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Original Article

Assessing the Reliability of Schwarz Analysis for Mandibular Length in South India

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Abstract

Racial, ethnic, sexual, and nutritional variances all have an impact on malocclusion and craniofacial growth in the South Indian inhabitants which is diverse in terms of ethnicity and culture. Therefore, the assessment and diagnosis of craniofacial anomalies depend critically on the availability of standard standards for the local population. The purpose of the study was to evaluate the accuracy of Schwarz's analysis in determining mandibular length in the population of South India. One hundred orthodontic patients' lateral cephalograms were evaluated in this retrospective study. Four age and gender-based categories were created from the sample. FACAD software was used to digitally measure the mandibular body length and anterior cranial base length. Using the formula from Schwarz's analysis, the mandibular body length was calculated. The significance of the calculated and actual mandibular body lengths for the entire sample and the four groups were compared using the Wilcoxon signed-rank test. The significance (p-value) value was set as 0.05. The estimated and actual mandibular lengths did not differ statistically significantly (P-value > 0.05) in mature females or males of any age, but there was a significant difference (P-value < 0.001) in growing females. Under the limitations of the present study, Schwarz's analysis is reliable for estimating mandibular body length in girls of non-growing age groups and males of all ages. Careful use of the analysis is necessary when it comes to expanding females in the South Indian population.

Key words: Schwarz analysis, Mandibular length, Cranial base length, Cephalometrics

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Introduction

The goal of orthodontics is to repair skeletal, muscular, and dental abnormalities to create a functional link between occlusion, muscle function, and aesthetics. Diagnostic aids are used in clinical settings to provide comprehensive orthodontic diagnoses. Orthodontic diagnostic tools fall into two categories: supplemental diagnostic aids and essential diagnostic aids. Clinical aids that are thought to be crucial in every situation are known as essential diagnostic tools. These comprise panoramic, bite-wing, periapical, and periapical radiographs; case history; clinical examination; research models; and facial photos. Additional diagnostic tools aren't always necessary. These include specialized radiographs such as occlusal radiographs, cephalometric radiographs, cone shift technique, cone beam computed tomography, computed tomography, hand-wrist radiographs to assess the age of skeletal maturation, muscle activity electromyograms, endocrine tests, basal metabolic rate estimation, diagnostic setup, and occlusograms [1].

Despite being a supplemental aid, cephalograms are a crucial diagnostic tool in orthodontics [2]. The relationship of the jaws in the anteroposterior, vertical, and transverse planes is frequently evaluated using cephalograms. The vertical and transverse relationship between the jaws is evaluated using postero-anterior cephalograms, while the anteroposterior connection is evaluated using lateral cephalograms [3].

For the patient, the anteroposterior relationship is typically quite important and requires a critical assessment. To diagnose and plan orthodontic treatment, orthopedic treatment, or even orthognathic surgery, a variety of skeletal and soft tissue cephalometric assessments have been documented in the literature [4]. A balanced face with facial harmony can be attained by allocating the skeletal portion according to their actual cephalometric norms [5].

To provide a precise way to evaluate sagittal base discrepancy, researchers have introduced linear and angular measurements [4, 6]. The link between maxillary length, mandibular body length, ramus length, and anterior cranial base length was proposed by Schwarz [7] in 1961. The following mathematical formula was used to describe the relationship:

$$\text{Mandibular body length} = \text{Anterior cranial base} + 3\text{ mm} \quad (1)$$

$$\text{Mandibular ramus length} = 5/7 \times \text{Mandibular body length} \quad (2)$$

$$\text{Maxillary length} = \tfrac{2}{3} \times \text{Mandibular body length} \quad (3)$$

The length of the mandible is important as it is considered one of the most pleasing structures of a face [8].

Previous studies have noted that the craniofacial morphology of various ethnic groups varies [9]. "A nation or population with a common bond such as geographical boundary, a culture or language, or being racially or historically related" is how the term "ethnic group" was defined. Since most research on cephalometric norms is done on Caucasian populations, the standards developed using these analyses might not apply to other racial or ethnic groups [10]. Racial, ethnic, sexual, and dietary variances are known to have an impact on craniofacial growth and malocclusion in the South Indian population, which is rich in ethnicity and cultural diversity [11]. As a result, it is detrimental for the local community to have a common norm for proper diagnosis and treatment planning [12]. Thus, the purpose of this study is to evaluate the validity of the Schwarz analysis for determining mandibular length in the population of South India.

Materials and Methods

This retrospective study was done at the Department of Orthodontics, Saveetha Dental College, Chennai. Pre-treatment lateral cephalograms of 100 patients with orthodontic conditions were included.

The samples were included based on the following selection criteria:

- Subjects with skeletal Class I relation
- Well-balanced facial profile
- No history of previous orthodontic treatment
- No history of trauma or craniofacial surgery
- No history of craniofacial anomalies or syndromes
- Lateral cephalogram of good diagnostic value with referencing scale
- Age > 10 years

The sample was divided into the following four groups based on the gender and age of the subjects.

- Group 1- Male subjects of age group < 20 years.
- Group 2- Male subjects of age group ≥ 20 years
- Group 3- Female subjects of age group < 20 years
- Group 4- Female subjects of age group ≥ 20 years.

Group 1, group 2, group 3, and group 4 included lateral cephalograms of 28, 16, 20, and 36 subjects, respectively.

Lateral cephalometric measurements for all the samples were done digitally using FACAD software. The anterior cranial base was measured from the sella entrance (Se) to Nasion (N). Sella entrance is the midpoint of the entrance of sella turcica (ST). Nasion is the most anterior point of the frontonasal suture in the midsagittal plane. Mandibular body length is measured along the tangent to the lower border of the mandible between the points gonion (Go) and menton (Me). The gonion is the cephalometric landmark located at the lowest, posterior, and lateral points on the angle. Menton is the most inferior point of the outline of the symphysis in the mid-sagittal plane. The calculated mandibular length was derived by adding 3 mm to the anterior cranial base length.

All the measurements were made by the same investigator. Intra-examiner error was assessed by repeating the measurements after 2 weeks for 10 randomly selected lateral cephalograms and checking the intraclass correlation coefficient (ICC). ICC value of 0.9 was obtained indicating a good correlation and negligible intra-examiner error.

Statistical analysis was done using SPSS software version 20.0 for Windows. Shapiro Wilk test and descriptive statistics were done to assess the normality of the data and to obtain the mean and standard deviation respectively. Wilcoxon signed-rank test was done to compare the measured and calculated mandibular body length for the overall sample as well as for the four groups separately. The significance (p-value) value was set as 0.05.

Results and Discussion

The complete sample's mean mandibular length, as determined by **Table 1** and **Figure 1**, is 70.62 ± 3.52 mm and 71.21 ± 4.41 mm, respectively. Similarly, the mean calculated mandibular length for groups 1, 2, 3, and 4 are 71.56 ± 4 mm, 73.85 ± 4.30 mm, 68.86 ± 2.47 mm, and 69.42 ± 1.67 mm, respectively. The mean actual mandibular length for the four groups are 70.86 ± 6.98 mm, 72 ± 4.02 mm, 72.98 ± 1.4 mm, and 70.16 ± 2.5 mm, respectively **(Table 2 and Figure 2)**.

Table 1. The table depicts the mean, standard deviation, and p-value of the Wilcoxon signed-rank test for the entire sample.

Measurements	Mean (mm)	Standard deviation (mm)	P-value
Calculated mandibular length	70.62	3.52	0.079
Actual mandibular length	71.21	4.41	

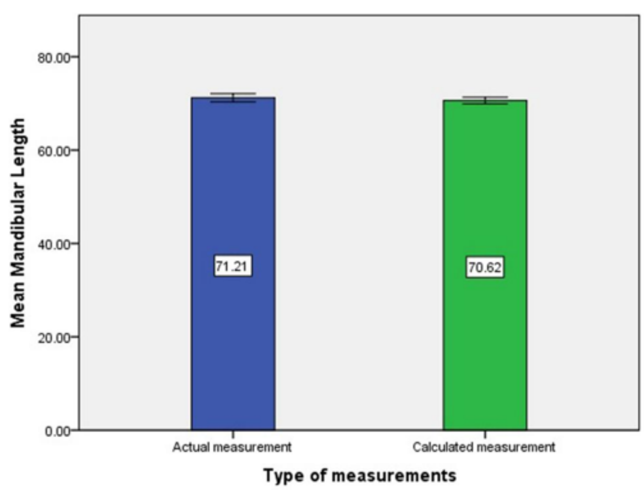

Figure 1. The bar graph represents the mean and standard error for a confidence interval of 95% for the two groups namely, calculated mandibular body length and actual mandibular length.

Table 2. The table depicts the mean, standard deviation, and p-value of the Wilcoxon signed-rank test for the four groups

Groups	Actual mandibular length (Mean ± SD in mm)	Calculated mandibular length (Mean ± SD in mm)	P-value
Group 1 (Male; < 20 years)	70.86 ± 6.98	71.56 ± 4	0.209
Group 2 (Male; ≥ 20 years)	72 ± 4.02	73.85 ± 4.30	0.176
Group 3 (Females; < 20 years)	72.98 ± 1.4	68.86 ± 2.47	< 0.001
Group 4 (Females; ≥ 20 years)	70.16 ± 2.5	69.42 ± 1.67	0.126

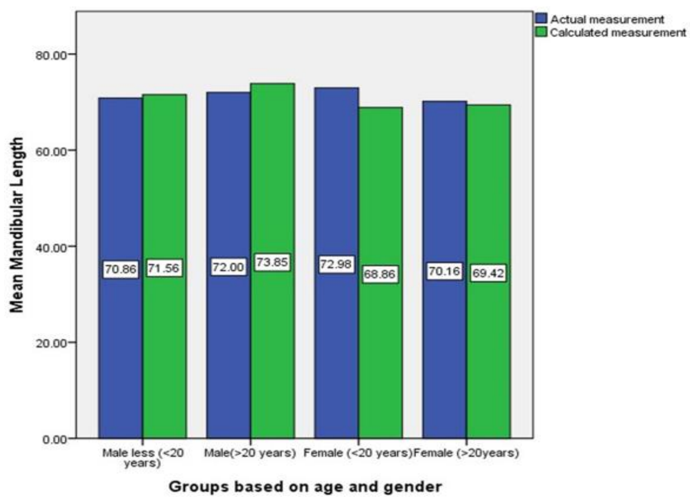

Figure 2. The bar graph depicts the comparison of the mean of calculated mandibular length and actual mandibular length for adult males, adult females, growing males, and growing females separately.

The data had an uneven distribution, according to the Shapiro-Wilk test results. Therefore, for each of the four groups and the entire sample, the calculated and actual mandibular lengths were compared using the Wilcoxon signed-rank test. When the estimated and actual mandibular lengths were compared across the full sample, a p-value of 0.079 was found, suggesting that the differences were not statistically significant **(Table 1)**. Groups 1, 2, and 4 showed similar outcomes, with p-values of 0.209, 0.176, and 0.126, respectively **(Table 2)**. There was a significant difference between the estimated and real mandibular lengths for group 3, as indicated by the P-value of less than 0.001 **(Table 2)**.

Cephalometric measurements are a reliable diagnostic tool for orthodontic diagnosis and treatment planning [13-16]. To diagnose sagittal skeletal discrepancies, the mandibular length must be measured. Functional appliances will be used to help skeletal Class II growing individuals with reduced mandibular length to promote mandibular growth [17-20]. Skeletal Class III patients, on the other hand, have longer mandibles, and the mandible's growth can be controlled with a facemask and chin cup [21, 22]. Another major factor in the etiology of obstructive sleep apnoea is decreased mandibular length, or micrognathia [23-27]. For patients with maxillary prognathism and maxillary retrognathism, the length of the maxillary jaw base is just as important in orthodontic and orthopedic treatment planning as the mandibular jaw base. The sort of orthognathic surgery to be done to address the current skeletal and dental disparities was also determined by the length of the jaw bases.

The most popular cephalometric skeletal analysis for figuring out the length of the jaw bases and anterior cranial base is the Schwarz analysis. Schwarz devised the analysis in 1961. According to his recommendation, the mandibular body length ought to be 3 mm more than the anterior cranium's base length.

Additionally, he stated that the length of the maxillary base and ascending ramus should be two-thirds and five-sevenths of the mandibular body, respectively [7]. An unattractive facial profile will arise from a significant deviation from the optimal jaw base length. For these patients to have an aesthetically pleasing face profile, functional, orthopedic, orthodontic, or surgical treatment may be required.

The purpose of the current study was to evaluate the validity of Schwarz analysis in the South Indian population because of the differences in craniofacial structures between genders, different ethnic groups, and racial groups, as well as the question of whether Caucasian cephalometric norms apply to these racial groups [28, 29]. For skeletal Class I patients with ideal facial profiles, the study measured and computed mandibular length. Additionally, it assessed how generalizable the analysis was to participants of various genders and development and non-growth. Growing subjects were defined as those under the age of 20, and non-growing adults were defined as those over the age of 20, because cranial base length might vary, people with craniofacial problems were not included. Patients having a history of trauma, craniofacial surgery, orthodontic therapy, or orthopedic treatment were also excluded because these conditions may have changed the mandibular length. The results show that the mandibular length of males in all age groups and non-growing females—but not growing females—can be precisely determined via Schwarz analysis. The estimated mandibular length for developing females was 3.937 mm shorter than the actual mandibular length. This may be explained by the fact that females experience the pubertal growth spurt earlier than boys do, as well as the higher rate of mandibular growth that occurs during this time.

The study's retrospective nature and the fact that the lateral cephalograms evaluated were obtained by several radiologists in various contexts were its main drawbacks. However, by calibrating each radiograph separately, the inaccuracy was reduced. Within the parameters of the current investigation, the estimated and actual mandibular lengths of adult girls and males of all ages in the South Indian population did not differ statistically significantly. It is advised to conduct additional research with a larger sample size and evaluate every Schwarz analysis parameter.

Conclusion

While the Schwarz analysis is dependable for determining mandibular body length in males of all ages and girls of non-growing age groups, it should be applied cautiously to developing females in the South Indian population, according to the study's limitations.

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Ethics statement: The study design was reviewed and approved by the Institutional Scientific Review Board (SDC/SIHEC/2020/DIASDATA/0619-0320).

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