Original Study

# RELIABILITY OF SCHWARZ ANALYSIS IN CALCULATING MANDIBULAR LENGTH FOR SOUTH INDIAN POPULATION

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**ABSTRACT**

The South Indian population is rich in ethnicity and cultural diversity, and craniofacial growth and malocclusion is influenced by racial, ethnic, sexual, and dietary differences. Therefore the need of standard norms for the local population is fundamental in the evaluation and diagnosis of craniofacial abnormalities. The study was aimed to assess the reliability of Schwarz analysis in measuring mandibular length for the South Indian population. This was a retrospective study evaluating lateral cephalograms of 100 orthodontic patients. The sample was divided into four groups based on age and gender. Anterior cranial base length and mandibular body length were measured digitally using FACAD software. Calculated mandibular body length was derived using the formula from Schwarz analysis. Wilcoxon signed-rank test was done to compare the significance of calculated mandibular body length and actual mandibular body length for the overall sample as well as the four groups. P-value was set as 0.05. There was no statistical significant difference between the calculated mandibular length and the actual mandibular length in males of all age groups and adult females (p-value > 0.05) whereas significant difference was noted in growing females (p-value < 0.001). Within the limitations of the present study, Schwarz analysis is reliable for measuring mandibular body length in males of all age groups and females of non-growing age groups. The analysis should be used with caution in growing females in the South Indian population.

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

## Introduction

Orthodontics is a field of dentistry which aims in establishing a functional relationship between occlusion, muscle function and esthetics by correcting the dental, skeletal and muscular discrepancies. Comprehensive orthodontic diagnostics is achieved by clinical implementation called diagnostic aids. Orthodontic diagnostic aids can be classified into essential diagnostic aids and supplemental diagnostic aids. Essential diagnostic aids are the clinical aids that are considered very important for all cases. These include case history, clinical examination, study models, periapical radiographs, bite-wing radiographs, panoramic radiographs and facial photographs. Supplemental diagnostic aids are those that are not essential in all cases. It includes specialized radiographs such as cephalometric radiographs, occlusal radiographs, selected lateral jaw views, cone shift technique, cone beam computed tomography, computed tomography, hand wrist radiographs to assess skeletal maturation age, electromyographic examination of muscle activity, endocrine tests, estimation of basal metabolic rate, diagnostic set-up and occlusograms [1].

Cephalogram, although a supplemental aid, is an important diagnostic tool in the field of orthodontics [2]. Cephalograms are routinely used to assess the relationship of jaws in all three spatial planes, namely, anteroposterior, vertical and transverse. Lateral cephalograms are used to assess the anteroposterior relation whereas postero-anterior cephalograms are used to assess the vertical and transverse relationship of the jaws [3]. The anteroposterior relation is usually of very much importance to the patient and needs a critical evaluation. Numerous skeletal and soft tissue cephalometric analyses are reported in the literature to diagnose and plan orthodontic treatment, orthopedic treatment or even orthognathic surgeries [4]. Through assigning the skeletal part in their true cephalometric norms, a well-balanced face with facial harmony can be achieved [5].

Linear and angular measurements have been introduced by researchers to get an accurate method to assess sagittal base discrepancy [4, 6]. Schwarz [7] in 1961 proposed the relationship between anterior cranial base length, mandibular body length, ramus length and maxillary length. The relationship was described as mathematical formula, which is stated as follows:

Mandibular body length = Anterior cranial base + 3mm (1)

Mandibular ramus length = 5/7 X Mandibular body length (2)

Maxillary length =⅔ X Mandibular body length (3)

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

Former researchers have observed the difference of the craniofacial morphology in different ethnic groups [9]. The term ethnic group was defined as a ‘nation or population with a common bond such as geographical boundary, a culture or language, or being racially or historically related. Most of the studies for cephalometric norms are done on

Caucasian populations and the norms established by utilizing these cephalometric analyses might be inapplicable for various racial or ethnic groups [10]. The South Indian population is rich in ethnicity and cultural diversity, and craniofacial growth and malocclusion is known to be influenced by racial, ethnic, sexual, and dietary differences [11]. Therefore a standard norm for the local inhabitants is detrimental for accurate diagnosis and treatment planning [12]. Therefore, this study aims at assessing the reliability of Schwarz analysis in measuring mandibular length for the South Indian population.

**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. Anterior cranial base was measured from sella entrance (Se) to Nasion (N). Sella entrance is the midpoint of the entrance of sella turcica. 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). Gonion is the cephalometric landmark located at the lowest, posterior and lateral point on the angle. Menton is the most inferior point of the outline of the symphysis in the mid-sagittal plane. Calculated mandibular length was derived by adding 3mm to 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 . Significance (p-value) value was set as 0.05.

**Results and Discussion**

The mean of calculated and actual mandibular length for the entire sample is 70.62 +/-3.52mm and 71.21 +/- 4.41mm respectively **(Table 1** and **Figure 1)**. Similarly, the mean calculated mandibular length for group 1, 2 , 3 and 4 are 71.56 +/- 4mm , 73.85 +/- 4.30mm, 68.86 +/- 2.47mm and 69.42+/- 1.67mm respectively. The mean actual mandibular length for the four groups are 70.86 +/- 6.98mm, 72 +/- 4.02mm, 72.98 +/- 1.4mm and 70.16 +/- 2.5mm 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 | |

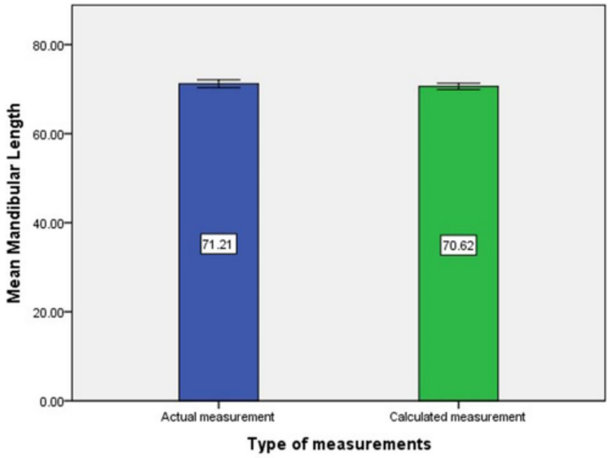


**Figure 1.** The bar graph represents the mean and standard error for confidence interval of 95% for the two groups namely, calculated mandibular body length and actual mandibular length.

**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 |

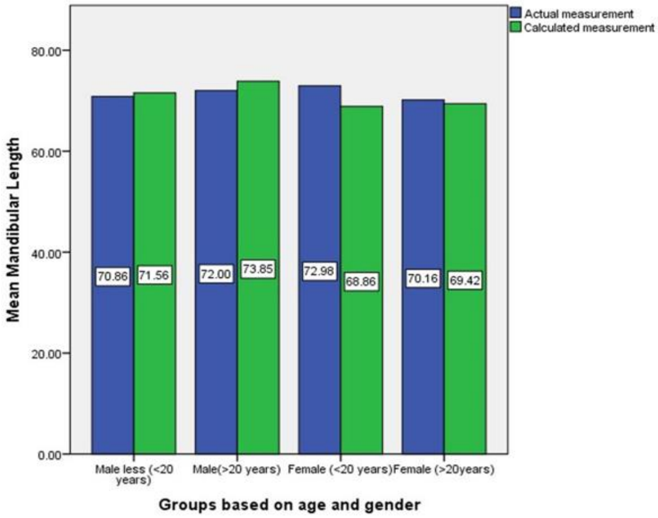


**Figure 2.** The bar graph depicts the comparison of the mean of calculated mandibular length and actual mandibular length for adult males, adult females, growing males and growing females separately .

Shapiro Wilk test revealed that the data was abnormally distributed. Therefore Wilcoxon signed-rank test was done to compare the actual mandibular length and calculated mandibular length among the entire sample as well as the four groups separately. A p-value of 0.079 was obtained on comparison of the calculated and actual mandibular length among the entire sample indicating that the values are statistically insignificant **(Table 1)**. Similar results were obtained for group 1, group 2 and group 4 with a p-value of 0.209, 0.176 and 0.126 respectively **(Table 2)**. P-value of <0.001 was obtained for group 3 indicating significant difference between the actual and calculated mandibular length **(Table 2)**.

Cephalometric measurements are a reliable diagnostic tool for orthodontic diagnosis and treatment planning [13-16]. Assessing the mandibular length is essential in diagnosing sagittal skeletal discrepancies. Skeletal Class II growing patients with decreased mandibular length will be treated by functional appliances to facilitate mandibular growth [17-20]. Whereas skeletal Class III patients have increased mandibular length and facemask and chin cup can be used to restrict the growth of the mandible [21, 22]. Decreased length of the mandible or micrognathia of mandible also plays an important role in the etiology of obstructive sleep apnoea [23-27]. Similar to the mandibular jaw base, the length of the maxillary jaw base also plays a significant role in orthodontic and orthopedic treatment planning for cases with maxillary prognathism and maxillary retrognathism. Length of the jaw bases also decided the type of the orthognathic surgeries to be performed to correct the existing skeletal and dental discrepancies.

Schwarz analysis is the commonly used cephalometric skeletal analysis to determine the length of the anterior cranial base and the jaw bases. The analysis was developed by Schwarz in 1961. He proposed that the ideal mandibular body length should be 3mm more than the anterior cranial base length. He also mentioned that maxillary base length and ascending ramus length must be 2/3rd and 5/7th of the length of the mandibular body respectively [7]. Gross variation in the length of the jaw bases from the ideal value will result in an unaesthetic facial profile. These patients may need to undergo functional, orthopedic, orthodontic or surgical treatment to achieve an esthetic facial profile.

Due to variations in craniofacial structures among genders , various ethnic groups and racial groups and the question of applicability of Caucasian cephalometric norms to these racial groups [28, 29] the present study was aimed to assess the reliability of Schwarz analysis in the South Indian population. The study analysed the calculated and measured mandibular length for skeletal Class I patients with ideal facial profile and also additionally assessed the applicability of the analysis among different gender and growing and non-growing subjects. Subjects below 20 years of age were considered as growing subjects and those above 20 years of age were considered as non-growing adults. Subjects with craniofacial syndromes were excluded as there might be variation in the cranial base length. Patients with a history of previous orthodontic or orthopedic treatment, craniofacial surgery or trauma were also excluded as these might have altered the mandibular length. In the results, we observed that Schwarz analysis is reliable in calculating the mandibular length for males of all age groups and non-growing females whereas it was not reliable for growing females. Actual mandibular length was 3.937mm more than the calculated mandibular length for growing females. This could be attributed to the early pubertal growth spurt seen in females than males and increased rate of mandibular growth seen during pubertal growth.

The limitations of the study was that it was a retrospective study and the lateral cephalograms assessed were taken by different radiologists under variable settings. But the error was minimised by calibrating all the radiographs individually. Within the limits, the present study revealed that there was no statistical significant difference between the calculated mandibular length and the actual mandibular length in males of all age groups and adult females of the South Indian population. Further studies with increased sample size and assessing all the parameters of Schwarz analysis is recommended.

## Conclusion

Within the limitations of the present study, Schwarz analysis is reliable for measuring mandibular body length in males of all age groups and females of non-growing age groups whereas the analysis should be used with caution in growing females in the South Indian population.

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**Conflict of interest:** None

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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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