การศึกษาการกระจายแรงสบฟัน พื้นที่การสบสัมผัส เวลาการสบฟัน และเวลาสบแยกออก โดยใช้เครื่องทีสแกนทรี ในคน 3 กลุ่มอายุ

The Study of Occlusal Force Distribution, Occlusal Contact Areas, Occlusion Time and Disclusion Time Recorded by the T-Scan III System in Three Different Groups of Age

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บทคัดย่อ

วัตถุประสงค์: การทดลองนี้มีความสนใจในการศึกษาค่าพารามิเตอร์ของระบบบดเคี้ยว ในกลุ่มคนที่มีอายุต่าง ๆ กัน

วัสดุและวิธีการ: ทำการศึกษาในกลุ่มคนไทยจำนวน 56 คน โดยแบ่งเป็น 3 กลุ่มอายุ ได้แก่ กลุ่มที่ 1 กลุ่มวัยรุ่นตอนต้น อายุ 20-39 ปี เป็นผู้ชายจำนวน 10 คนและผู้หญิง จำนวน 15 คน กลุ่มที่ 2 ได้แก่ กลุ่มผู้ใหญ่ตอนต้น อายุ 40-60 ปี เป็นผู้ชายจำนวน 10 คนและผู้หญิง จำนวน 15 คน และกลุ่มที่ 3 ได้แก่ กลุ่มผู้สูงอายุ ที่มีอายุมากกว่า 60 ปีขึ้นไป เป็นผู้ชายจำนวน 2 คนและผู้หญิง จำนวน 4 คน การวัดค่าพารามิเตอร์ของระบบบดเคี้ยว ทำโดยใช้เครื่องทีสแกนทรี มีชื่อเต็มว่า T-Scan computerized เป็นเครื่อง

Abstract

Objective: The aim of this study is to examine the occlusal parameters in the general population in different age groups, which there is still a few studies.

Materials and Methods: Fifty-six Thai subjects were divided into three different groups of age; group 1; young adulthood 20-39 years (10 males, 15 females), group 2; middle adulthood 40-60 years (10 males, 15 females) and group 3; elder more than 60 years (2 males, 4 females). The T-Scan III computerized occlusal analysis system was used to record a multi-bite closure and the oc-

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มือบันทึกการกัดสบฟันในลักษณะพลวัต ค่าที่ศึกษา ได้แก่ ร้อยละของการกระจายแรงสบฟัน พื้นที่การสบสัมผัส เวลาการสบฟัน และเวลาสบแยกออก โดยมีการเปรียบเทียบค่าเหล่านี้ระหว่างคนในแต่ละกลุ่มอายุ การเปรียบเทียบค่าทางสถิติที่ระดับนัยสำคัญ 0.05

ผลการศึกษา: พบว่าค่าร้อยละของการกระจายแรงสบฟัน พื้นที่การสบสัมผัส เวลาสบฟัน และเวลาสบแยกออกไม่มีความแตกต่างกันเมื่อเปรียบเทียบระหว่างกลุ่มคนที่มีอายุต่าง ๆ กัน 3 กลุ่ม เมื่อทำการเปรียบเทียบค่าร้อยละของการกระจายแรงสบฟันเปรียบเทียบทางด้านซ้ายและด้านขวาในคนกลุ่มอายุเดียวกัน พบว่าทั้ง 2 ด้านไม่มีความแตกต่างกัน แต่ค่าร้อยละของการกระจายแรงสบฟันหลังมีค่ามากกว่าค่าร้อยละการสบฟันหน้าอย่างมีนัยสำคัญทางสถิติในคนกลุ่มอายุเดียวกัน และสำหรับการเวลาสบแยกออกของการเยื้องไปทางด้านซ้ายมีความแตกต่างกันกับการเยื้องไปทางด้านขวาอย่างมีนัยสำคัญทางสถิติ

สรุปผล: ค่าการกระจายแรงสบฟัน พื้นที่การสบสัมผัส เวลาสบฟัน และเวลาสบแยกออกไม่มีความแตกต่างระหว่างกลุ่มคนที่มีอายุต่างกัน แต่พบเวลาสบแยกออกของการเยื้องไปทางด้านซ้ายมีความแตกต่างกันกับการเยื้องไปทางด้านขวาระหว่างกลุ่มคนที่มีอายุต่างกัน

คำสำคัญ: การวิเคราะห์การบดเคี้ยวด้วยคอมพิวเตอร์ เครื่องทีสแกนทรี การกระจายแรงสบฟัน พื้นที่การสบสัมผัส เวลาสบฟัน และเวลาสบแยกออก

clusal parameters for each subject in all age groups. The percentage of occlusal force distribution, the occlusal contact area, the occlusion time and the disclusion time were calculated for all groups.

Results: The occlusal force distribution, the occlusal contact areas, the occlusion time and the disclusion time during maximum intercuspation position were similar in all groups. There was no statistically significant difference (p>0.05) in all groups. When the occlusal force distribution was compared within group, the bilateral right to left side occlusal force distribution was not statistically different for all groups. Statistically significant differences (p = 0.001) of occlusal distribution were recorded between the anterior and posterior quadrants in all groups which the more values were found in posterior when compared to the anterior areas. Moreover, a statistically significant difference (p=0.023, and p=0.021) was found in disclusion time during left and right lateral excursion, respectively.

Conclusion: This present study found no differences in the occlusal force distribution, occlusal contact areas, occlusion time and disclusion time between three different age groups. Only the differences of the disclusion time during left and right lateral excursion were found.

Keywords: computerized occlusal analysis, T-Scan III, occlusal force distribution, occlusal contact area, occlusion time, disclusion time

Introduction

Occlusion is universally accepted as a key factor for clinical success in dentistry and plays a dynamic role in the stability of stomatognathic system. Harmony in the muscles of mastication, the temporomandibular joint, the teeth and restorations are closely interrelated.[1] Therefore, a stable, harmonious and well balanced occlusion is the end-goal of every dental treatment, and cannot be limited to specialties such as orthodontists and prosthodontists. The term occlusion refers to the contact between the incising or masticating surfaces of the maxillary and mandibular teeth. Although, there are various theories regarding occlusion such as Centric Relation[2], Neuromuscular position[3], Maximum Intercuspation[4], there has been no clear consensus as to which is the most effective. Despite the controversies, one concept commonly agreed upon is that during mandibular closure, all teeth should occlude simultaneously. When the teeth occlude, an equal percentage of occlusal force should be shared between the right and left arch-halves[5], suggesting the relationship between the occlusal contacts and the occlusal forces. There have been continuous attempts to study the occlusal concepts that can be comprehensively implemented into daily practice, but each philosophy gives rise to more questions and association between the complex occlusal phenomenon and its relationship to the stomatognathic system and associated disorders.

The parameters of the occlusion system, are the occlusal force, occlusal force balance, occlusal force distribution, occlusal contact areas, occlusion time and disclusion time, etc.[2] In an attempt to study the occlusal parameters between non orthodontically treated subjects compared to orthodontically treated subjects, Qadeer, *et al*.[6] found no statistically significant difference between bilateral occlusal force distribution between the two groups, a statistically significant difference was observed in quadrants force distribution with higher force percentages posteriorly (89.42%) and much less anteriorly (10.58%) in orthodontically treated subjects when compared to the natural dentition. Sadamori, *et al*.[7], found a significant asymmetry of occlusal force balance between left and right sides in temporomandibular disorder (TMD) patients higher than the healthy subjects. A study by Wieczorek, *et al*.[8], have shown the symmetry of left-right muscles activity in asymptomatic young adults is not related to symmetry of occlusal contacts.

Many studies of occlusal contact areas, Gümüş, *et al*.[9], studied in bruxism patients, there was found no differences in posterior contact of bruxism patients before and after stabilization splint treatment. However, differences in posterior contact were observed between bruxists and normal individuals prior to treatment, and these differences disappeared following treatment. Furthermore, there were studies in TMD patients which found the values of occlusal contact areas in TMD patients were lower than those in healthy subjects.[7,9] Consistently with the study by Lee, *et al*.[10] that have shown as occlusion improvement and occlusal contact areas increased after treatment. Moreover, there was a study by Imamura, *et al*.[11], they found that occlusal contact areas increased with clenching strength.

Disclusion time is defined as the time, in seconds, required to disclude the working and nonworking molar and premolar from the habitual centric closure position to the completion of the mandibular excursion. This definition was first defined by Kerstein and Wright.[12] Previous researches have shown a direct link between disclusion time and muscle contraction levels in the masseter and temporalis muscles. Specifically, it was observed that lengthy disclusion time (>1.39 sec.) elevates levels of muscle contractions in these muscles, and that short disclusion time (<0.5 sec.) dramatically reduces these same muscle contractions

to near resting state values.[12,13] Consistent with another study in patients with chronic myofascial pain dysfunction (MPDS), it was found that the mean disclusion time was significantly longer in the MPDS patient group than in the non-MPDS group.[14] Anyway, there was different results from the study by Gümüş, *et al*.[9], which studied in bruxism patients and found that the mean disclusion time for all subjects was less than 1.39 seconds, and no link was found between disclusion time and bruxism.

There are many studies used a variety of many methods and tools to analyze the occlusal parameters or assessments of the dental occlusion. Afrashtehfar and Qadeer[15], had categorized the tools and methods into 2 main categories: 1) Qualitative occlusal registration technologies, these are the conventional methods such as articulating paper, shim stock, waxes, and silicone impressions; 2) Quantitative occlusal registration technologies, these have been developed to overcome the limitations of qualitative assessment, such as subjective interpretation which are the photo-occlusion and T-Scan system. For this study, we choose T-Scan system to examine the various occlusal parameters in quantity. The full name of T-Scan is T-Scan computerized occlusal analysis system (Tekscan™ Inc., South Boston, MA, USA). This is a diagnostic device that records patient's dynamics bite force, including relative occlusal force, location and timing.

As mentioned above, it can be seen that there have been attempts to study the occlusal parameters in a variety of sample groups. Most of them studied the age range in the young adult samples. There is a few studies of the natural dental occlusion in the other age groups. For this reason, we are interested in studying the occlusal parameters in the general population in the different groups of age.

Materials and methods

A total of 56 subjects were randomly selected from patients, personnel staffs, dentists, dental assistants and dental students presented in the Faculty of Dentistry, Mahidol University from March 2017 to June 2018. An informed consent was signed by each subject after receiving an explanation of the goals and protocol of the study. The study was approved by the institutional review board of the Faculty of Dentistry, Mahidol University (approval no.MU-DT/PY-IRB 2017/009.2102).

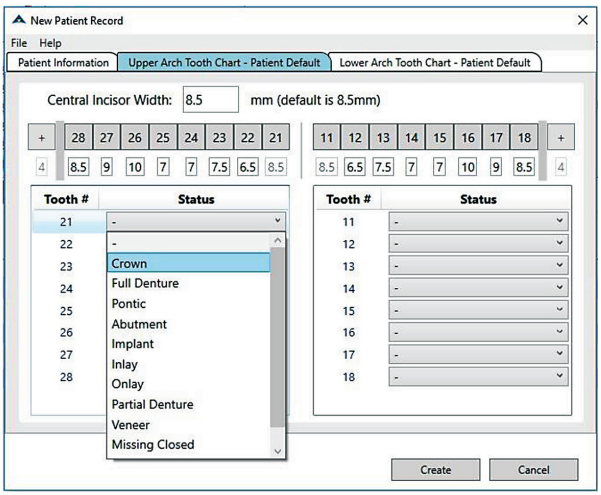
A total of 56 subjects (22 males, 34 females) were classified into three different age groups; group 1, young adults 20-39 years old (10 males, 15 females), group 2, middle adulthood 40-60 years old (10 males, 15 females) and group 3, elder group over 60 years old (2 males, 4 females). Inclusion criteria were as follow : 1) no more than four missing teeth excluding third molars 2) not more than one edentulous space within each arch 3) no anterior or posterior crossbite, open bite and deep bite 4) no orthodontic treatment or completed orthodontic treatment at least one year prior to participation in this study 5) no more than one fixed/removable prosthesis within each arch 6) capable of biting in maximum intercuspation position without pain of the masticatory muscles or temporomandibular joint 7) no problem in mandibular movement or history of locked-jaw. The subjects who could not be recorded by T-Scan III, were excluded from the study.

A complete dental history and oral examination was recorded for each subject. Once all the relevant dental history and signed consent was collected, a Multi-bite closure and excursive recordings were obtained using T-Scan III to analyze the occlusal parameters. All T-Scan recording were made when the subject sitting upright in the dental chair. For Multi-bite recordings, each subject was instructed to occlude into the recording sensor three times in succession using their maximum bite force, so that the best closure among the three bites can be selected for analysis.

T-Scan III system methods

T-Scan III occlusal analysis system is a diagnostic device that records patient's dynamics bite force, including relative occlusal force, location and timing. The T-Scan III system consists of a hand-held device with a USB port to be connected to a laptop or a Windows-based PC, the hand-held device contains a U-shaped pressure-measuring sensor that fits into the patient's mouth between the occluding teeth. The pressure-measuring sensor is a grid-based, Mylar-encased recording sensor that is 100 micron (0.10 mm) thick and consists of 1100-1300 compressible sensitive receptor points made of conductive ink. When the patient bites on the sensor, the electrical resistance of the conductive sensor is reduced, since the applied force compresses the particles together that allows the sensor to register relative force and distribution of tooth contacts over a pixel size 1.61 mm^2.[15,16]

The T-Scan III system variables measured in this study consist of percentages of occlusal force distribution, occlusal contact areas, occlusion time and disclusion time. The occlusion time (OT) is the elapsed time in seconds, measured from the 1st tooth contact until all the teeth have occluded (maximum intercuspation), as a subject closes all their teeth together from completely open (no tooth contact) to the beginning of static intercuspation. The disclusion time (DT) is the elapsed time in seconds, measured from the beginning of an excursive movement made in one direction (left or right) with all teeth in complete intercuspation through until the guidance has been achieved and the remaining teeth have discluded (canines and/or incisors are in contact).



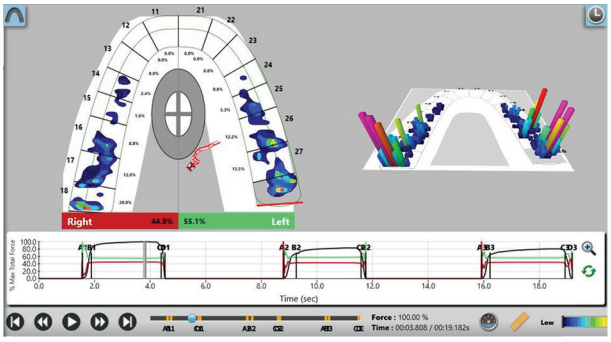
รูปที่ 1 *ตารางแผนภูมิรูปภาพฟันแสดงโดยเครื่องทีสแกน ทรี*

Figure 1 *The T-Scan III tooth chart*

Prior to T-Scan III recording, each subject had his or her demographic data, dental teeth dimensions and tooth distribution entered into the T-Scan tooth chart (Fig 1), to help customize the graphical dental arch for each individual subject in the T-Scan software. This study used T-Scan Dental Occlusal Analysis System software version 9.1 (Tekscan™ Inc., South Boston, MA, USA).

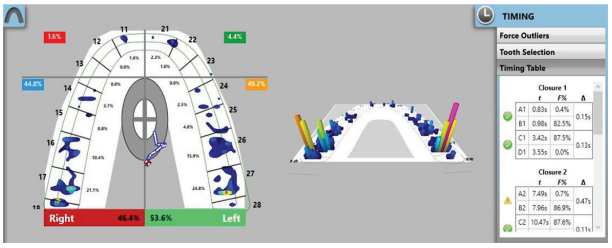
Before recording, each subject was taught the required mandibular movements and was asked to practice for multi-bite and lateral mandibular excursions to reduce measurement errors. All Multi-bite T-Scan recordings were made while the subject sitting upright in the dental chair. Then, calibration of the sensor was done to match the sensor's recording sensitivity level to the occlusal force range of each subject. Subjects were instructed to occlude into the recording sensor three times in succession using their maximum bite force. After that, the next recording were followed by lateral mandibular excursions movement on both left and right sides. From all three times recording, only one single closure of each movement that contained the maximum and stable record of occlusal force was selected for analysis (Fig 2). All clinical examinations and T-Scan measurements were performed by one dentist.

In the maximum intercuspation record, data analysis was done by selecting the maximum intercuspation frame. The percentages of occlusal force distribution at left-right, anterior left-anterior right and posterior left-posterior right, occlusion time and



รูปที่ 2 *ตัวอย่างกราฟแสดงการสบฟันกัดปิดหลายครั้งแบบเสถียร*

Figure 2 *An example of a multi-bite closure stable graph*



รูปที่ 3 *ภาพ 2 มิติและ 3 มิติ ของการกระจายแรงสบฟัน ระยะเวลาการสบฟัน และเวลาสบแยกออก*

Figure 3 *The 2D and 3D occlusal force distribution, occlusion time and disclusion time*

disclusion time were recorded from each subject (Fig 3). The occlusal contact areas were determined by clicking on the "Save ASCII" icon in the menu bar of the display screen. After that, the data from the T-Scan program was tabulated in the excel sheet (Microsoft Excel 2016; Microsoft Corp., Seattle WA, USA), where the number of pixels was counted. The number of pixels was multiplied by 1.61 mm^2 (the area of each pixel) to measure as the occlusal contact areas. In the lateral excursion movement record, data analysis was accomplished by playing and observing the occlusal force changes. The occlusion time and disclusion time was recorded from the subjects.

Statistical analysis was conducted by using SPSS statistics program version 23 (SPSS Inc., Chicago, IL, USA). Normality of distribution of variables was examined using the Kolmogorov-Smirnov test. The significance level of the statistical analysis is 95% (p<0.05). Paired-sample t-test or Wilcoxon match-pair signed-rank test was used to compare the within group differences. In addition, a One-way ANOVA or Kruskal-Wallis H test was used to analyze the differences between the three groups of age.

Results

The distribution of demographic features of the subjects in each group was shown in Table 1. The subjects aged between 20 to 75 years, with a mean age of 41.50 + 14.02 years. All of the subjects were divided into three different age groups for the comparison. The majority of subjects were female (60.7%) and person who have no history of orthodontic treatment (73.2%). In each group, the mean of number of teeth (27.52+1.74, 28.80+2.33, 29.17+2.93) and number of tooth contacts (7.56+0.77, 8.40+1.23, 8.33+1.63) are similar. The type of occlusal scheme in young adults (group 1) and in middle adulthood (group 2) were mostly the group function on both right and left sides. Furthermore, there was no canine guidance occlusal scheme in the elder (group 3), only anterior guidance and group function were found.

In this study, each group have similar occlusal force distribution on the two sides, there was no statistically significant difference (p>0.05) between left and right sides. However, there was found statistically significant difference (p<0.05) in between anterior-posterior force distribution (Table 3) and between occlusion time-disclusion time during maximum intercuspation position in all groups (Table 4). When the arch was divided into anterior and posterior quadrants, significantly higher occlusal force percentage was found posteriorly than that found anteriorly. When the subjects bited in maximum intercuspation position, occlusion time significantly longer than disclusion time (Table 3,4).

ตารางที่ 1 *ข้อมูลทั่วไปของกลุ่มตัวอย่าง*

Table 1 *Demographic data of the subjects*

	Group 1 (20-39 yrs.) (n=25)	**Group 2 (40-60 yrs.)** (n=25)	**Group 3 (>60 yrs.)** (n=6)
• Age Mean *(SD)*	29.36 (5.94) min=20, max=39	46.96 (5.65) min=40, max=57	69.33 (4.97) min=64, max=75
• Sex			
- Male *n* (%)	10 (40.0%)	10 (40.0%)	2 (33.3%)
- Female *n* (%)	15 (60.0%)	15 (60.0%)	4 (66.7%)
• Number of teeth Mean *(SD)*	27.52 (1.74) min=24, max=30	28.80 (2.33) min=24, max=32	29.17 (2.93) min=25, max=32
• Number of tooth contacts *Mean (SD)*	7.56 (0.77) min=6, max=8	8.40 (1.23) min=6, max=10	8.33 (1.63) min=6, max=10
• Number of tooth with restoration *Mean (SD)*	3.52 (2.85) min=0, max=9	4.96 (4.75) min=0, max=16	5.67 (3.93) min=0, max=10
• History of Orthodontic tx.			
- No *n* (%)	15 (60.0%)	21 (84.0%)	5 (83.3%)
- Yes *n* (%)	10 (40.0%)	4 (16.0%)	1 (16.7%)
• Occlusal scheme			
o Left side			
- Anterior guidance *n* (%)	5 (20.0%)	4 (16.0%)	2 (33.3%)
- Canine guidance *n* (%)	6 (24.0%)	5 (20.0%)	0 (0.0%)
- Group function *n* (%)	14 (56.0%)	16 (64.0%)	4 (66.7%)
o Right side			
- Anterior guidance *n* (%)	8 (32.0%)	5 (20.0%)	2 (33.3%)
- Canine guidance *n* (%)	5 (20.0%)	4 (16.0%)	0 (0.0%)
- Group function *n* (%)	12 (48.0%)	16 (64.0%)	4 (66.7%)

ตารางที่ 2 *ตารางเปรียบเทียบการกระจายแรงสบฟันที่ด้านซ้ายกับด้านขวาโดยเปรียบเทียบภายในกลุ่มเดียวกัน*

Table 2 *Comparison of occlusal force distribution on the left and right sides within group.*

	Occlusal force distribution (%)		
	Lt-FD Mean(SD)	Rt-FD Mean(SD)	*p*-value
Group 1 (20-39 yrs.)	52.72 (9.01)	47.28 (9.01)	0.144
Group 2 (40-60 yrs.)	50.31 (8.64)	49.69 (8.64)	0.858
Group 3 (>60 yrs.)	52.30 (10.70)	47.70 (10.70)	0.621

Note: *Significant difference. The *p*-values were analyzed by Paired-sample t test or Wilcoxon matched-pair signed-rank test.

ตารางที่ 3 *ตารางเปรียบเทียบการกระจายแรงสบฟันที่ด้านหน้ากับด้านหลังโดยเปรียบเทียบภายในกลุ่มเดียวกัน*

Table 3 *Comparison of occlusal force distribution on the anterior and posterior areas within group.*

	Occlusal force distribution (%)		
	Ant-FD Mean(SD)	Post-FD Mean(SD)	*p*-value
Group 1 (20-39 yrs.)	9.66 (10.97)	90.33 (10.96)	<0.001*
Group 2 (40-60 yrs.)	5.78 (5.20)	94.22 (5.19)	<0.001*
Group 3 (>60 yrs.)	6.68 (3.99)	93.32 (3.99)	<0.001*

Note: *Significant difference. The *p*-values were analyzed by Paired-sample t test or Wilcoxon matched-pair signed-rank test.

ตารางที่ 4 *ตารางเปรียบเทียบเวลาการสบฟัน และเวลาสบแยกออก โดยเปรียบเทียบภายในกลุ่มเดียวกัน*

Table 4 *Comparison of occlusion time and disclusion time within group*

	Occlusion time and disclusion time (second)		
	OT-MIP Mean(SD)	DT-MIP Mean(SD)	*p*-value
Group 1 (20-39 yrs.)	0.43 (0.24)	0.21 (0.11)	0.001*
Group 2 (40-60 yrs.)	0.39 (0.23)	0.24 (0.14)	0.006*
Group 3 (>60 yrs.)	0.52 (0.12)	0.21 (0.14)	0.008*

Note: *Significant difference. The *p*-values were analyzed by Paired-sample t test or Wilcoxon matched-pair signed-rank test.

ตารางที่ 5 *ตารางเปรียบเทียบการกระจายแรงสบฟันที่ด้านซ้ายกับด้านขวา ที่ด้านหน้ากับด้านหลัง และค่าความแตกต่างของการกระจายแรงสบฟันด้านหลังกับด้านหน้า โดยเปรียบเทียบระหว่างแต่ละกลุ่ม*

Table 5 *Comparison of the occlusal force distribution between groups*

	Occlusal force distribution (%)			
	Group 1 (20-39 yrs.) (n=25) Mean (SD)	Group 2 (40-60 yrs.) (n=25) Mean (SD)	Group 3 (>60 yrs.) (n=6) Mean (SD)	*p*-value
Lt-FD	52.72 (9.01)	50.31 (8.64)	52.30 (10.70)	0.629
Rt-FD	47.28 (9.01)	49.69 (8.64)	47.70 (10.70)	0.629
Ant-FD	9.66 (10.97)	5.78 (5.20)	6.68 (3.99)	0.607
Post-FD	90.33 (10.96)	94.22 (5.19)	93.32 (3.99)	0.602
Diff-Post-Ant-FD	80.67 (21.93)	88.45 (10.38)	86.63 (7.99)	0.602

Note: The *p*-value of Lt-FD, Rt-FD and Diff-Lt-Rt-FD were analyzed by One-Way ANOVA. The *p*-value of Ant-FD, Post-FD and Diff-Post-Ant-FD were analyzed by Kruskal-Wallis H test.

ตารางที่ 6 *ตารางเปรียบเทียบเวลาการสบฟัน และเวลาสบแยกออก โดยเปรียบเทียบระหว่างแต่ละกลุ่ม*

Table 6 *Comparisons of occlusion time and disclusion time between groups*

	Occlusion time and disclusion time (seconds)			
	Group 1 (20-39 yrs.) (n=25) Mean (SD)	Group 2 (40-60 yrs.) (n=25) Mean (SD)	Group 3 (>60 yrs.) (n=6) Mean (SD)	*p*-value
OT-MIP	0.43 (0.24)	0.39 (0.23)	0.52 (0.12)	0.145
DT-MIP	0.21 (0.10)	0.24 (0.14)	0.21 (0.14)	0.574
DT-Lt-Excursion	0.93 (0.49)**	1.21 (0.78)	1.77 (0.82)**	0.023*
DT-Rt-Excursion	0.89 (0.51)**	1.33 (0.51)**	1.21 (0.71)	0.021*

Note: *, **Significant difference. The *p*-value of OT-MIP was analyzed by Kruskal-Wallis H test. The *p*-value of DT-MIP, DT-Lt-Excursion and DT-Rt-Excursion were analyzed by One-Way ANOVA.

ตารางที่ 7 *ตารางเปรียบเทียบพื้นที่การสบสัมผัสระหว่างแต่ละกลุ่ม*

Table 7 *Comparisons of the occlusal contact areas between groups*

	Occlusal contact areas (mm^2)			
	Group 1 (20-39 yrs.) (n=25) Mean (SD)	Group 2 (40-60 yrs.) (n=25) Mean (SD)	Group 3 (>60 yrs.) (n=6) Mean (SD)	*p*-value
Occlusal contact area (mm^2)	202.60 (85.64)	248.39 (90.05)	215.47 (52.09)	0.168

The *p*-value of occlusal contact area was analyzed by One-Way ANOVA.

As Table 5 shows the data of occlusal force distribution when compare between groups, the occlusal force distribution in each sides of the three different groups of age was similar, no statistically significant differences (p>0.05) were found in percentage of occlusal force distribution in left side, right side, anterior quadrant, posterior quadrant and the values of difference between anterior and posterior quadrant.

The data of occlusion time and disclusion time in all groups was shown in Table 6. No statistically significant differences were found in occlusion time and disclusion time during maximum intercuspation position. Alternatively, a statistically significant difference (p=0.023, and p=0.021) was found in disclusion time during left and right lateral excursion, respectively. The results of the multiple comparison test showed that the disclusion time during left lateral excursion of group 1 was significant differences (p=0.028) from group 3 and the disclusion time during right lateral excursion of group 1 was significant differences (p=0.022) from group 2.

As Table 7 shows the data of occlusal contact areas when compare between groups, the occlusal contact areas were similar in all groups. There was no statistically significant difference (p>0.05) in all groups.

Discussion

The present study of the occlusal parameters was conducted in three different groups of age. There is a small number of subjects in group 3 because of the condition of inclusion criteria such as: no more than four missing teeth excluding third molars; only one edentulous space within each arch; capable of biting in maximum intercuspation position without pain of the masticatory muscles or temporomandibular joint. Therefore, it was very difficult to find the elder subjects to suit these criteria. In all groups, the majority of occlusal scheme was group function. The minority was anterior protected guidance or canine guidance. This is similar to the earlier epidemiological data such as study by Asawaworarit and Mitrirattanakul[17] showed that the majority of occlusal scheme of Thai populations (68.3%) was group function occlusal scheme. For the remaining, 17.3% of the populations possessed canine protected occlusion, 12.5% possessed combination of both occlusal schemes. And also corresponds to the data that study by Beyron[18] showed fairly overwhelmingly that adult Australian aborigines had group function occlusion. From this study, in the elderly subjects, there was no canine guidance, which was likely due to the attrition of teeth, causing the canine guidance to disappear.

This present study compared occlusal force distribution percentages between left and right sides, anterior and posterior regions. The result of this study was found no significant difference between left-right side in each groups. However, when the arch was divided into anterior and posterior quadrants, significantly higher occlusal force percentage was found posteriorly than was found anteriorly which all 3 groups giving the same results. These were consistent with the previous studies by Qadeer, *et al*.[6] and Zivko-Babić, *et al*.[19], who studied the occlusal force in natural dentition. They also found a statistically significant differences between the forces posterior and anterior, while the difference between the forces left and right is not statistically significant. These results will be consistent with the concept that, when the structures of the masticatory system are functioning efficiently and without pathology during jaw closing and biting, the contact of all posterior teeth is even and simultaneous. The anterior teeth also come into contact but more lightly than the posterior teeth. In the upright head position and alert feeding position, posterior tooth contacts are heavier than anterior tooth contact.[20]

In this study, we found statistically significant difference in between occlusion time-disclusion

time during maximum intercuspation position in all groups which the occlusion time significantly longer than disclusion time. This result was similar in all groups when we compared within each group. But when comparing the occlusion time or disclusion time between all three different age groups, no statistically significant differences were found in occlusion time or disclusion time during maximum intercuspation position. Alternatively, the result of this study showed that the disclusion time during left lateral excursion of group 1 was significant differences from group 3 and the disclusion time during right lateral excursion of group 1 was significant differences from group 2. This may be due to the ability to do the lateral movement of mandible in the elderly age subjects and the percentage of the different occlusal schemes between groups. The second and third groups showed more percentage of the group function occlusal scheme which should be because of the attrition in the posterior teeth of the older populations.

Moreover, the result of this study showed that the occlusal contact area was similar with no statistically significant difference in all groups. When considering the occlusal contact area in the group 3, which is an elderly person, had an occlusal contact area values less than group 2, which is a middle adulthood. This may be due to the fact that older people have lower bite forces than young adulthood. Although many studies suggest that maximum bite force is not associated to age[21-24], but it is likely that the elderly will have lower bite force than young adulthood due to the decrease of muscle mass and strength. The decrease in muscle mass and strength is a marked process in the loss of functional capacity in the aging individual, expressed by a reduction in the number and size of the muscle fibers.[7,23] There have been previous studies by Imamura, *et al*.[11] and Kumagai, *et al*.[25], found that the occlusal contact area increased as clenching strength or occlusal force increased. When the higher level of clenching intensity applied between antagonistic teeth, the more tooth displacements would occur in the periodontal socket. This results in a decrease of space between antagonistic teeth and an increase in occlusal contact area. Therefore, when the elderly group has a tendency to decrease in bite force, the occlusal contact area is less than the middle adulthood group. Anyway, it did not statistically significant difference between the two groups. When consider between group 1 and group 2, it is found that group 2 has a tendency of occlusal contact area more than group 1, which is a young adulthood. The larger contact area in the middle adulthood was explained as a result of the physiological attrition. The gradual attrition of the occlusal surface is a physiological process of tooth during the age increased. It can be assumed that both of these groups had a similar maximum bite force and muscle mass and strength.

Conclusion

The present study found the values of occlusal force distribution, occlusal contact areas, occlusion time and disclusion time were not different in three different age groups. Since we collected these samples as a normal occlusion patient with no problem of temporomanidibular diseases (TMD) and have almost all natural permanent teeth, the result can be implied that the normal occlusion in the different group of ages are similar in the pattern. The clinical application for all of the dental specialties is to be concern of this pattern when building up the new restorations for the patients. Moreover, the further studies of the more subjects to represent the populations are recommended.

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