



Correlation of Mandibular Angle and Malocclusion with Hand Grip Strength in Vertical, Horizontal and Average Grower

Akshata Awachat ^{a*} and Vikrant Jadhav ^{a#}

^a *Department of Orthodontics and Dentofacial Orthopedics, Sharad Pawar Dental College, Datta Meghe Institute of Medical Sciences, Sawangi (M), Wardha, India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Study Protocol

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ABSTRACT

Background: An orthodontic treatment focuses on improving an individual's facial esthetics and functional occlusion via improved chewing patterns, muscular power, increased force, and occlusal contact area through a more efficient masticatory function. Every decision made during orthodontics treatment will be influenced by the patient's growth pattern and /or muscle strength.

Objectives: To evaluate the gonial Angle in vertical, horizontal and average grower, to evaluate the hand grip strength in vertical, horizontal and average grower and to correlate between gonial angle with hand grip strength in vertical, horizontal and average growth pattern.

Methodology: We will study a patient group undergoing orthodontics treatment with vertical, horizontal, and average growth patterns in the Orthodontics Department at Sharad Pawar Dental College and Hospital in Sawangi (Meghe), Wardha District. The calculated sample size of the study will be 196, under criteria 49 for vertical, 49 for horizontal, and 98 for the average growth pattern. Both male and female norms for the value are to be evaluated based on the value.

Expected Results: Hand grip strength is to be compared between average, horizontal and vertical growers. Hand grip strength would be inferior in the large gonial angle group compared to the small gonial angle group. Gonial angle is the most conspicuous determining factor of Hand grip strength. Assessment of growth pattern has a vital role in diagnosis and treatment planning.

Lecturer;

*Corresponding author: E-mail: awachat24akshata@gmail.com;

Conclusion: In the present study it will be an attempt to analyze effectiveness of gonial angle in vertical, horizontal and average growth pattern patients compared with hand grip strength. Subject with large and small gonial angle groups using cephalometric radiograph shall be assessed with hand grip strength. A major finding of this study is that gonial angle is one of the key factors for the strength of Hand grips.

Keywords: Hand grip strength; growth patterns; malocclusion; gonial angle; cephalometric radiograph.

1. INTRODUCTION

An orthodontic treatment focuses on improving an individual's facial esthetics and functional occlusion via enhancing chewing patterns, muscular power, increased force, and occlusal contact area through improved masticatory function. Every decision made during orthodontics treatment will be influenced by the patient's growth pattern and /or muscle strength. There is a difference in muscle activity of vertical, horizontal and average grower's which ultimately affect the mandible angle during growth. Horizontal grower has forward growth direction, they are counter-clockwise grower, have hypodivergent facial pattern, and have strong muscular strength. Vertical grower has downward growth direction, they are clockwise grower, have hyperdivergent facial pattern, and have weak muscular strength.

Gonial angle is the point at which the mandibular corpus and ascending ramus meet is called gonion. In men, the angle formed by the corpus and ascending ramus is closer to 90° . In women, this angle is greater, up to 110° - 120° . An assessment of a person's age can also be greatly aided by the gonial angle. The downward rotation of the mandible in backward and downward direction could be described as a high angle, which presented as a patient who displayed an increased gonial angle. In contrast, the upward and forward position of the mandible is referred to as a low angle, and these patients showed a decrease in gonial angle [1]. Consequently, it becomes one of the most necessary factors to consider when designing an orthodontic or surgical plan for a patient. The position of attachment of muscle, muscular strength, and tonicity are the factors responsible for the variations in the form of mandibular growth and degree of gonial angle.

Hand grip strength is recognized as a reliable and efficient method for measuring physical function and is combined with muscle strength [2]. In this study, we will be focusing on the relationship between mandibular angle (gonial angle) and hand grip strength to evaluate the

effects of muscle strength on the growth of the mandible and gonial angle.

2. OBJECTIVES

a) To evaluate the gonial Angle in vertical, horizontal and average grower. b) To evaluate the hand grip strength in vertical, horizontal and average grower. c) To correlate between gonial angle with hand grip strength in vertical, horizontal and average growth pattern.

3. METHODS

3.1 Study Design

Prospective and observational study.

The present study will be conducted in the Orthodontics Department at Sharad Pawar Dental College and Hospital in Sawangi (Meghe), Wardha District, on patients undergoing orthodontics treatment having vertical, horizontal, and average growth patterns.

3.2 Inclusion Criteria

The inclusion criteria for the sample will be

- a) Both male and female,
- b) 18 years and above age group people of vertical/horizontal or average growth pattern,
- c) Presence of malocclusion,
- d) Complete absence of syndrome involving abnormality of muscular or maxillofacial morphology such as cleft lip and / or cleft palate,
- e) Absence of injuries to the upper limbs,
- f) Complete availability of required data.

3.3 Exclusion Criteria

The excluding criteria for the sample will be

- a) Diseased and syndromic patient,
- b) Presence of symptoms of temporomandibular dysfunction including pain.

Participants in this study must meet the inclusion and exclusion criteria to be eligible to participate.

3.4 Preoperative Screening and Evaluation

Lateral Cephalogram of the ongoing patients will be evaluated for the gonial angle measurement in vertical, horizontal and average growth pattern [3]. The gonial angle will be calculated at the point of contact between the ramus plane and the mandibular plane. The subject will be categorized by the average mean value of each Cephalogram value into two groups (Small gonial angle group and large gonial angle group) and Hand grip strength measurements will be compared between the two groups. Hand grip strength will be calculated as a measure of muscle strength and will be measure using a hand grip Dynamometer. The Hand grip strength with one hand on either side will be measured twice seated; the average value will be taken into account in the analysis.

3.5 Data sources/ measurement

We will study a patient group undergoing orthodontics treatment with vertical, horizontal, and average growth patterns in the Department of Orthodontics and Dentofacial Orthopedics at Sharad Pawar Dental College and Hospital, Sawangi (Meghe), Wardha.

Variables: Mandibular angle, Hand grip strength (Right or left), Gender. **Bias:** There is no bias present.

3.6 Study Size

Sample was calculated using an Open Epi, Version 3 using the mean difference from the parent article [4]. The calculated sample size of the study will be 196, under criteria 49 for vertical, 49 for horizontal, and 98 for the average growth pattern. By comparing the value, we can determine whether the data are appropriately matched to female and male norms.



Fig. 1. Hand grip dynamometer

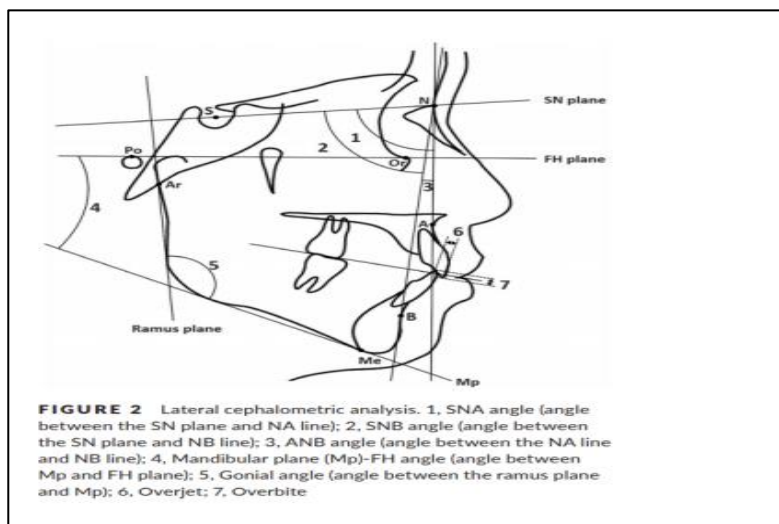


FIGURE 2 Lateral cephalometric analysis. 1, SNA angle (angle between the SN plane and NA line); 2, SNB angle (angle between the SN plane and NB line); 3, ANB angle (angle between the NA line and NB line); 4, Mandibular plane (Mp)-FH angle (angle between Mp and FH plane); 5, Gonial angle (angle between the ramus plane and Mp); 6, Overjet; 7, Overbite

3.7 Statistical Methods

Descriptive analysis and means will be compared using Unpaired T Test and ANOVA.

4. EXPECTED RESULTS

Hand grip strength is to be compared between average, horizontal and vertical growers. Hand grip strength would be inferior in the large gonial angle group compared to the small gonial angle group. Gonial angle is the most conspicuous determining factor of Hand grip strength. Assessment of growth pattern has a vital role in diagnosis and treatment planning.

Descriptive data: Descriptive statistics will be done with the help of frequency, percentage, mean and standard deviation.

5. DISCUSSION

Researchers concluded that gonial angle accounted for the largest segment of variance in HS in the study by NAKAGAWA et al. In people who have a larger gonial angle and a small overbite, crossbite in the molar region, the HS was low. In conclusion, we cannot reject the hypothesis that the morphology of the maxillofacial region or malocclusion is associated with HS. A number of factors are related to HS, including age, sex, height and BMI. There did not appear to be a difference in body height, BMI or age among the large and small gonial angle groups, although there was a marked difference in HS values between them. This indicates that HS was unaffected by sex, height, age, and BMI.

It was found by them that the gonial angle in the maxillofacial structure was related to HS. It was extensively known that there is a relationship among craniofacial morphology, jaw muscle size and MOF. A direct relationship exists among the directions of the muscle such as masseters and temporalis muscles and it is believed that the gonial angle is directly connected to maximum occlusal force. HS and upper and lower limb muscle strength are associated with muscle power, they suggested that MM could have an effect on both MOF as well as muscle mass of the limb skeleton.

It was not possible in this study to show if HS was controlled for skeletal type or whether malocclusion was the only factor. In order to understand which types of malocclusion are connected with HS, more studies need to be

conducted in subjects with the same skeletal morphology [4].

Jean-Yves Hogrel, this study has provided baseline data on maximum grip strength in health state subjects aged five to eighty years of age, and it showed that children and adults have similar maximum grip strengths that varied greatly with hand circumference. Men and women, children and adults, can each be predicted with the same regression-based equation. Comparing individuals may be greatly facilitated by this. This relationship has been discussed previously, as well as its applications.

Using the Jamar dynamometer, maximum grip strength values determined using both adults and children were consistent with previous studies in both groups. It was found that right-hand individuals were significantly dominant on their right side, whereas left-handed persons were not significantly stronger on their left side. Brown et al. noted that left-hand individuals have more muscularity on the right side. Making adaptations to an environment that was designed by and intended for right-handers might be interpreted as an adaptation to an environment that may not be correlated to preferences and performance. Children and adolescents fall into a wide age range due to the restrictions of the present age ranges because major changes typically occur as they grow older and mature. Despite the greater number of participants, the number of subjects in smaller age groups was not statistically significant enough. Although predictive equations are better than norms, they still serve a useful purpose.

Various populations are likely to benefit from measures and monitoring grip strength. The grip strength of a hand can now be measured using a high-sensitivity and precise dynamometer, developed recently. Aim of this study was to generate estimates of maximum isometric grip strength using a new dynamometer (the MyoGrip) to be compared with data obtained with the Jamar device and to develop predictive equations for the study group of normal subjects (children and adults) [5].

According to the study performed by Rubika J, Felicita AS, and Sivambiga V. to examine the calculation of the gonial angle using panoramic radiographs and lateral cephalograms in patients between 6-12 years. In the determination of the gonial angle, the use of panoramic radiography was investigated, and the study revealed

measuring gonial angle taken on the panoramic imaging is an objective and reproducible approach. The deviation on cephalometric viewing is approximately 2.2-2.36 degrees and the variation in the angle calculated by this technique is based on the common and reasonable errors in 0.5-1 degree.

Based on the clinical cephalometric FMA, Rubika et al categorize the samples as horizontal, average, and vertical. Each of these groups had FMAs of $19.6^\circ \pm 0.45^\circ$, $24.93^\circ \pm 0.26^\circ$ and $29.41^\circ \pm 0.25^\circ$, respectively. Vertical growth, horizontal growth, and the average growth pattern of $33.93^\circ \pm 1.32^\circ$ with a significance level of 0.000 and 95% confidence interval, the results were statistically significant. In both vertical and horizontal growth patterns, the higher gonial angle varies from 53.2568° to 57.3432° , while the average gonial angle varies from 52.9738° to 57.3596° . According to the growth pattern, the upper gonial angle is approximately similar horizontally, vertically, and on average. On the other hand, the lower gonial angle is greater in the degree of angular deviation in relation to horizontal, average and vertical growth pattern and could be applied as an analytical tool when understanding growth pattern.

Based on Rakosi, in Caucasian, a normal angle for gonial angle in the case of average growth pattern vary by $128^\circ \pm 7^\circ$ which was somewhat similar to measurements $127.0333^\circ \pm 0.99710^\circ$ and extended up to 124.9940° to 129.0726° . The upper gonial angle recorded an average growth pattern that varied from 52° to 55° . Lower gonial angle was 70° to 75° . This study found that the small gonial angle extended between 69.6812° to 73.3855° and had a mean of $71.5333^\circ \pm 0.90555^\circ$. Compared to the population, this value was lower [1].

The study was conducted by Mathiowetz V. to test the Jamar and Rolyan hydraulic dynamometers, for compatibility and also their accuracy for measuring grip strength in a clinical context. Research findings indicated that the Jamar and Rolyan dynamometers achieved satisfactory parallel accuracy, superior inter-instrument accuracy, and high system stability [2].

In a study by Zouei-Booshehri M, Aghili HA, Abasi M, and Ezoddini-Ardakani F, it seems that lateral cephalograms are not sensitive to side angles as well as panoramic radiography. In addition, the right and left gonial angle scans are

easily measured in panoramic radiography without overlapping anatomic landmarks, which is common on lateral cephalograms. Accordingly, it appears that panoramic radiography, an inexpensive and widely available technique, is an accessible and practical means of determining the ipsilateral gonial angles [3].

Larrazabal-Moron C, Sanchis-Gimeno JA: The study was performed by use of panoramic radiography (orthopantomography), that produces comparable results to lateral radiography, as being applied to as many as 30 young healthy subjects. A sample of young individuals without orthodontic treatment was used for the examinations, which were done out in a masked fashion. Several thirds of the evaluated population will require orthodontic treatment according to Bilgic et al. (2015). There is a possibility that orthodontic treatment may affect gonial angle values as orthodontic treatment is becoming more popular. Consequently, orthodontic treatment outcomes are crucial to both surgeons and orthodontic patients with mandibular hypoplasia to plan reconstructive surgery. Among the age subgroups analyzed, they discovered a significantly inverse correlation between age and gonial angle values, with the young individuals (5–10 years old) having the highest values and the older individuals (26–30 years old) having the lowest values.

Moreover, the study also revealed that women have in comparison to men, at five to ten years of age, the values are much higher. As children aged, the angle values dropped until they were no longer meaningfully different between sexes at eleven to fifteen years old.

Accordingly, there were marked differences between the males and females over 16 years of age. The decline in both males and females, the values of gonial angle seem to decline or stop at around 21 years of age, since the values at 21–25 and 26–30 years of age are about the same. Meanwhile, Upadhyay et al. (2012) found that gender was not significantly different by age group.

The study shows a significant difference between male and female Caucasian Mediterranean values in children under 10 years of age. After 11–15 years, angle values did not vary significantly based on gender, but did decrease. Furthermore, the men older than sixteen years tend to have better scores than the

women, and most importantly, the decrease in gonial angle values appears to stagnate gradually after twenty one years of age. When analyzing human remains, the differences in patterns can be used as a criterion for determining age and gender [6].

6. CONCLUSION

In the present study it will be an attempt to analyze effectiveness of gonial angle in vertical, horizontal and average growth pattern patients compared with hand grip strength. Subject with large and small gonial angle groups using cephalometric radiograph shall be assessed with hand grip strength. A major finding of this study is that gonial angle is one of the key factors for the strength of Hand grips.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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