

Occlusal scheme in a group of Thais

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PURPOSE. To study the distribution of various occlusal schemes as well as associated static occlusal relationship among Thais. **MATERIALS AND METHODS.** The subjects' occlusal schemes on the left and right sides were classified as canine protected occlusion, group function, or unclassified according to the definition from Glossary of Prosthodontic Terms (8th edition). In addition, the presence of occlusal interferences during mandibular excursions were recorded. The measurement of the horizontal overlap and vertical overlap was also performed. Chi-square, One-way ANOVA and Mann-Whitney U statistical tests were used with level of significance set at $P=.05$. **RESULTS.** Total of 104 subjects were included in this study. The ratio for male to female was 1.8 to 1. Average age of the population was 25.01 ± 6.87 years old. The mean vertical overlap and horizontal overlap were 1.94 ± 1.20 and 2.41 ± 1.32 mm respectively. The majority of the populations (68.3%) possessed group function occlusal scheme. For the remaining, 17.3% possess canine protected occlusion and 12.5% possess combination of both occlusal schemes. We also found that occlusal interference was presented in 20.2% of the population. The most common was protrusive interference (57.14%), the second was balancing interference (38.1%) and the third was working interference (4.1%). **CONCLUSION.** Among Thais, the most common occlusal scheme was group function, however there were no significant occlusal factors related to any particular occlusal scheme. [J Adv Prosthodont 2011;3:132-5]

KEY WORDS: Dynamic occlusion; Group function; Canine protected occlusion; Occlusion type

INTRODUCTION

Dental occlusion has been an essential part for all dental works in restorative dentistry. Dental treatment has the ability to basically alter static and dynamic occlusal relationships, while trying to accomplish as near "ideal" occlusion as possible. For dynamic occlusal relationships, there are three main concepts regarding tooth contact during the lateral excursion of mandibular movement: 1) balanced occlusion, which was developed from the work of Bonwill,¹ 2) canine guidance, described by D' Amico,² and 3) group function, as discussed by Beyron.³

Tooth loading in canine guidance and group-function occlusions is considered to be different.⁴ According to Glossary of Prosthodontic Terms (8th edition),⁵ group function is defined as multiple contact relations between the maxillary and mandibular teeth in lateral movements on the working side. The simultaneous contact of numerous teeth acts as a group to distribute occlusal forces. Whereas canine protected articulation is defined by the glossary as a form of mutually protected articulation in which the vertical and horizontal overlap of the canine

teeth disengages the posterior teeth in the excursive movements of the mandible.

Both canine guidance and group-function guidance occlusions are considered normal. The latter occlusal scheme occurs naturally as a result of occlusal wear.⁶ When an entire occlusion to be restored, either occlusal scheme will serve effectively. However, when only a part of the occlusion is to be restored, the restoration must be consistent with the existing occlusal scheme. Despite which occlusal scheme is used, the dentist must preserve that scheme during routine postoperative appointments.⁷⁻¹¹

For the field of restorative dentistry especially during the process of oral rehabilitation, the rationale to choose occlusal scheme could be based on epidemiological data in combination with study on physiology of the masticatory system. For this reason, the purpose of this study was to obtain the epidemiological data on the distribution of 2 major occlusal schemes (group function and canine protected occlusion) as well as associated static occlusal relationship such as vertical and horizontal overlap and its relationship with the occlusal scheme among Thais.

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MATERIALS AND METHODS

The population for this study consisted of 104 subjects attending clinic at Faculty of Dentistry, Mahidol University (67 males and 37 females). The age of subjects ranged from 18 - 50 years, with a mean age of 25.01 ± 6.87 years. The study was approved by Mahidol University Institutional Review Board. (MU IRB# 2009/093.1905) Subjects who met the following criteria were selected:

- No previous or current orthodontic treatment.
- The presence of completed permanent dentition except for the third molars
- No previous occlusal adjustments
- No large restorations involving the incisal edge or a cusp tip
- No crowns or fixed partial dentures
- No apparent pathologic periodontal problems
- Upper and lower canines in the line of the arch
- No tooth showing attrition into the dentine

The static occlusion of each subject was assessed by intra-oral examination on a dental chair under direct vision. The incisor relationship were recorded according to the classification of the British Standard Institute.¹² Dynamic occlusion was determined with the aid of shimstock with 8 mm width, 8 μ m thickness (Almore shimstock, Hanel, Langenau, Germany) to confirm tooth contact.

The examination was carried out with subjects seated in an upright position in a dental chair with the Frankfort plane parallel to the floor. All recordings were made by the same operator in the same period of the day (morning hours) to avoid possible diurnal variation.¹³ For the lateral excursion, occlusal contacts were recorded on the working and the nonworking sides.

Subjects were asked to perform the movements with the aid of a handheld mirror. The shimstock was placed on the occlusal surfaces of teeth from the canine backward; the subject was then asked to close his/her mandible into maximum intercuspation. Gliding movement was performed to the right or the left while the examiner maintained a constant pulling force on the shimstock. On reaching the 0.5 mm position, the teeth holding the shimstock were recorded as working side contacts. The subject was asked to repeat the movement with the shimstock placed on the opposite side to record the non-working side contact. Occlusal contacts at the protrusive excursion of mandibular movement were recorded at the edge-to-edge position. The shimstock was placed on the incisal edges of the anterior teeth. The subject was asked to close into maximum intercuspation and then slide to the edge-to-edge protrusive position while the examiner maintained a constant pulling pressure. Once the teeth were at the edge-to-edge position, teeth holding the shimstock were considered to be in contact and were recorded. The shimstock was then placed on the occlusal surfaces of posterior teeth, and the subject was asked

to repeat the same movement to check for the presence of posterior tooth contact.

Chi-square test was used to examine the relationship between types of occlusal scheme and gender as well as the relationship with the presence of interferences. For the comparison of vertical and horizontal overlap distances among types of occlusal scheme, the oneway analysis of variance (ANOVA) was employed. Lastly, the Mann-Whitney U test was used to compare the vertical and horizontal overlap in relation to the presence of protrusive interference. The level of significance for all statistical analysis was set at $P=.05$.

RESULTS

Total of 104 subjects were included in this study. The ratio for Male to Female was 1.8:1. The mean vertical overlap and horizontal overlap found in this population were 1.94 ± 1.20 and 2.41 ± 1.32 mm respectively.

The majority of the populations (68.3%) possessed group function occlusal scheme. For the remaining, 17.3% of the populations possessed canine protected occlusion, 12.5% possessed combination of both occlusal schemes. There were 2 subjects (1.9%) with their occlusal schemes unclassifiable as there was only one pair of the opposing posterior teeth in contact during lateral excursions.

The study also found that majority of the populations (79.8%) did not have any occlusal interference. For the population with occlusal interference (20.2%), we found that the most common interference was protrusive interference (57.14%), the second was balancing interference (38.1%) and the third was working interference (4.1%). Next we examined the distribution of occlusal scheme within each gender as well as the distribution of gender within each occlusal scheme and discovered that there was no statistical differences (Chi-square test; $P=.743$) for either distributions. There was almost equal distribution of group function, canine protected occlusion and combination occlusal scheme for each gender (Table 1).

For the incisal relationship, the distance of both horizontal overlap and vertical overlap were not statistically different among both occlusal schemes and the combination group. On the other hand, there was a tendency of less vertical overlap in group function when compared to canine protected occlusion

Table 1. Occlusal scheme distribution within each gender

	Male (N = 67)	Female (N = 37)
Group function (n = 71)	46 (68.7%)	25 (67.6%)
Canine protected occlusion (n = 18)	11 (16.4%)	7 (18.9%)
Combination (n = 13)	8 (11.9%)	5 (13.5%)
Unclassified (n = 2)	2 (3.0%)	0 (0.0%)

occlusal scheme. However, there was no statistical significant difference for this observation (Table 2).

Our study revealed that the majority in each occlusal scheme does not process occlusal interferences ranging from approximately 89% in canine protected occlusion to 79% in group function (Table 3). However, there was no significant relationship between the presence of interferences and occlusal scheme (Chi-square test; $P=.743$).

Lastly, we examined the difference in distance of horizontal overlap and vertical overlap in population with or without protrusive interferences (Table 4). We found that for vertical overlap, there was less distance for the population with protrusive interference (1.33 ± 0.62 mm) than the distance for the population without the protrusive interference (2.02 ± 1.24 mm).

DISCUSSION

Our findings of the majority of studied population processed group function occlusal scheme. This is similar to the earlier epidemiological data such as study by Beyron³ showed fairly overwhelmingly that adult Australian aborigines had group function occlusion. Weinberg¹⁴ found that 81% of his studied population possessed group function occlusal scheme, whereas only 5% had canine guided occlusal scheme. By contrast,

Scaife and Holt¹⁵ examined 1200 individuals, and discovered that the majority had either unilateral or bilateral canine protected occlusion. The discrepancy among studies may be due to the difference in examined population, culture and regular food intakes as well as influence of the materials used to register the contacts. As Tarazi *et al.*¹⁶ demonstrated that the number of recorded tooth contacts varies with the material used to record registrations.

For the occlusal interference, Posselt¹⁷ described this term as a cuspal contact forcing the mandible to deviate from a normal pattern of movement. The eighth edition of the glossary of prosthodontic terms⁵ states an occlusal interference as any tooth contact that inhibits the remaining occluding surfaces from attaining stable and harmonious contacts. Ash and Ramfjord¹⁸ described the term occlusal interference as an occlusal contact relationship that interferes in a meaningful way with function or parafunction. Even though there were slight differences of definition of this term, it has been long a subject of interest, study and debate in dental field. Our study found that majority of the population does not process occlusal interferences. The type of occlusal interferences that has the highest percentage is protrusive interference followed by balancing side interference. This is surprising that our finding was less occlusal interferences which the most common was balancing or non-working interference.

The result of the incisal relation found from this study was similar with previous study¹⁸ in the Thai population. They found the average of vertical overlap (2.28 ± 1.13 mm) was greater than horizontal overlap (2.68 ± 1.1 mm). They also found that the common range of vertical overlap was 1 - 3 mm, and the horizontal overlap was 2 - 4 mm. This finding was similar to our finding. Interestingly, we found that the shorter distance of vertical overlap was found in the population with protrusive interference. However, there was no difference for the horizontal overlap between the population with or without protrusive interference.

A number of limitations can be noted in the above mentioned studies. No reference was made to the location of the canine in terms of its relationship to the line of the arch nor to the degree of attrition of the canine, which is of particular importance in examining the assumption that attrition could lead from one type of contact during lateral movement to another.¹⁹ In this study, subjects with marked attrition were excluded based on the assumption made by McAdam⁴ and Woda *et al.*¹⁹ that canine

Table 2. Measurement of incisal relationship (horizontal overlap and vertical overlap) for each type of occlusal scheme

	Horizontal overlap (mm)	Vertical overlap (mm)
Group function (n = 71)	2.38 ± 1.23	1.81 ± 1.09
Canine protected occlusion (n = 18)	2.58 ± 1.29	2.39 ± 1.40
Combination (n = 13)	2.58 ± 1.81	2.08 ± 1.47
P value	.781	.178

Table 3. Presence of occlusal interferences for each type of occlusal scheme

	Presence of interferences	
	Yes	No
Group function (n = 71)	15 (21.1%)	56 (78.9%)
Canine protected occlusion (n = 18)	2 (11.1%)	16 (88.9%)
Combination (n = 13)	2 (15.4%)	11 (84.6%)
Unclassify (n = 2)	2 (100.0%)	0 (0.0%)

Table 4. Comparison of vertical overlap and horizontal overlap regarding the presence of protrusive interference

		N	Mean (m.m)	P value*
Vertical overlap	no protrusive interference	92	2.02 ± 1.24	.037
	protrusive interference	12	1.33 ± 0.62	
Horizontal overlap	no protrusive interference	92	2.45 ± 1.36	.424
	protrusive interference	12	2.17 ± 0.91	

guidance and group function appear to correspond to two successive states of the evolving dentition under the effect of attrition.

The inclusion criteria for this study were set to assure the presence of a natural dentition as well as the absence of noticeable periodontal problems. These criteria were set because the neuromuscular control of occlusal stability as well as masticatory muscles can be influenced by the periodontal input.^{20,21}

Moreover, the position at which the occlusal contact pattern was recorded (cusp to cusp) may not be representative of the functional range of the lateral excursion of mandibular movement. Chewing kinematics can vary based on several factors such as age, dental static occlusion, facial morphology, and so on.^{22,23}

Another fact for consideration is that changes occurring during the development of occlusion could influence the occlusal contact pattern. Heikinheimo *et al.*²⁴ reported an increase in occlusal interferences between the ages of 12 and 15 years. Other studies showed a decreasing prevalence with increasing age.^{19,25,26} The fact that the sample was composed of subjects aged from 18 to 50 years, could be the explanation for the slight differences in the result from other studies as the changes occurring during occlusal development could influence the occlusal contact pattern.

CONCLUSION

This study demonstrated that among Thais, the most common occlusal scheme is group function, but there was no demographic or occlusal factors that strongly related to any particular occlusal scheme. However, we did not focus our study on the exact association between other static occlusal relationship parameters such as Angle's classification with the other dynamic occlusal relationship parameter other than occlusal scheme. This should be conducted in the future study.

REFERENCES

- Bonwill WGA. Geometric and mechanical laws of articulation: anatomical articulation. Transactions of the Odontological Society of Pennsylvania; 1885. p. 119.
- D'Amico A. Functional occlusion of the natural teeth of man. *J Prosthet Dent* 1961;11:899-915.
- Beyron H. Occlusal relations and mastication in Australian aborigines. *Acta Odontol Scand* 1964;22:597-678.
- McAdam DB. Tooth loading and cuspal guidance in canine and group-function occlusions. *J Prosthet Dent* 1976;35:283-90.
- American academy of Prosthodontics. The glossary of prosthodontic terms. *J Prosthet Dent* 2005;94:10-92.
- Abdullah A, Sherfudhin H, Omar R, Johansson A. Prevalence of occlusal tooth wear and its relationship to lateral and protrusive contact schemes in a young adult Indian population. *Acta Odontol Scand* 1994;52:191-7.
- Wiskott HW, Belser UC. A rationale for a simplified occlusal design in restorative dentistry: historical review and clinical guidelines. *J Prosthet Dent* 1995;73:169-83.
- Hagag G, Yoshida K, Miura H. Occlusion, prosthodontic treatment, and temporomandibular disorders: a review. *J Med Dent Sci* 2000;47:61-6.
- McIntyre FM, Jureyda O. Occlusal function. Beyond centric relation. *Dent Clin North Am* 2001;45:173-80.
- Nikolopoulou F, Ktena-Agapitou P. Rationale for choices of occlusal schemes for complete dentures supported by implants. *J Oral Implantol* 2006;32:200-3.
- Al-Nimri KS, Bataineh AB, Abo-Farha S. Functional occlusal patterns and their relationship to static occlusion. *Angle Orthod* 2010;80:65-71.
- Houston WJB, Stephens CD, Tulley WJ. A Textbook of orthodontics. 2nd ed. Wright Publications; 1992.
- Berry DC, Singh BP. Daily variations in occlusal contacts. *J Prosthet Dent* 1983;50:386-91.
- Weinberg LA. A cinematic study of centric and eccentric occlusions. *J Prosthet Dent* 1964;14:290-3.
- Scaife RR Jr, Holt JE. Natural occurrence of cuspid guidance. *J Prosthet Dent* 1969;22:225-9.
- Tarazi E, Ticotsky-Zadok N. Occlusal schemes of complete dentures-a review of the literature. *Refuat Hapeh Vehashinayim* 2007;24:56-64, 85-6.
- Posselt U. Physiology of Occlusion and Rehabilitation. Oxford; Blackwell Scientific Publications; 1968.
- Ash MM, Ramfjord S. Occlusion. Philadelphia; WB Saunders Co; 1996.
- Asawaworarit N, Suchatlampong C, Asawaworarit W. Average incisal relationships. *J Dent Assoc Thai* 1992;42:171-5.
- Woda A, Vigneron P, Kay D. Nonfunctional and functional occlusal contacts: a review of the literature. *J Prosthet Dent* 1979;42:335-41.
- Manns A, Chan C, Miralles R. Influence of group function and canine guidance on electromyographic activity of elevator muscles. *J Prosthet Dent* 1987;57:494-501.
- Ferrario VF, Tartaglia GM, Galletta A, Grassi GP, Sforza C. The influence of occlusion on jaw and neck muscle activity: a surface EMG study in healthy young adults. *J Oral Rehabil* 2006;33:341-8.
- Gerstner GE, Marchi F, Haerian H. Relationship between anteroposterior maxillomandibular morphology and masticatory jaw movement patterns. *Am J Orthod Dentofacial Orthop* 1999;115:258-66.
- Ahlgren J. Pattern of chewing and malocclusion of teeth. A clinical study. *Acta Odontol Scand* 1967;25:3-13.
- Heikinheimo K, Salmi K, Myllärniemi S, Kirveskari P. A longitudinal study of occlusal interferences and signs of craniomandibular disorder at the ages of 12 and 15 years. *Eur J Orthod* 1990;12:190-7.
- Pahkala R, Laine T. Variation in function of the masticatory system in 1008 rural children. *J Clin Pediatr Dent* 1991;16:25-30.
- Egermark-Eriksson I, Carlsson GE, Ingervall B. Prevalence of mandibular dysfunction and orofacial parafunction in 7-, 11- and 15-year-old Swedish children. *Eur J Orthod* 1981;3:163-72.