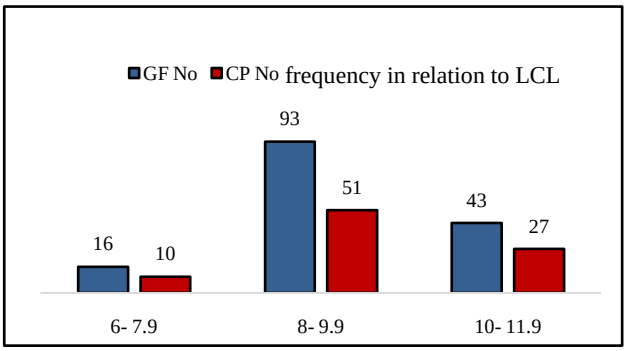

Fig. 16: The histogram of GF and CP against LCL

5 Discussion

The predominant Angle's class in the sample was Class I while Class III constituted the least percentage because the negative readings of the HOL and VOL were excluded. The results of this study were comparable to that done by other researchers, [12], [22], [23]. Our findings were in agreement that there was no statistically significant difference between Angle's classes in relation to gender, [24], [25].

The mean of HOL and VOL of all ethnic groups as well as gender were almost equal.
Those results were in agreement with that obtained by other researchers, [5], [12].

The natural occurrence of the type of eccentric lateral occlusion was variable. This discrepancy may be due to the use of different techniques to detect the types of eccentric occlusion. In our study, we found that Malays have more GF compared to the others and Indians have more CP, However, the difference was not statistically significant for genders and ethnic groups.

[12], suggested the presence of a correlation between Angle's classification and the type of eccentric occlusion in her study on 500 Iraqis. The results revealed that Class I had almost the same percentages of CP and GF while Class II D1 had more GF, while Class IID 2 were predominantly CP and the majority of Class III had GF. The same findings were found by Scaife and Holt, [23].

In this research, we found that Class I, II D 1, and III Angle's classification showed higher percentages of GF eccentric occlusion compared to CP. While Class II D 2 constituted the highest percentage of CP. This finding matches many researchers, [12], [26], [23], [18].
A study showed that the predominant type of lateral occlusion in Class III subjects was group function occlusion, [12]. While our finding concerning Class III revealed that the presence of both types of eccentric occlusion was almost equal. A possible explanation may be the inclusion of nearly 0.9mm VOL in our study. The incidence of eccentric occlusion in each Angle's Class were found significantly different, therefore, we can conclude that the Angle's classification is an effective factor in eccentric occlusion determination.

45% of subjects with low HOL (0-0.9mm) were with group function occlusion, while subjects with (7-8.9mm) HOL were all with group function. Therefore, increased HOL is associated with a predominance of GF, [12].

During the normal range of VOL i.e. 1-3mm, group function incidence was more than canine protection. When the VOL surpasses 3mm the incidence of CP begins to increase sharply reaching more than 80% of the cases when the VOL exceeds 5mm. This happens because if vertical overlap increases, the anterior portion of the mandible will need to move further down during protrusion due to increased incisal guidance. In persons with steep anterior guidance, the posterior teeth are more readily to disocclude during eccentric movement, thus, the chances of flattening by attrition are less. Hence, when the vertical overlap increases, the chances of the individuals having a canine protected occlusion increases. Our findings are in agreement with that of Hana, [12].

In this study, there was no clear relation between the increased length of the upper canines

and the incidence of eccentric occlusion. When the length of the maxillary canines exceeds 11 mm. more than 80% of the cases have GF occlusion.

During edge-to-edge protrusion, subjects with Class I occlusion have 43% anterior teeth contact with posterior teeth disocclusion. Subjects with Class II Division 1 have 73% of anterior teeth contact with disocclusion of posterior teeth contact. In Class II Division 2 the anterior teeth contact while posterior teeth disocclusion was 100%. In Class III, the percentage of anterior and posterior teeth contacts during protrusion was 76%. These findings are also supported by some authors, [20], [21]. In Class II Division 1, they found 80% of anterior teeth contact with disocclusion of posterior teeth whereas, in Class II Division 2, the anterior contact with disocclusion of posterior teeth during protrusion was 100%, in Class III, there was 67% of the posterior teeth contact during protrusion. More authors revealed that CP occlusion was the dominant type of dynamic occlusion (57%) and most of the subjects had no posterior contact in protrusive movement (78%). There was an association between canine guidance and Class II occlusion. During protrusion, Class II subjects have a high prevalence of anterior teeth contact with disocclusion of posterior teeth whereas, for Class III occlusion, a high prevalence of anterior and posterior teeth contact is observed.

The use of slightly different techniques and tools precision in recording the eccentric occlusion is the culprit in this discrepancy because of the findings.

4 Conclusion

The predominant Angle's Class for all ethnic groups was Class I. No statistically significant differences between the ethnic constituents of the Malaysian population in relation to the incidence of each Angle's Classes. The mean values of HOL and VOL were 2.6mm and 2.9mm respectively with no significant differences between genders and among ethnic groups.

The incidence of GF was more than CP (64% and 36 % respectively).

No statistical difference between genders and ethnic groups regarding the incidence of GF and CP was found.

The effect of Angle's classification was clear on the incidence of eccentric types (GF occlusion was predominant in Class II Division 1. CP incidence was predominant in Class II Division 2).

The amount of HOL affected the type of laterality. The highest the value, the more the incidence of GF. As the amount of VOL increases the incidence of CP increases.

No significant effect of the canine length was statistically validated on the type of lateral occlusions, however, the protrusive contacts are affected by Angle's classification. Most Class II had anterior teeth contacts with posterior teeth disocclusion. Class III were mostly with anterior and posterior teeth contacts during edge-to-edge protrusion, while Class I individuals had almost equal incidence.

An equation was generated to predict any overlap and the related eccentric occlusion during rehabilitation.

HOL= .886+ .777(VOL).

We suggest future studies include the following factors to reveal their effect on the incidence of GF and CP such as the effects of Inter condylar distance, occlusal plane inclination, canine cusp angle, the curve of Spee.

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-Laith Al-Samawi, wrote the manuscript and did the statistical analyses of the data.

-Hana Al-Ani, has designed and supervised the protocol accuracy, supervised sample selection, and clinical data collection.

-Humam participated in the data collection and ensured volunteer supervision during clinical work and execution of the experiment.

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