

The relationship between static and dynamic occlusion based on the relationship between anterior and posterior teeth and the occlusion scheme in dentistry students

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ABSTRACT. Occlusion is important in the mastication process. Tooth occlusion is generally classified into static occlusion and dynamic occlusion. Static occlusion is visible through the relation of both anterior and posterior teeth. Incisor relationships were classified according to the British Standard Institution (BSI), while Angle was classified based on the relationship of the first molars in permanent teeth. The classification of occlusion according to Angle and BSI is based on the description of the shape of the arch, tooth position, and tooth contact in the intercusp position. This study aims to determine the distribution of static occlusion based on the relationship between anterior and posterior teeth as well as dynamic occlusion distribution based on the occlusion scheme and the relationship between static and dynamic occlusion in students of the Faculty of Dentistry, University of North Sumatra. It is a descriptive-analytic with a cross-sectional study design. The sample consisted of 100 students with a complete set of teeth. Each sample was examined using shim stock and articulation paper. The results of statistical using the chi-square test showed a significant relationship between static and dynamic occlusion based on the relationship between anterior teeth ($p < 0.05$) and the relationship between posterior teeth ($p < 0.05$).

KEYWORDS: occlusion, static occlusion, dynamic occlusion

INTRODUCTION

Occlusion is the intercusp contact between the maxillary and mandibular dentition in all positions and movements of the mandible. Occlusion is controlled by components of the neuromuscular and masticatory systems viz: teeth, periodontal structures, maxilla and mandible, temporomandibular joint, muscles, and ligaments. Normal occlusion of the dentition can be categorized into two aspects: static occlusion and dynamic occlusion.¹

A static occlusion is a contact between the maxillary and mandibular teeth that occurs when the jaw is stationary. Static occlusion can be seen through the anterior and posterior teeth relationship.² The most common occlusal relationship can be seen through the relationship of the posterior teeth. Angle characterizes static occlusion based on the relationship of the first molar in the permanent dentition into three, namely: class I, class II and class III.^{2,3} The relationship of the incisors is classified based on the British Standard Institution (BSI), namely: class 1, class II Division 1,

Class II Division 2, and class III. The classification of occlusion according to Angle and BSI is based on the description of the arch's shape, the teeth' position, and tooth contact in the intercusp position.^{2,4} In the study of Al-Hiyasat et al. (2004), stated that the prevalence of static occlusion with class II jaw relations, namely: 29% in class II molars and 37% in class II incisors (20% Division 1 and 17% Division 2).⁴

Dynamic occlusion is the occlusal contact that results when the mandible moves relative to the maxilla, either anteriorly, laterally, or posteriorly. There are two functional occlusions of the posterior teeth during lateral movement of the mandible: canine protection and group function.^{3,5} According to the Glossary of Prosthodontics Terms, canine protection is a mutually protective and beneficial form of articulation in which the vertical and horizontal overlap of the canines prevents the posterior teeth from contacting during excursive mandibular movement. The group function is the amount of contact between the mandibular and

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maxillary teeth on the working side during lateral movement, where the simultaneous connection of some teeth acts as a group to distribute occlusal forces.⁵

Occlusion is significant in the mastication process. Occlusion abnormalities can interfere with efficiency in masticatory function and if in a more severe condition, can disrupt the temporomandibular joint. Research by Al-Hiyasat et al. (2004) states that the relationship between static occlusion and dynamic occlusion shows that canine protection is most prevalent in class II (for molar and incisor relationships) while the least associated with type I and class III.⁴ In research by Al-Nimri et al. (2010) on the relationship between static and dynamic occlusion in dental students with an age range of 21-30 years stated that in the 0.5 mm position, the dynamic occlusion pattern is different from static occlusion, but not significant. At the 3

mm position, the active occlusion pattern was significantly related to the incisor teeth. According to the study of Tipton and Rinchuse (1991), cited from Al-Nimri et al. (2010), there is no relationship between static occlusion and dynamic occlusion.⁶ This study confirms that changes in the occlusion scheme of canine protection and group function are found in the transition stage from adolescence to adulthood during the post-graduate period, which can be related to food habits, psychological factors, and stress.⁷

Some literature still shows differences in the relationship between static occlusion and dynamic occlusion. So the author is interested in researching the connection between static occlusion and dynamic occlusion in the natural teeth of students of the Faculty of Dentistry, University of North Sumatra.

MATERIALS AND METHODS

The type of research conducted in this study was descriptive-analytic using a cross-sectional research design, where the case sample was only observed once, and the variables were measured according to the state or status at the time of observation. This research was conducted through direct interviews and clinical examinations. The population in this study is a large number of subjects. It has specific criteria, such as students still actively studying in 2013-2018 at the Faculty of Dentistry, University of North Sumatra.

Sampling was carried out using a purposive sampling technique with a simple random sample by following the inclusion criteria; all students who are actively studying at FKG USU aged over 17-22 years with complete dental conditions and not in orthodontic treatment, patients who are willing to participate in research activities and as exclusion criteria; patients with caries or fillings and the presence of deciduous teeth. The number of samples was added by $\pm 10\%$ of the specified sample. Therefore the number of samples used in this study was 100 people.

The researcher examined the patient's oral cavity by instructing the patient to wear a cheek retractor. The researcher made visual observations when the subject occluded the anterior teeth by measuring the overbite and overjet on the incisors. Then examined the molar teeth using a mouth glass.

The researcher made a straight line on the labial surface of the maxillary and mandibular anterior teeth. The subject was instructed to move the mandible to the labial about 3 mm. The movement was seen from the straight line that had been made on the surface of the anterior teeth. The researcher positioned the articulating paper between the occlusal plateau of the canine and posterior teeth. Then the subject was instructed to perform the maximum bite. The operator held the articulating form while the subject performed the bite. The tooth surface area with a mark on the occlusal surface is tried again with a shim stock to see the contact. The method is the same as the articulating paper, but only the area with a mark. When the shim stock is pulled, there is resistance or tearing, which indicates that contact has occurred.

Patient data were obtained from the questionnaire and presented by calculating the percentage distribution. Then a significant test was carried out with chi-square to test the relationship between two categorical variables and measure the strength of the relationship between one variable and another categorical variable. Based on the chi-square test results, it can be determined which variables show a significant relationship ($p < 0.05$).

RESULTS

Based on this study obtained data, in static occlusion with anterior tooth relationships, 45 people (45%) class I, 21 people (21%) class II Division 1, 21 people (21%) class II Division 2, and 13 people (13%) class III. While in the static occlusion of posterior tooth relationships, there were 45 people (45%) in class I, 42 people (42%) in class II, and 13 people (13%) in class III. (**Table 1**)

Table 1. Distribution of Static Occlusion Based on the Relationship of Anterior and Posterior Teeth in Students of the Faculty of Dentistry, University of North Sumatra

Static Occlusion		Amount	
		N	%
Relation of Anterior	Class I	45	45
	Class II (Division 1)	21	21
	Class II (Division 2)	21	21
	Class III	13	13
Relation of Posterior	Class I	45	45
	Class II	42	42
	Class III	13	13

Based on the results of the dynamic occlusion examination conducted on 100 people, it was found that 59 people (59%) had a canine protection occlusion scheme, 35 people (35%) had a group function occlusion scheme, and 6 people (6%) had a mixed occlusion scheme between canine protection and group function. (**Table 2**).

Table 2. Distribution of Dynamic Occlusion Based on Occlusion Schemes in Students of the Faculty of Dentistry, University of North Sumatra

Dynamic Occlusion	Amount	
	N	%
Canine protection	59	59
Group function	35	35
Mixed Canine protection dan group function	6	6
Total	100	100

In **Table 3**, the results of the study of occlusion schemes based on anterior tooth relationships are from 59 people (59%) who have a canine protection occlusion scheme found 24 people (24%) class I, 15 people (15%) class II Division 1 and 17 people (17%) Division 2, 3 people (3%) class III.

Table 3. Distribution of Dynamic Occlusion Based on Occlusion Schemes in Students of the Faculty of Dentistry, University of North Sumatra

Static Occlusion		Dinamic Occlusion								p
		<i>Canine protection</i>		<i>Group function</i>		<i>Mixed canine protection dan group function</i>		Amount		
		n	%	n	%	n	%	n	%	
Relation of Anterior	Class I	24	24	20	20	1	1	45	45	0,011*
	Class II									
	Division 1	15	15	4	4	2	2	21	21	
	Class II									
	Division 2	17	17	3	3	1	1	21	21	
	Class III	3	3	8	8	2	2	13	13	
	Amount	59	59	35	35	6	6	100	100	
Relation of Posterior	Class I	24	24	20	20	1	1	45	45	0,003*
	Class II	32	32	7	7	3	3	42	42	
	Class III	3	3	8	8	2	2	13	13	
	Amount	59	59	35	35	6	6	100	100	

A total of 35 people group have a function occlusion scheme, 20 people (20%) were found in class I, 4 people (4%) in class II Division 1 and 3 people (3%) in class II Division 2, and 8 people (8%) in class III. Total 6 people (6%) who had a mixed occlusion scheme between canine protection and group function, 1 person (1%) was found in class I, 2 people (2%) in class II Division

1, 1 person (1%) in class II Division 2 and 2 people (2%) in class III. Based on statistical tests using the chi-square test, it was found that there was a significant relationship between static and dynamic occlusion based on anterior tooth relationships with a value of $p=0.011$ ($p<0.05$). In Table 3, the results of the study of occlusion schemes based on posterior tooth relationships are

DISCUSSION

Static occlusion can be identified based on Angle's classification in 1907 and subsequently by Andrews in 1972. This classification is based on the description of arch shape, tooth position, and tooth contact in the intercuspal position. The examination of static occlusion in this study was carried out visually to see the connection between the maxillary and mandibular teeth that occurs when the jaw is not moving.⁴ In this study, static occlusion obtained the highest number of subjects was Class I relationships, as many as 45 people (45%) both anterior and posterior, and the least number in class III, namely 13 people (13%). The results of this study are the same as research conducted by Touzi et al. (2015), where the number of subjects obtained was more in the class I relationship at 72.86% and the least class III at 3.02%.³ In Class II Division 1 and Division 2, the same results were obtained, namely 21 people (21%), and 42 people (42%) posterior class II while in the research of Al-Hiyasat et al. (2004), the prevalence of class II was 37% based on anterior tooth relationships (20% Division 1 and 17% Division 2), 29% based on class II posterior tooth relationships. In the study by Touzi et al. (2015), there were 24.12% of class II.⁴ (Table 1)

Table 2 shows that most research subjects have a canine protection occlusion scheme of 59 people (59%). The results of this study are the same as research conducted by Al-Hiyasat et al. (2004) on 447 subjects showing a 57% canine protection percentage. Still, there are differences in results for group function with a percentage of 13%, while 17% have mixed canine protection and group function occlusion schemes. The difference

out of 59 people (59%) who have a canine protection occlusion scheme found 24 people (24%) class I, 32 people (32%) class II and 3 people (3%) class III. Total 35 people who had a group function occlusion scheme, 20 people (20%) were class I, seven people (7%) were class II, and 8 people (8%) were class III. In the mix between canine protection and group function from 6 people (6%), there is 1 person (1%) in class I, 3 (3%) people in class II, and 2 (2%) people in class III. Based on statistical tests using the chi-square test, it was found that there was a significant relationship between static and dynamic occlusion based on posterior tooth relationships with a value of $p=0.003$ ($p<0.05$).

in the results of this study is due to the much younger age group of the research subjects. The younger age in this study is the reason for the difference in research. It is to previous research, which states that occlusion schemes correlate with age.⁴ In this study, the samples examined were 17-22 years. Therefore, the results correlate directly with existing research where canine protection occlusion schemes are more commonly found at a young age.

The theory of the canine protection occlusion scheme is based on the concept that the canines are the most suitable teeth to guide the movement of lateral excursion. Therefore, all teeth do not contact except the maxillary canines with the mandible on the working side during the lateral excursion. Some reasons why canine tooth contact is ideal for guiding mandibular movement are because the canine teeth have an excellent root-crown ratio to absorb occlusal pressure, and the roots of the canine teeth are longer. They have a wider root surface area than the other teeth, so the periodontal ligaments are more numerous and mechanoreceptors, which receive stimuli in the form of mechanical tension and pressure on the teeth. The palatal surface of the maxillary canine teeth is concave or concave, very suitable for guiding lateral movement.⁸

The study of Touzi et al. (2015) showed different results, and it was seen that the most occlusion scheme was 45.9% in a group function, while canine protection was 24.09%.³ In the study of Aswaworit et al. (2011), where the majority of the population in their study had a group function occlusion scheme, this is the same as

epidemiological data from Byron's research (1964) (cited from Aswaworit et al. 2011), showing that adult Australian aborigines have a group function occlusion scheme. Weinberg (1964) (awarded from Aswaworit et al. 2011) found 81% of his study belonged to a group function occlusion scheme, of which only 5% were canine protection occlusion schemes.⁹ The dissimilarity across studies is due to differences in population examination, culture and dietary intake received, and the influence of the materials used to evaluate contact.

The study conducted by Athiban (2014) on 239 subjects selected between the age group of 17-22 years showed that the majority of 92.3% and 88.37% had canine protection in the age group of 17 and 18 years while above the age of 19 years, there was an increase in the prevalence of group function occlusion, which was about 77.19%, 100%, 88.37% of individuals in the age group of 20, 21, 22 years. This study confirms that the change in occlusion scheme from canine protection to group function found in the transition stage from adolescence to adulthood can be related to dietary habits, psychological factors, and stress. This study found the group function occlusion scheme with less presentation. This result is in line with several existing studies which state that group function is found in various age groups but is most prevalent in older age groups. The group function is known to be more stimulating to the periodontium than other occlusion schemes because it balances the jaw arch as we age.¹⁰

This study's results were mixed between canine protection and group function of as many as six people (6%). It is the same as Al-Hiyasat's research which shows that subjects with mixed occlusion schemes between canine protection and group function are found less. In the results of statistical tests using the chi-square test, significant results were obtained between occlusion schemes based on anterior tooth relationships with $p = 0.011$ ($p < 0.05$). This study found 24 people (24%) in class I, who had the most canine protection occlusion scheme. From 35 people who had a group function occlusion scheme found, 20 people (20%) were class I, the results of this study were the same as those conducted by Al-Hiyasat et al. (2004) there was a canine protection occlusion scheme 114 (56%) class I, 60 (67%) class II Division 1, 62 (82%) class II Division 2, 17 (21%) class III. Group function occlusion scheme 25 (12%) class I, 10 (11%) class II Division 1, 6 (8%) class II Division 2, 16 (20%) class III while in mixed between canine protection and group function 45 (22%) class I, 7

(8) class II Division 1, 6 (8) class II Division 2, 18 (23%) class III.⁴

In table 3, the occlusion scheme based on the anterior tooth relationship is from 59 people (59%) who have a canine protection occlusion scheme found 24 people (24%) class I, 15 people (15%) class II Division 1, and 17 people (17%) Division 2, 3 people (3%) class III. Of the 35 people who had a group function occlusion scheme, 20 people (20%) were found in type I, four people (4%) in class II Division 1 and 3 people (3%) in class II Division 2, and 8 people (8%) in class III. Of the 6 people (6%) who had a mixed occlusion scheme between canine protection and group function, 1 person (1%) was found in class I, 2 people (2%) in class II Division 1, 1 person (1%) in class II Division 2 and 2 people (2%) in class III. In the results of statistical tests using the chi-square test, significant results were obtained between occlusion schemes based on anterior tooth relationships with $p = 0.011$ ($p < 0.05$). From the results of this study, who had the most canine protection occlusion scheme found 24 people (24%) class I, and from 35 people who had a group function occlusion scheme found, 20 people (20%) class I.

Several studies have shown that in healthy dentition, canine protection is an ideal relationship during extrinsic movement of the mandible for the dentition, muscles, and temporomandibular joint.¹¹ In adolescence, the shape of the canine teeth is generally still pointed and sharp, resulting in steepening and increasing the prevalence of canine protection occlusion schemes. In the canine protection occlusion scheme, the canine teeth guide the movement of the lower jaw.¹²

In Class II occlusion, the anterior teeth show a vertical overlap protrusion which causes the steepness of the anterior teeth to prevent the posterior teeth from making minimal lateral contact, so the most significant prevalence is canine protection. It can be seen in class II occlusion is most affected by partial excursion and shows a significant decrease in canine protection. Class II occlusion tends to be dominated by canine safety, while the prevalence of canine protection is low in Class III occlusion. In contrast, class III is less affected by the degree of excursion, as the posterior teeth play the most dominant role in controlling the occlusion during the partial excursion. The role of the posterior teeth will continue until the complete excursion. Class III occlusion tends to show minimal anterior tooth overlap, edge-to-edge relationship, or crossbite, reducing the influence of the anterior teeth on lateral occlusion. Therefore the greatest prevalence

of class III occlusion is group function and balanced occlusion.¹²

A good occlusion should allow the mandible to translate without occlusal resistance during functional movements, especially in the posterior segment, so that the efficiency of mastication on the working side is not lost, the axial distribution is more even and can avoid overloading the temporomandibular joint. In the field of prosthodontics, one of the goals of denture manufacturing is to restore function. Therefore, the prosthodontist requires a good understanding of occlusion to rehabilitate the occlusion and achieve dynamic function.¹³

Aswaworit et al. (2011) concluded that several factors influence the lateral occlusion scheme. The first factor is the lateral excursion distance; the occlusal morphology is complex, and the location and magnitude of tooth contacts can be influenced by the degree of excursion. There are two categories of occlusal contacts; partial (0.5-1.5mm) and full (2-3mm). The second factor is the individual's age; the functional teeth also increase as age increases, affecting tooth contact in static and dynamic positions. The third factor is the static occlusion relationship, and some studies mentioned that anterior teeth and arch size could affect the occlusion scheme relationship.^{9,12}

The most fundamental difference between the two occlusion schemes is which teeth contact during lateral movement. Both occlusions have multiple posterior tooth contacts in the intercuspal position (centric occlusion), preventing posterior tooth contact on the non-working side during lateral movement and preventing posterior tooth contact when the anterior teeth come into contact with the protrusive movement. Several studies have examined the possible relationship between static occlusion and functional occlusion. Balance occlusion appears much more significant and appears to be more predominant in subjects with normal (ideal) static occlusion or Class I occlusion compared to Angle malocclusion. When jaw movements are examined from the frontal plane, subjects with normal occlusion tend to have more superficial and less crossed activities than subjects with malocclusion.^{12,14}

The jaw relationship refers to the position of the mandible concerning the maxilla and can be said to be the relationship of the teeth between the maxilla and the mandible. The maximal

intercuspal position is a tooth-to-tooth relationship that does not depend on how the jaw muscle or joint anatomy would position the mandible. The centric relation is the maxillary-mandibular relationship obtained when the individual chews and swallows. The ideal occlusion relationship results in a harmonious condition between the jaw muscles. The position of the condyles concerning the disc and fossa and the maximum contact of the dentition. In normal occlusion, there is a reflex function of the neuromuscular system, which results in movement of the mandible, thus avoiding premature contact. It leads the mandible to the maximum intercuspal position with the condyles in the optimal position. It will result in hypertonic symptoms from the surrounding muscles or trauma to the TMJ. In pathological occlusion, there can be signs of trauma and damage. There is attrition on the occlusal surface due to overuse, bulge fracture, and tooth mobility. Therefore the dentist must know the occlusion and be able to analyze it.¹⁴

Obstacles in centric occlusion can sometimes be seen in cases with Class II Division 2 relationships and among patients with restorations on the anterior teeth, leading to limited or no movement when the posterior teeth come into contact, thus having a locking effect on the patient's jaw. It is not well tolerated and can manifest as pain and discomfort, restoration failure, and adverse effects on supporting structures, and can result in unwanted tooth movement.¹⁵

In normal dentition, mutually protected or canine-protected occlusion is the ideal relationship in the extrinsic movement of the mandible on the teeth, muscles, and temporomandibular joint. The canine can promote optimal stress distribution between the anterior and posterior teeth. Several studies with the same methodology as this study also showed signs of TMJ dysfunction conditions that are more commonly found in group function occlusion schemes that offer the incidence of various types of centric occlusion on the relationship of healthy teeth and with abnormalities of the odontoid-stomatognathic system. Proper selection and arrangement of teeth should also follow the ideal occlusion pattern according to the existing teeth' static occlusion and dynamic occlusion conditions.

CONCLUSION

Based on the results of this study, there is a significant relationship between static and dynamic occlusion based on anterior tooth relationships with a value of $p = 0.011$ ($p < 0.05$), and there is a substantial relationship between static and dynamic occlusion based on posterior

tooth relationships with a value of $p = 0.003$ ($p < 0.05$). In this study, there are clinical implications. Namely: the results of this study can be used to help diagnose the patient's occlusion scheme before treatment

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