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Maximum Opening and Closing Forces Exerted by Diverse Skeletal Types

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Skeletal open and closed bite individuals present significant differences in diagnosis, treatment planning and prognosis in present day orthodontics. The differences in the closed bite patient include, a proportionally over developed posterior facial height (Björk 1960), proportionally greater upper anterior facial height (Sassouni 1969), a deficiency in alveolar height (Schudy 1964), and a small gonial angle (Proctor and DeVincenzo 1970). The anatomical variations in these diverse skeletal patterns are well understood, but the etiology is basically unknown.

There is a paucity of data regarding quantitative muscle function differences between skeletal open and closed bite individuals. According to Rowlett (1932 and 1933), the construction and use of gnathodynamometers for measuring the biting forces date back to 1681 when Borelli, in Italy, devised an apparatus and recorded about 430 pounds of bite strength. Sassouni (1969) reported that skeletal open bite patients had a closing force betweeen 50 to 80 pounds, whereas, closed bite patients had between 150 to 200 pounds of force. Although considerable interest has ben shown in the measurment of forces exterted during mastication with natural and artificial dentitions, no measurments documenting the opening forces of the mandible have ben found in the literature.

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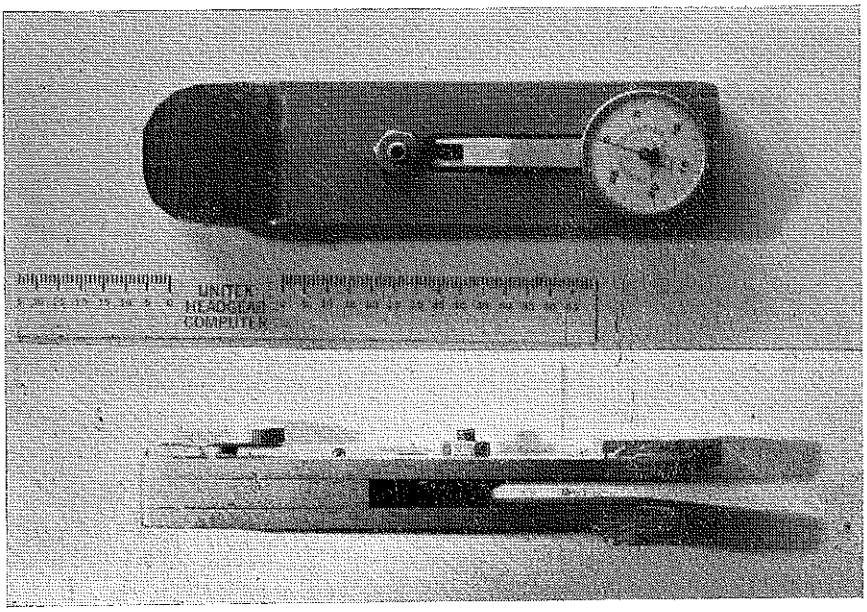
The purpose of this investigation is to quantitate and compare the opening and closing forces in a selected sample of skeletal open and closed bite individuals.

Material and Methods

Twenty-three skeletal open bite and twenty-one skeletal closed bite individuals were selected in this study. Selection for the closed bite group was made on the basis of a sella nasion mandibular plane angle of 25 degrees or less while the open bite class had values for this angle of 42 degrees or greater.

An apparatus called a gnathodynamometer made of Ortho International Service, Inc. for Viken Sassouni was used to measure closing forces (figures 1 and 2).



Figures 1 and 2.

To measure opening forces, an apparatus consisting of a scissors jack, a foam pad and a standard bathroom scale was utilized (figure 3).

A sensitive Detecto Scale, made by Higgin Scales, Inc., Los Angeles, was used in order to determine the accuracy of the bathroom scale and the gnathodynamometer.

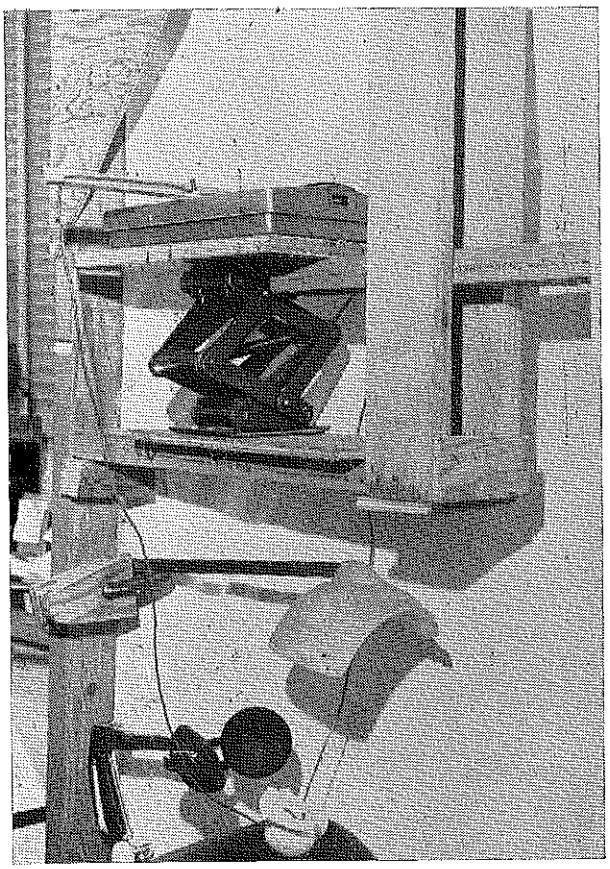


Figure 3.

The gnathodynamometer was placed in the mouth so that the long axis was parallel to the occlusal table on the side where the biting force was measured (figure 4). It was positioned bucco-lingually so that the middle of the appliance laid over the central groove of the upper molars and extended to the distal surface of the upper first molar. The patient was instructed to bite the appliance as hard as possible and this procedure was performed, alternating between right and left sides, six times. An average of measurments of each side recorded as final right and left readings.

The patient was seated in the dental chair so that the inferior border of the mandible was parallel to the floor. The patient was

Figure 4

asked to clench the teeth, and the masseter muscle was palpated to determine its anterior surface. The foam pad was positioned under the inferior border of the mandible so that the most anterior portion

of the pad corresponded to the anterior surface of the masseter muscle. Increasing increments of force were applied untill the subject could not open his mouth. The greatest force at which late opening was possible recorded. The data was analyzed by the computer to find out the mean and standart deviations. Tests of significance were computed in order to determine if the mean differences was sifgnigicant between recorded variables. Significance was indicated by $P<0,05$, borderline significance by $0,05<P<0,01$ and results with a $P>0,10$ were considered nonsignificant. A linear correlation analysis was performed to determine the association among the measured forces and also among age with these forces.

Results and Discussion

Taylor (1936), Waugh (1937), Worner and Anderson (1944) stated that biting strees sems to be greater in males than females. However, Brawley and Sedwick (1940) did not find any difference between measured biting forces for males and females. Shiere (1955) found that there was no stastitical significant relationship in the masticatory performances between the sexes. In this research it was observed that, male subjects tend to produce greater readings than females. A possible explanation for the geater applied forces in males is the stronger muscular and skeletal development and more aggressive and dominant characteristic tendencies exhibited by them.

Brawley and Sedwick (1940) stated that the values for biting pressure showed a gradual increase with age. However, White (1967) found that age was not significantly correlated to maximum biting pressure, as well as with opening forces for each skeletal type. A reasonable assumption for this report could be that the cranial and facial muscles have more influence on the skeleton in younger aged subjects than older aged subjects. Psycologically, younger aged groups would not be fearful of breaking a tooth when recording a maximal force. Whereas, the older age group might let this become a factor during maximal biting.

There was no significant differences in biting values when comparing right and left sides of sekeletal types. A logical answer for this report might be a similar skeletal or muscular pattern, or

both, as Well as the same masticatory habits for each side in these skeletal types.

The maximum opening forces of the diverse skeletal groups revealed a nonsignificant difference, whereas, the average closing forces presented a significant difference. Probably infrahyoid and suprahyoid muscles are the same in strength or tonus in both skeletal groups. However, masticatory muscles possibly are stronger with closed bite subjetcts than with open bite subjects.

Skeletal open and closed bite types showed a significant difference and a strong correlation between the average closing forces and opening forces. This is probably due to strong muscles of mastication in comparison to weak suprahyoid and infrahyoid muscles in both skeletal types.

In reference to the above mentioned data, some mention must be made as to the slight variations in the results and the significant relationship obtained. No matter now accurate the gnathodynamometer was constructed, there probably might be a small range of error in its use. The error may be also valid for the appliance that was made for measuring the opening force.

The fingings in this study imply further investigation to obtain greater understanding of skeletal open and closed bite patients.

Summary and Conclusions

An appliance was constructed to measure the maximum opening force, whereas, a gnathodynamometer was utilized to record maximum closing force of 44 subjects. The collected data was analyzed by computer regardless of sex, to determine both the mean and the standard deviation of the opening forces, and the average right and left side closing forces. The data was also computed for the above mentioned variables to find out the mean and the standard deviation for both sexes. The student's t test was utilized to determine if there were any significant differences in the before mentioned variables. A linear correlation analysis was made using data of age and measured forces to see if a relationship existed.

The following conclusions were obtained from this investigation.

1) Right side and left side for each skeletal type did not show any important difference.

2) Each skeletal type exhibited significant positive correlation between maximum opening and closing forces.

3) Skeletal open and closed bite subjects did present significant diffrences in measuring the maximum opening and closing forces.

4) Maximum biting and opening forces tend to greater in males than females, but the results were only of bordeline significance.

ÖZET

Toplam 44 olan iskeletsel hypodivergent ve hyperdivergent kişilerde maksimum ısırma gücünü bulmak için gnathodinametreden ve maksimum ağız açma kuvvetini tespit etmek için de özel bir aygıttan yararlanıldı. Elde edilen sonuçlar, elektronik beyinle çözümlendi. Bu suretle cinsiyet göz önüne alınmadan ağız açma gücünde, sağ ve sol ısırma güçlerinin ortalaması ve standard deviasyonları saptandı. Aynı işlem cinsiyet dikkate alınarak tekrarlandı. Bundan sonra bahsedilen bu değişkenler arasında bir farkın bulunup bulunmadığını saptamak için de manalılık testi «test of significance» uygulandı. Son olarak yaş ve ölçülen değerler arasında bir ilişkinin bulunup bulunmadığı «doğrusal korelasyon» analizi ile tespit edildi.

Araştırmada elde edilen sonuçlar:

1 — Her iki iskeletsel tipte maksimum sağ ve sol ısırma gücü arasında bir fark yoktur.

2 — Her iki iskeletsel grupta maksimum ağız açma ve kapama kuvvetleri arasında pozitif bir orantı vardır.

3 — skeletsel divergent tipli kişilerin ağız açma ve kapama güçleri arasında belirli farklar mevcuttur.

4 — Erkekler, kadınlara nazaran, ağız açma ve kapamada $0,05 < P < 0,10$ sınırları içinde (Borderline significance) bir fark göstermektedirler.

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