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Research Article

Size of Balkwill Angle. A Cephalometric Study

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Abstract

The Bonwill's triangle, the height of the triangle and Balkwill angle have used in attempts to construct dental articulators capable of reproducing mandibular movements.

This study was carried out at the Department of Dentistry at the National and Kapodistrian University of Athens. We used for this investigation x-rays of patients with Class I and Class II malocclusion. The population of this study was twenty five adolescents (10 - 19 years old).

The results showed that the mean value of the Balkwill angle for the patients with Class I was 20,82°. The mean value of the Balkwill angle for the population with Class II was 26,64°. Our results show that there was a difference of size of the angle between the two populations. The difference was statistically significant ($p < 0,001$).

Keywords: *Bonwill's Triangle; Balkwill Angle; Cephalometric Study*

Introduction

It is known that lines joining to the midpoints of the mandibular condyles and incisor point form an equilateral Bonwill triangle. The Balkwill angle is formed between the imaginary occlusal plane and the imaginary plane of the Bonwill triangle [1].

Monson refereed a condylar inclination of 35 degrees and a Balkwill angle of 15,5 degrees. These angles didn't coincide with the average values found by Gysi and Balkwill. The condylar inclination was 30 degrees and 26 degrees for the Balkwill angle [2].

In 1866 Balkwill measured craniometrically the angle manned after him in a few mandibles and found a mean value of 26 degrees.

In 1950 Bergström measured the Balkwill angle in profile X-rays of crania and found an average value 18 degrees [3].

The variations of this angle influence the cusp angulation or the inclination of cuspless posterior teeth in complete dentures [4].

Köhler's study referred 21 degrees for Balkwill angle. Hart's study recommended 20 degrees and Bergström evaluation was 18 degrees [1].

A Balkwill angle of 25 degrees has been recommended for the usage with some European articulators, for instance, the Artex made by Girrbach from Germany, and the Ivoclar from Lichtenstein. However, the German made Kavo and the Japanese made Spacy, articulator, recommended Balkwill angle 20 degrees [5]. From geometrical point of view, Balkwill angle also takes part and influences to cusp height and occlusal form of the tooth [6]. Until these days Bonwill's triangle has been related for the correct mounting of the complete dentures and the construction of the articulators [7,8].

The calculation of cusp angulation for complete dentures is based on the Christensen phenomenon and depends on the Christensen angle.

The formula for the Christensen angle is sine [β + φ) +γ] = sine (β=φ) p/a sine β. Where:

β = Is the inclination of the condylar guidance

φ = Is the Balkwill angle

γ = Is the Christensen phenomenon

p = Is the length of protrusion

a = Is the height in the Bonwill triangle [7].

Dr. Christensen showed that the Balkwill angle was equal to the inclination of the condylar guidance (β = φ) [7].

It has been reported that was no study in world literature that relates Angle's Class with Bonwill triangle and Balkwill angle. Edward Angle, who is considered the father of modern orthodontics, he was the first to classify malocclusion. The classification was based on the relative position of the permanent maxillary first molar. Angle's classification created the following three groups:

a) Angle's Class I Neutrocclusion

b) Angle's Class II Distocclusion (overjet)

c) Angle's Class III Mesiocclusion (negative overjet).

The aim of this investigation was to examine the natural bandwidth of the parameters describing articulation. The Balkwill angle is of them [9].

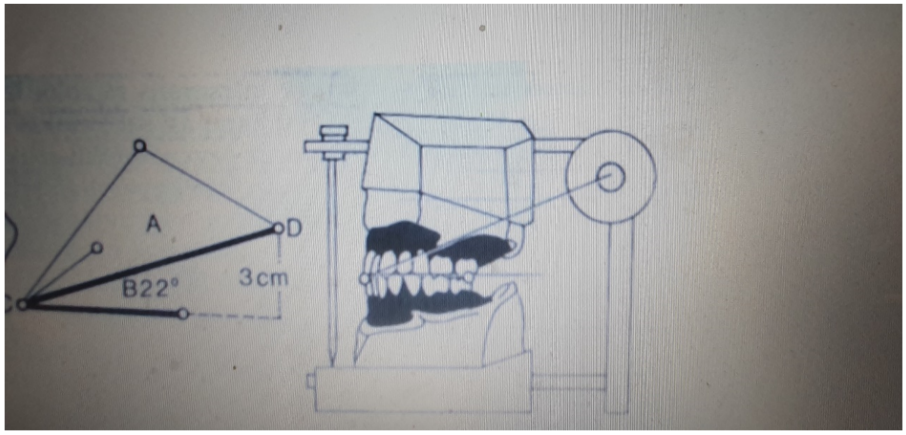

Figure 1: *Shows complete dentures mounted in an average position (Balkwill angle and Bonwill's triangle).*

Materials and Methods

Our study was carried out at the Department of Dentistry at the National and Kapodistrian University of Athens. The lateral cephalograms of patients were collected by the Department of Orthodontics of the Dental School.

Overall 25 lateral cephalograms of patients with Class I and 25 lateral cephalograms of patients with Class II were examined. The population of this study was adolescents (10 - 19 years old). More specifically, there were 13 Females and 12 Males. The measurements of Balkwill angle were taken by three examiners. The examiners did not have knowledge of the size of the angle as measured by the other examiners. Two of the examiners were orthodontists and one was the dentist. The orthodontists have previous experience in angle measurement using the radiograph and the dentist had little previous experience but was trained by the orthodontists.

The Balkwill angle was formed by imaginary plane of the Bonwill triangle and the imaginary occlusal plane. This occlusal plane was designed by the incisors and the distobuccal cusps of the mandibular second molars.

The purpose of this study was to measure the size of the Balkwill angle in the lateral cephalogram were taken in patients with Class I and Class II malocclusion.

Results

The data constitute two independent random samples. One from population of patients with Class I and the second sample was patients with Class II malocclusion. We assume that the size of Balkwill angle was normally distributed in both populations. The population variances were unknown and unequal.

N ($n_1 + n_2$)	Mean	Std. Dev
$n_1 = 25$	20,82	1,580
$n_2 = 25$	22,64	2,086

Table 1: *Distribution of Balkwill angle for patients with class I and class II.*

We assumed 95 percent confidence interval, 1 - 0,5/2 = 0.975 and degreed of freedom 48. $t_{0.975,48} = 1,960$.

Hypothesis: $H_o: \mu_1 = \mu_2$, $H_A \mu_1 \neq \mu_2$. We had a two-tailed test. We observed that the lower limit 0.3454 was negative and 1,7054 positive. Thus, zero included in the interval. We rejected the null hypothesis $\mu_1 = \mu_2$. The size of Balkwill angle for Class I was different for the size of the Balkwill angle for Class II.

We can conclude that on the basis of these data, there is an indication that the two population means are not equal.

Discussion

An articulator is a mechanical tool for establishing the relationship between the upper and lower jaws. An articulator stimulates the patient's jaw movement and the position is used by the dentists to determine the occlusion of removable and fixed prostheses [10].

In 1866 Balkwill measured craniometrically the angle named after him in a few mandibles. He found a mean value of angle 26 degrees [1].

In our study the size of this angle for the patients with Class I was 20,82 degrees with a range of 17 degrees to 24°. The mean value of this angle for the patients with Class II was 26,64 degrees with a range of 17° to 26°.

A morphometric study on the position of TMJ showed that the mean value of the Balkwill angle was 20,4 degrees with a range of 9 degrees to 27,6 degrees [6].

We showed the mean value of Balkwill angle for Class II was 26,64° with a range of 17 degrees to 26 degrees, in our cephalometric investigation. Other studies showed that the mean value of the angle for the patients with Class II was 17° to 25°. In 1982 some investigators measured the size of various Balkwill angles. They showed that the measurements for this angle for female were 23 - 37°. The difference of 3 - 11° was statistically significant ($p < 0,001$). In male Balkwill angle I was a mean value of 25 - 59°. The corresponding value for Balkwill angle II was 21,55° [1,5].

There was a difference of mean value of Balkwill angle of our measurements with the results of the other studies. It was related to the condylar reference points.

In our study the measurements of the size of Balkwill angle was related to the Classification of Class I and Class II. The other studies, the measurements were independent of this classification. The investigators didn't take into account this parameter. Our results showed that there was a difference of sizes of the angle between the two populations. This difference was statistically significant ($p < 0,001$).

Conclusion

Based on this research study the following conclusions were drawn:

1. The measurements of the size of Balkwill angle were related to the Classification of jaw Class I and Class II.
2. Considerable differences of sizes of Balkwill angle were found between the two groups ($p < 0,001$).

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