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Research Report

Effects of strong bite force on the facial vertical dimension of pembarong performers

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ABSTRACT

Background: *A pembarong performer is a reog dancer who bites on a piece of wood inserted into his/her mouth in order to support a 60 kg Barongan or Dadak Merak mask. The teeth supporting this large and heavy mask are directly affected, as the strong bite force exerted during a dance could affect their vertical and sagital facial dimensions.* ***Purpose:*** *This study aimed to examine the influence of the bite force of pembarong performers due to their vertical and sagital facial dimensions.* ***Methods:*** *The study reported here involved fifteen pembarong performers and thirteen individuals with normal occlusion (with specific criteria). The bite force of these subjects was measured with a dental prescale sensor during its centric occlusion. A cephalometric variation measurement was subsequently performed on all subjects with its effects on their vertical and sagital facial dimensions being measured.* ***Results:*** *The bite force value of the pembarong performers was 394.3816 ± 7.68787 Newtons, while the normal occlusion was 371.7784 ± 4.77791 Newtons. There was no correlation between the bite force and the facial sagital dimension of these subjects. However, a significant correlation did exist between bite force and lower facial height/total facial height (LFH/TFH) ratio (p = 0.013). Conversely, no significant correlation between bite force and posterior facial height/total facial height (PFH/TFH) ratio (p = 0.785) was detected. There was an inverse correlation between bite force and LFH/TFH ratio (r = -.464).* ***Conclusion:*** *Bite force is directly related to the decrease in LFH/TFH ratio. Occlusal pressure exerted by the posterior teeth on the alveolar bone may increase bone density at the endosteal surface of cortical bone.*

Keywords: *bite force; facial vertical dimension; pembarong*

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INTRODUCTION

The pattern of human growth and development differs from one individual to another. Facial growth, for instance, can be easily identified if linked with craniofacial shape. Vertical facial growth can also be influenced by many factors, including facial and masticating muscle function. These soft tissues play a role in determining the shape and morphology of the face itself.[1]

Bite force can be defined as a force applied by the masticating muscles in dental occlusion resulting from the combined force of the various components within the masticatory system which acts on individual teeth. Bite force is also considered to be an indicator of the functional state of the masticatory system due to the activities of the masseter, medial pterygoid and lateral pterigoid muscles, as well as the biomechanical jaw and biomechanical reflex. Thus, bite force value varies from one individual to another depending on many factors, leading to changed face height and dental status. An increase or decrease in face height dimension due to bite force may be influenced by several factors, such as age, gender, and periodontal tissue condition.[2]

Bite force may also serve as an indicator of masticatory function and tooth load.[3] The presence of bite force and the role of the mastication muscles have the potential to alter craniofacial shape, especially with regard to alveolar bone mass and the thickness of the mandibular.[4,5] In addition, bite

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force can affect facial morphology through the development of a condition in which anterior facial height appears lower than that of its posterior counterpart.[6] Chewing pencils, pacifiers, and other hard objects may cause dento-facial disorders. The force with which hard objects are bitten is considered to be mechanical in nature and one inducing alveolar bone changes.[7]

Reog Ponorogo is a culture originating in East Java more precisely the Ponorogo district. The pembarong performer who bites the 60 kg mask (Figure 1) during a performance may, unfortunately, find his facial height affected by this habit.[1,7]

In producing position treatment results, an orthodontist should have knowledge of an individual's bite force which provides information about facial morphology and influences the choice of the most appropriate type of mechanic for the subsequent selected treatment. In addition, a strong bite produces vertical force affecting the maintenance period of a malocclusion, especially with the use of class II elastics. This negates the orthodontic force but further improves the bite force during mastication.[8] The study examined, using cephalometric methods, the strong bite force of pembarong performers that has potentially influenced their facial development.

Figure 1. Barongan (A) with cakotan, a wooden board (B), the 60kg tiger mask that bite by a pembarong performer

MATERIALS AND METHODS

Twenty-eight patients, consisting of fifteen pembarong performers and thirteen subjects, served as the control group. Before the study was conducted, an ethical fit test was carried out on the team in accordance with the research ethical code of the Faculty of Dental Medicine, Universitas Airlangga, Surabaya. This research was then conducted at the Clinic of Orthodontics, Faculty of Dental Medicine, Universitas Airlangga.

The criteria applied to the pembarong performers consisted of their being male, aged between 25 and 40 years, with at least 3 years' professional experience of delivering 12-24 reog shows annually. The control group criteria were those of being male, 25-40 years old, demonstrating Angle's class I malocclusion (i.e. light tight, without bilateral or unilateral molar mutilation, no deep or open bite, no root canal region treatment, no bruxism, and no abnormal TMJ).

A value for the bite force during centric occlusion was obtained using a modified sensor dental prescale (Tekscan Inc., South Boston, Massachusetts). Bite force values were measured by asking subjects to bite down three times on a rubber-coated sensor at 30-second intervals. The mean value of the bite force was then calculated.[3]

The cephalometric analysis of vertical dimensions was undertaken by calculating the ratio of the linear distance measurement of the anterior facial height (N-Me) to the posterior facial height (S-Go). The lower facial height measurement represented the distance from the palatal plane (ANS-PNS) to the Me point (Figure 2). All measurements were collected using a ruler (mm) and a ratio of 100%.

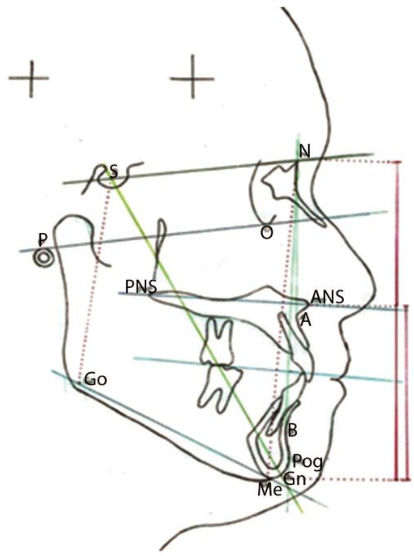

Figure 2. Cephalometric landmark points of the subjects (S, N, ANS, PNS, P, Go, Gn, Me).

The lateral cephalogram measurements for the pembarong performers and the control were processed using Statistical Product and Service Solution (SPSS) Sofware version 17 (IBM Company, Armonk, New York, AS). The data was then analysed by means of a Kolmogorov-Smirnov test to ascertain its distribution. At the next stage, an independent t-test was carried out to identify potential differences between the pembarong performers and the control group. A correlation test was subsequently conducted to determine the effects of bite force on cephalometric variation measurement.

Bite force value is specific to each individual depending on his or her day-to-day activities. The bite force of pembarong performers (n=15) and control (n=13) were measured, the purpose being to compare the effects of bite force on the cephalometric variation measurement of the pembarong performers with those of the control. The tools used to measure the bite force were calibrated at the Department of Material and Metallurgical Engineering, Faculty of Industrial Technology, Institute of Technology Surabaya. The calibration equation obtained was Y = 438-3.421X with Y representing bite force (Newton) and X the resistance (ohms).

The variables of bite force were SNA, SNB, ANB, Y-axis, MP-PP, MPA, Wits Apraisal, PFH/AFH ratio, and LFH/TFH ratio. All were normally distributed, resulting in homogeneous data with a p value >0.05. A difference test was subsequently conducted on each variable.

RESULTS

The average value bite force of the pembarong performers was 394.3816 Newtons, while that of the control group stood at 371.7784 Newtons. The cephalometric measurement indicated that there was no correlation between bite force and SNA, SNB, ANB, Y-axis, MP-PP, MPA, Wits appraisal, as well as PFH/TFH ratio (all p values were >0.05). However, correlation did exist between bite force and LFH/TFH ratio (p = 0.13). The correlation coefficient (Pearson) obtained was -.464 confirming the existence of an inverse correlation between bite force and LFH/TFH ratio. In other words, if the bite force value is significant, then the LFH/TFH ratio will be small.

In addition, the regression model of LFH/TFH was 124.756-0.197 (bite force). This indicates that the LFH/TFH ratio can be identified based on the regression constant of 124.756 - 0.197 (bite force obtained). Consequently, the ratio of LFH/TFH can be measured only by identifying the value of bite force and vice versa.

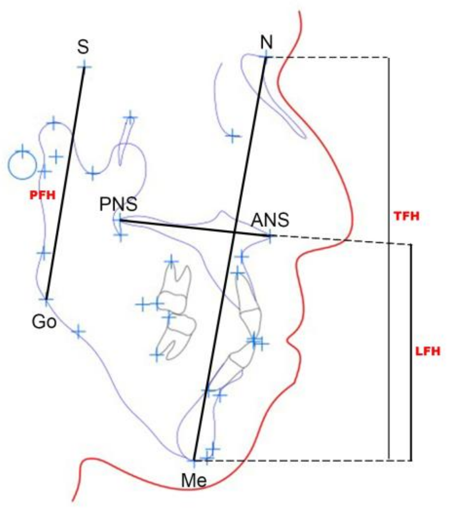

Figure 3. PFH of the pembarong performer (left) was shorter than that of the control group (right).

DISCUSSION

Bite force is usually employed as an indicator of masticatory function and tooth load, which is relatively and clinically measurable.[3] The average value of bite force of the pembarong performer was 394.38 Newtons, while that of the control group was 371.78 Newtons. Nanda and Kapila similarly found there to be a considerable contrast in bite force with the normal occlusion of 423.27 ± 113.92 Newtons.[9] This discrepancy depends on racial type since the Caucasian race, for example, differs from its Deutro-malay counterpart. The former has different social habits and facial patterns that have endured over a long period. For

Table 1. Mean, standard deviation (SD), and significance values (p) of the bite force of pembarong performers and control based on results of the t-test

Maximum bite force	N	Mean	SD	p
Pembarong	15	394.3816	7.68787	.000
Control	13	371.7784	4.77791	

Table 2. Results of the correlation test with Pearson values (r) and significance values (p)

No.	Variables	Correlation Test	
		r	p
1	SNA	-.74	.707
2	SNB	-.126	.523
3	ANB	.057	.774
4	Y-axis	.136	.491
5	MP-PP	.108	.583
6	MPA	.044	.823
7	Wits Ap	.198	.313
8	PFH/AFH	.054	.785
9	LFH/TFH	-.464	.003

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instance, the cranial-facial morphology of the Inuit features hypertrophy of the muscular mass in the mandibular angular region due to their dietary patterns.[10] Other differences result from the sensitivity and accuracy of the measuring instrument employed.[2]

The bite force of the pembarong subjects studied was significant due to their habit of biting down on the support incorporated into a 60 kg barongan and dadap peacock mask during dances and exercise. Bite force that is exerted comparatively often with a specific frequency in normal daily functions will result in a relatively constant value.[8]

The complex dentofacial growth system is related to three components, namely; muscle function, skeletal growth, and tooth development.[4] Biting a mask weighed 60 kg can lead to excessive muscle contractions in the face, neck, and teeth. When a pembarong performer bites the mask, the bones of his head and face areas will be subjected to considerable pressure due to the excessive contraction of the facial muscles (temporal, masseter, bucinator, oral floor muscles). The resulting facial and head muscle function will then interfere with and hinder normal bone development which results from the stimulation of muscle function forwarded to the bone.[1] Masseter and temporalis muscle contractions occur unilaterally when biting with maximum force.[11]

There was no significant difference in the ratio of the posterior facial height - the anterior facial height between pembarong performers and the control group.[1] The low correlation between bite force and the anterior-posterior facial height ratio indicates that bite force does not directly affect the cephalometric variation measurement.[8]

There was a significant difference in the ratio of LFH/TFH (Figure 3). The posterior facial height of the pembarong performer was shorter than that of the control group. This is possibly due to tooth wear leading to shortening of the posterior facial height. Bite force affects the shortening of muscle mass.[2] Bite force will generate constant occlusal force, resulting in the incisors appearing elongated and the overbite increasing, as a consequence shortening the posterior facial height.[8] Moreover, individuals with shorter faces tend to exert greater bite force than that of those with longer faces. This difference is statistically significant because of the increase in the tooth occlusal contact area in short-faced people.[12]

Powerful bite force will probably render the LFH/TFH ratio slight because of the compactness of the microscopic alveolar bone structure. Therefore, the bite force will induce pressure in the surrounding alveolar bone. Under normal circumstances, a physiological regulation occurs within the bone, with pressure side osteoclasts being formed directly on the periodontal ligaments.[4] Moreover, the power applied when biting something is more than the normal average capacity. This can lead to bone atrophy due to an increase in bone remodeling and inhibition of the formation of osteoblasts, with the result that the trabecular bone may disappear and the thickness of the cortical bone may increase starting with the endosteal surface.[10] Similarly, reduced alveolar bone trabecular density will occur in persons with a powerful bite force.[13,14]

A significant correlation also existed between bite force and alveolar bone thickness during mastication (during the alveolar bone remodeling phase). Therefore, if the mastication function proves adequate, the development of the mandible, especially the alveolar bone, will be stimulated.[4] High pressure during the mastication process will then improve bone remodeling. The pressure along the bone generated by the bite force, decreasing from the cervical to the tooth root, can reduce the thickness of the alveolar bone.[4]

In conclusion, bite force, while having no effect on the sagittal dimension, does affect the vertical dimension. There is bite force impact on the LFH/TFH ratio, namely a negative correlation. The more powerful the bite force, the smaller the LFH/TFH ratio will be. This means that the posterior facial height will be smaller due to the shortening of alveolar bone mass.

REFERENCES

1. Goenharto S, Usman P. Perbedaan tinggi wajah pembarong dan bukan pembarong pada kesenian reog Ponorogo. Maj Ked Gigi (Dent J). 2003; 36(2): 42–4.
2. Koc D, Dogan A, Bek B. Bite force and influential factors on bite force measurements: a literature review. Eur J Dent. 2010; 4(2): 223–32.
3. Bakke M. Bite force and occlusion. Semin Orthod. 2006; 12(2): 120–6.
4. Lemos AD, Gambareli FR, Serra MD, Pocztaruk R de L, Gavião MBD. Chewing performance and bite force in children. Brazilian J Oral Sci. 2006; 5(18): 1101–8.
5. Thongudomporn U, Chongsuvivatwong V, Geater A. The effect of maximum bite force on alveolar bone morphology. Orthod Craniofac Res. 2009; 12(1): 1–8.
6. Ash MM, Ramfjord S. Occlusion. 4th ed. Philadelphia: W.B. Saunders Company; 1995. p. 87-8.
7. Salzman JA. Orthodontics in daily practice. Pennsylvania: Lippincott Williams and Wilkins; 1974. p. 75-6.
8. Braun S, Bantleon HP, Hnat WP, Freudenthaler JW, Marcotte MR, Johnson BE. A study of bite force, part 1: Relationship to various physical characteristics. Angle Orthod. 1995; 65(5): 367–72.
9. Nanda R, Kapila S. Current therapy in orthodontics. St Louis-Missouri: Mosby Elsevier; 2010. p. 227-35.
10. Graber TM, Vanarsdall RL. Orthodontics : current principles and techniques. Missouri: Mosby Inc; 2000. p. 663.
11. Bakke M, Michler L, Han K, Möller E. Clinical significance of isometric bite force versus electrical activity in temporal and masseter muscles. Scand J Dent Res. 1989; 97(6): 539–51.
12. Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics. 4th ed. St Louis-Missouri: Mosby Elsevier; 2007. p. 151.
13. Braun S, Bantleon HP, Hnat WP, Freudenthaler JW, Marcotte MR, Johnson BE. A study of bite force, part 2: Relationship to various cephalometric measurements. Angle Orthod. 1995; 65(5): 373–7.
14. Kamegai T, Tatsuki T, Nagano H, Mitsuhashi H, Kumeta J, Tatsuki Y, Kamegai T, Inaba D. A determination of bite force in northern Japanese children. Eur J Orthod. 2005; 27(1): 53–7.

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