Effect of short one third lower face toward mastication performance in deutero malay

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ABSTRACT

The one-third lower face height belongs to ideal proportion, ratio 1:1:1, of vertical face height. The one-third lower face height could be influenced by mastication. The one-third lower face height that shorter than normal ratio is generally followed by deep bite which may lead to temporomandibular disfunction even so eustachian tube disfunction, this condition may interfere mastication function, which can be measured by mastication performance. The research objective was to determine the effects of short lower face height to the mastication performance based on overbite. The research method was a cross-sectional study with epidemiology survey type. Research subjects 12-15 years old junior high school with Deutero Melayu Sub races in Bandung. Sampling technique used multistage random sampling by determining the size of sample based on potluck sample and gained 24 children (group 1) with normal ratio of vertical face height and 27 children with short lower facial height which were 11 children overbite normal (group 2) and 16 children deep bite (group 3). Mastication performance by 20 times chewing artificial test food then followed by sieving test. Mastication performance value represented by the median particle size (MPS) and the distribution of the particle distribution (b). The results of average MPS and b between group 1, 2 and 3 used statistical analysis MPS with ANOVA test which Fhit=5.56 and pvalue=0.0075, b which Fhit=3.41 and pvalue=0.0430 showed a significant differences. Continued with group T test MPS (pvalue = 0.0925) dan b (pvalue = 0.2076) between group 1 and 2 showed a non significant differences. While between group 1 and 3 showed a highly significant differences in MPS (pvalue = 0.0037 and ¤ = 0,01) and a significant differences in b (pvalue = 0.0141 and ¤ = 0,05). Conclusions of this study was children with short lower face height and normal overbite did not decrease the mastication performance while children with deep bite decrease the mastication performance.

***Keywords**: short lower face height, deep bite, mastication performance*

ABSTRAK

Proporsi tinggi vertikal wajah dibagi menjadi tiga bagian dengan rasio normal 1:1:1. Proporsi wajah yang berhubungan dengan fungsi mastikasi adalah sepertiga bawah wajah. Tinggi sepertiga bawah wajah pendek umumnya disertai dengan deep bite dapat memberikan dampak lebih lanjut berupa gangguan sendi temporomandibular, bahkan disfungsi eustachian tube. Hal tersebut dapat mengganggu fungsi mastikasi. Tujuan penelitian adalah untuk mengetahui efek tinggi sepertiga bawah wajah pendek terhadap performa mastikasi berdasarkan overbite. Metode penelitian adalah cross sectional dengan

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tipe survei epidemiologi. Subjek penelitian anak usia 12-15 tahun Sub ras Deutero Melayu di kota Bandung. Teknik sampling menggunakan multistage random sampling dengan penentuan besarnya ukuran sampel berdasarkan sampel seadanya dan diperoleh 24 anak (kel 1) dengan tinggi wajah normal dan 27 anak dengan tinggi sepertiga bawah wajah pendek terdiri dari 11 anak overbite normal (kelompok 2), 16 anak deep bite (kelompok 3). Performa mastikasi diukur dengan 20 kali pengunyahan artificial test food kemudian dilakukan uji pengayakan. Nilai performa mastikasi dinyatakan dengan median particle size (MPS) dan distribusi sebaran partikel (b). Analisa uji ANOVA diperoleh MPS dengan F_{hit} = 5.56 dan pvalue = 0.0075, serta b dengan F_{hit} = 3.41 dan nilai pvalue = 0.0430 menunjukkan perbedaan yang signifikan. Dilanjutkan uji T berkelompok MPS (p_{value} = 0.0925) dan b (p_{value} = 0.2076) antara kelompok 1 dan 2 menunjukkan perbedaan yang tidak signifikan. Sedangkan antara kelompok 1 dan 3 perbedaan MPS (p_{value} = 0.0037 dan □ = 0,01) sangat signifikan dan perbedaan b (p_{value} = 0.0141 dan □ = 0,05) signifikan. Simpulan penelitian ini adalah anak dengan tinggi sepertiga bawah wajah pendek yang disertai overbite normal tidak menurunkan performa mastikasi sedangkan deep bite menurunkan performa mastikasi.

Kata kunci: *tinggi sepertiga bawah wajah pendek, deep bite, performa mastikasi*

INTRODUCTION

The bad habit in children in the world are consume junk food approximately 157.000.000 portions every month.[1] This unhealthy pattern will be worse by the lack of fiber consumption from fruits and vegetables. The results of Riskesdas in 2007 reveal that there are 93.6% 10 years old consume less fruits and vegetables.[2]

The change of eating pattern can influence the activity of mastication muscle and will decrease the function of mastication. The study conducted by Bouvier[3] reveals that the habit of less fiber consumption will decrease the activity of mastication muscle and will decrease the function of mastication. Harding[4] states that types of food texture consumed will influence the growth of face especially the growth of mandible. The evolution of food texture become soft will decrease the mastication function and will influence the growth of craniofacial.[5-9] The change of mastication function will trigger muscle imbalance, bones and teeth. Thus it will affect the growth and development of children especially craniofacial organ.[10]

The growth function and mastication maturation occur through the process, if adequate, it will stimulate and the suitable function for the growth of normal maxilla and mandibula.[12] Mandible has a plastic formation and the form will be indirectly influenced by physical consistency of food. Thus it can change the form and function of mandible.[13] The study conducted by Martina16 also states that the one-third height under face has a close relationship with the height of dentoalveolar. The study conducted by Bouvier[3] and Volkman[14] reveal that less mastication function is caused by a low number of masseter muscle activity due to unhealthy food consumption, it can affect the growth of mandible and can reduce the one-third height lower face from normal ratio is 1:1:1.[11]

The study conducted by Al-Zubaidi[17] reveals that children with deep bite have a short height of one-third height lower face, the study differentiates children with open bite, overbite normal and deep bite. Deep bite is a malocclusion caused by a change of eating pattern that will influence the performance of mastication.[18,19] According to Pereira[20] deep bite occlusion can give a continuous effect that disturbs temporomandibular[10] joint and even dysfunction of eustachian tube.[21]

There has not been a high prevalence of one-third height under face in Indonesia, and there have not been any studies concerning children with short one-third height lower face based on overbite. Studies concerning humans' mastication are also scant, even have not been yet conducted in Indonesia. Thus the researcher is interested in revealing the effect of one-third height lower face over mastication performance in kids with the ages ranging from 12 – 15 years old Deutero Malay Sub-race.

MATERIAL AND METHODS

The study was a cross-sectional epidemiologic survey. The populations of the study were junior high school students in Bandung with the ages ranging from 12 years old to 15 years old, with the origin of Deutero Malay. The technique of sampling is multistage random sampling using presence samples that fulfil the criteria.The selection of kids with the age between 12-15 years old and the origin of Deutero Malay sub-race is through questioner. The examination was conducted using an intra oral examination and extra oral examination. Every sample would sit down straight to occlusal line on the floor, then the proportion of one-third height face was measured using clipper. The measurement of one-third height vertical face using clippers which was measured from the point of trichion to glabella for one-third upper face, glabella point to subnasale point to measure one-third middle face and subnasale point to menton point to measure one-third lower face. The measurement is in milimeter (mm). The measurements of overbite are from sample models. Models were in occlusion condition, from the edge of incisor teeth of upper incisif jaw of the models ate then was engraved using a pencil towards lower jaw incisif teeth, and was measured using a ruler. The models were then asked to chew artificial test food as much as 20 times with normal chewing. The chews were then gathered in a filtering paper and were then dried. The chews were then pondered, if there were any differences more than 6 % from the initial weight, samples would be asked to chew more.

The chews were then filtered in 7 levels as follows: 5.6 mm2, 4 mm2, 2.8 mm2, 2 mm2, 0.85 mm2, 0.425 mm2, and 0.25 mm2. The filtration was put in a vibrator for 20 minutes with 3000 RPM. Different artificial test food in each filter was then pondered and measured using the formula of mastication performance from Rosin-Rammler :

$$Qw = 100[1-2-(x/x50)b]$$

Qw is a cumulative weight of particles with smaller diameter from x (maximum filter gap), MPS (median particle size) is a filter gap diameter that can be passed through by 50% of artificial test food from the measurement, and "b" is a unit-less measure (Constanta) that displays a spread of particle distribution.

The results of the measurement were then compared with control sample. The size of the mastication performance is measured through the score of MPS of each group. The smaller score of MPS shows a better mastication performance.

The analysis of the data uses ANOVA test to reveal the differences of the height of one-third lower face over mastication performance based on overbite between group 1, 2 and 3. If a significant score has been obtained after the ANOVA test, then a t-test will be conducted to see the difference.

RESULTS

The Score of Median Particle Size (MPS)

Table 1 shows that the results of the examination of MPS' score are various in each group. Control Group with the score of MPS 0.85 mm2 with the total of n=3 (12.5%),

The score of MPS 2 mm2 with the total of n=8 (33.33%) and the score of MPS 2.8 mm2 with the most sample numbers, that is n=13 (54.17%). Control group shows that the lower score of MPS with the most sample numbers is in the score MPS 2.8 mm2.

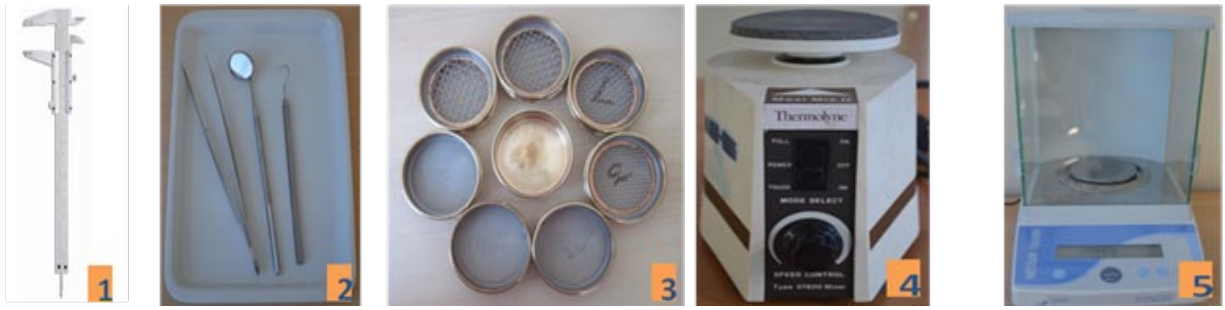

Figure 1. The instrument of the study: 1. Callipers; 2. Diagnostic tool; 3. Filter; 4. Vibrator; 5. Artificial Food Test.

The group of short one-third height lower face with normal overbite with sample numbers n=3 (27.27%) has the score of MPS 2 mm2, the samples are n=7 (63.63%) with the score of MPS 2.8 mm2 meanwhile with n=1 it has the score of MPS 4 mm2 (9.09%). Table 1 shows that the group of one-third height short lower face with deep bite and the most samples n=7 (43.75%) has the score of MPS 4 mm2, and a number of n=5 (31.25%) have the score of MPS 2.8 mm2 and samples of n=4 (25%) have the score of MPS 2 mm2. The score of MPS of one-third height short lower face with deep bite group is higher than control group and one-third height short lower face with normal overbite.

Table 1. MPS Score of Group 1, 2, and 3.

Group	MPS (mm^2)						
	5.6	4	2.8	2	0.85	0.45	0.25
1 (n)			13	8	3		
2 (n)		1	7	3			
3 (n)		7	5	4			

note 1. Control Group; 2. One-third height short lower face with normal overbite group; 3. One-third short lower face with deep bite group

Particle Spread Distribution Score (b)

Particle distribution spread (b) in control group can be seen in Diagram 1, short one-third height lower face with normal overbite group can be seen in Diagram 2 and one-third height short lower face with deep bite group can be seen in Diagram 3. Diagram 1 shows that control group has the lowest initial b score point compared to one-third height short lower face with normal over-bite group's and deep bite's. This thing displays a steep curve so that the mastication performance of control group can be better.

Diagram 1 shows that the particle spread score of control group has the most b score at the MPS 2,8 mm2, even though in one-third short lower face with normal overbite group (Diagram 2) has also the most b score at the MPS 2.8 mm2, but the b score at the MPS 4mm2 shows mastication performance that declines. In Diagram 3 b particle spread in one-third height short lower face with deep bite group at the MPS 4 mm2 (Diagram 3) shows the lowest mastication performance.

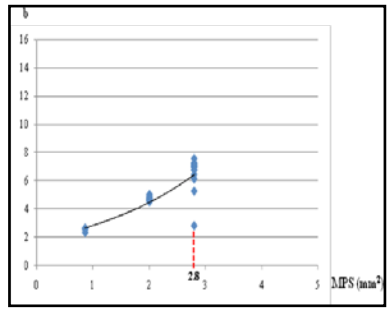

Diagram 1. Particle Spread Distribution of Control Group.

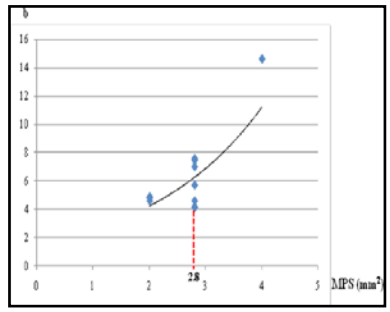

Diagram 2. Particle Spread Distribution of One-third Height Short Lower Face with Normal Overbite Group.

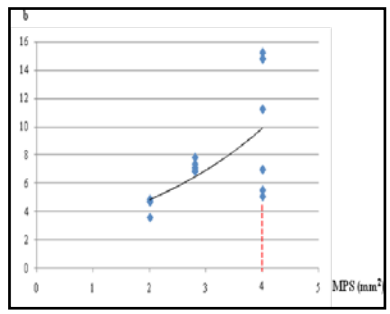

Diagram 3. Particle Spread Distribution of One-third Height Short Lower Face with Deep Bite Group

Mastication performance of control group, One-third Height Short Lower Face with Normal Overbite group, and One-third Height Short Lower Face with deep Bite group is tested using ANOVA. The difference can be acknowledged by group T test. The data of the study was then analyzed using ANOVA can be seen at the table 4. The statistic analysis shows that:

Median Particle Size (MPS):

The result of ANOVA test gives Fcalculated = 5.56 (pvalue = 0.0075) which is statistically different so that it can be concluded that there are differences of MPS in three research groups.

Table 4. The Results of ANOVA test - MPS

Source	*SS*	*df*	*MS*	F_{hit}	F_{tab}	*p-value*	Sifat
Treatment	5,3210	2	2,66051	5,56	3,23	,0075	**)
Error	18,6614	39	0,47850				
Total	23,9824	41					

Table 5 the Results of ANOVA test - b

Source	*SS*	*df*	*MS*	F_{hit}	F_{tab}	*p-value*	Sifat
Treatment	60,562312	2	30,2811560	3,41	3,23	,0430	*)
Error	345,946286	39	8,8704176				
Total	406,508598	41					

Explanation:F tabel with significance level 95% with df (2;39); o) = not significant; *) = significant; **) = very significant

Particle Spread Distribution (b):

The results of ANOVA test in table 5 gives Fcalculated = 3.41 (p value = 0.0430) are statistically different so that it can be concluded that there are differences of b score in three research groups.

Statistic results of MPS score using T-test in groups, average comparisons between control group, One-third Height Short Lower Face with Normal Overbite group, and One-third Height Short Lower Face with deep Bite group can be seen in the following table:

Group		1	2	3	
	Average	2,2966	2,6909	3,1250	Sifat
1	2,2966				
2	2,6909	,0925			o)
3	3,1250	,0037	,1536		**)

Table 6. The results of MPS T-test Group.

In table 6 it is shown that there are differences of MPS average score between the three research groups. The average score of MPS in control group is 2, 2966 and the score of one-third height short lower face with normal overbite group is 2, 6909 with pvalue = 0,0925 , it shows insignificant differences, meanwhile the highest average score of MPS is in one-third height short lower face with deep bite group which is 3,1250 with pvalue = 0,0037 at ¤ = 0,01, it shows a significant a with control group. Meanwhile between one-third height short lower face with normal overbite group and one-third height short lower face with deep bite group, there is insignificant difference. The average b score between control group, one-third height short lower face with normal overbite group, and one-third height short lower face with deep bite group can be seen at this following table:

Table 7 the results of b Score of Group T-test

Group		1	2	3	
	Average	5,1982	6,3504	7,9800	**Sifat**
1	5,1982				
2	6,3504	,2076			o)
3	7,9800	,0140	,2540		*)

Explanation:¤ = 0,05

In Table 7, it is seen that differences of b score between control group is 5,1982 and one-third height short lower face with normal overbite group which is 6,3504 with pvalue = 0,2076 shows an insignificant difference, meanwhile the average b score of one-third height short lower face with deep bite group which is 7,9800 with pvalue = 0, 0140 at ¤ = 0,05 shows a significant difference with control group . Meanwhile between the difference between one-third height short lower face with normal overbite group and one-third height short lower face with deep bite group is not significant.

From the statistic data, it is obtained that pvalue = 0,0037 < ¤ = 0,01 for MPS and pvalue = 0,0140 < ¤ = 0,05 for b score.

DISCUSSION

Descriptively, one-third height short lower face with deep bite group is more than one-third height short lower face with normal overbite group (See Diagram 1). This is in line Al-Zubaidi17 that kids with deep bite, in general, have a one-third height short lower face. But, the study reveals that there are kids with normal overbite even though they have a one-third height short lower face.

The average score of MPS in control group and one-third height short lower face with normal overbite group is lower than the average score in one-third height short lower face with deep bite group. Descriptively, Kids with one-third height short lower face deep bite have the highest MPS score compared to other groups, it shows that the mastication performance of the group is lower than control group. In line with Rios-Vera25 who states that deep bite group (Class II division 2 Angle) has a low mastication performance. MPS scores in control group and one-third height short lower face with normal overbite group are varied, but a number of samples have the same MPS score as seen in Table 1.

The similarities between a few samples can be caused by adaptation criteria of mastication muscle towards functional needs of chewing. This is supported by Grunheid26 that states jaw muscle is a functional unity that can adapt as its anatomical characteristic. Dynamic criteria of jaw muscle fiber can change its phenotype to optimize contraction function by minimizing energy. Adaptive response of jaw muscle caused by physiologic and pathologic condition even though it is used at the same time within chewing system, the responses are not always similar, it is because of the differences of criteria, intensity, and duration and stimulus.

The result of the study between control group and one-third height short lower face with normal overbite group does not show a significant decrease of mastication, it can be caused by an adaptive condition from kids' mastication adaptation towards the difference of volume and food consistency that gets more improved as they grow.25-27 In one-third height short lower face with normal overbite group, there is still an anterior guidance needed in mandibula movement to lateral.10

Yet, the results of the study between control group and one-third height short lower face with deep bite group show a statistically significant decrease of mastication performance. It is because in deep bite condition kids have overbite that is bigger than one-third initial that will cause mandibula anterior teeth to get locked by maxilla anterior teeth thus it cannot do protrusive movement with anterior guidance which later will form posterior interference, it is the contact of non working side posterior teeth. This will make it hard for mandibula to move into lateral and it can disturb face crushing and grinding. Normally, when protrusive movement with anterior guidance takes place, there is no contact between posterior teeth. Chewing process is so disturbed that causes mastication process imbalance. Besides, mandibular condyles press the temporomandibular joint that makes mastication muscle work more than its capacity and later cause muscle tiredness and the imbalance of mastication system.10,28 This is in line with the study conducted by Robert L. Lee18 that states kids with deep bite occlusion suffer from strain and tiredness of face and chewing muscle because they have a higher activity of muscle rather than kids with normal occlusion.23

Mastication steps are divided into anterior movement and lateral mandibula movement. Food in mouth will be chewed with a lot of lateral mandibula movement and it will decrease as the food is chewed. The total of mandibula lateral movement depends on food consistency. Hard food will cause the mandibula lateral movement to get faster, but if the food is soft, the movement will get slower that makes the food not destroyed.10 The change of food pattern to soft food will cause mastication muscle not to work as its function. It will later influence the growth of face and decrease the function of mastication.6 However, there are other factors such as mastication muscle activityi,20 biting power,22 masetere muscle thickness,29-31 numbers of chews, numbers of occlusal contact, and malocclusion that influence the mastication performance.24,25

Research in kids of one-third height short lower face shows two occlusion conditions in anterior, they are normal overbite and deep bite. The measurement of mastication performance in the two conditions is that the mastication performance of one-third height short lower face with

normal overbite group does not show any significant decrease, meanwhile one-third height short lower face with deep bite group shows a statistically significant decrease. Yet, the difference of mastication performance of one-third height short lower face with normal overbite group and deep bite group is not significant.

CONCLUSION

Based on the result of the study, it can be concluded that children with short of one-third height lower face with normal overbite do not decrease their mastication performance.

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