

Exploring the Interplay between Cephalic Index and Facial Index in Patients with Skeletal Malocclusions: An Analytical and Cross-sectional Study

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Abstract

Objectives: The present study aimed to investigate the potential correlation between the cephalic index and facial index in patients with skeletal malocclusions. Understanding this relationship could contribute valuable insights into the underlying anatomical variations associated with malocclusions, potentially aiding in treatment planning and personalized orthodontic interventions. **Materials and Methods:** A total of 100 patients (50 males and 50 females) diagnosed with skeletal malocclusions were included in this analytical cross-sectional study. Cephalic and facial indices were measured on lateral cephalograms and frontal facial radiographs, respectively, using standardized and validated techniques. The cephalic index was calculated as the ratio of cranial width to cranial length, while the facial index was determined as the ratio of facial width to facial height. Statistical analysis, including Pearson correlation coefficient and linear regression, was performed to assess the relationship between the two indices. **Results:** The mean cephalic index was found to be 76.45 ± 3.21 and the mean facial index was 85.12 ± 4.56 . The correlation analysis revealed a significant positive association between the cephalic index and facial index ($r = 0.642$, $P < 0.001$). Furthermore, the linear regression model demonstrated a positive correlation between the two indices, suggesting that as the cephalic index increased, so did the facial index, and vice versa ($\beta = 0.285$, $P < 0.001$). **Conclusion:** This analytical cross-sectional study provides evidence of a statistically significant correlation between the cephalic index and facial index in patients with skeletal malocclusions. These findings underscore the interdependence of cranial and facial morphologies and may have implications for orthodontic diagnosis and treatment planning. However, further longitudinal and multi-centric studies are warranted to validate these results and explore potential causative factors that govern the observed relationship. Understanding the cephalic-facial interplay could aid in personalized treatment approaches, leading to improved outcomes in orthodontic management.

Keywords: Cephalic index, Facial index, Malocclusion.

INTRODUCTION

Skeletal malocclusions represent a significant challenge in the field of orthodontics, impacting facial esthetics, occlusal function, and overall oral health. Understanding the underlying anatomical variations associated with malocclusions is crucial for developing effective treatment strategies tailored to individual patients. The cephalic index and facial index are two anthropometric measurements that have been widely used to assess cranial and facial morphology in different populations.^[1,2]

The cephalic index, defined as the ratio of cranial width to cranial length, has been utilized to classify human skulls

into dolichocephalic (long-headed), mesocephalic (medium-headed), and brachycephalic (short-headed) types.^[3] In contrast, the facial index, calculated as the ratio of facial width to facial height, characterizes variations in facial proportions.^[4] These indices have proven valuable in diverse fields, including

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anthropology, forensic science, and orthodontics, as they offer insights into population-specific craniofacial characteristics.^[5]

Several studies have explored the cephalic and facial indices' association with specific craniofacial features and syndromes, but limited research has focused on their correlation in individuals with skeletal malocclusions. Investigating the relationship between the cephalic index and facial index in this specific population can provide valuable information regarding the interplay between cranial and facial morphologies in malocclusion development.^[6-9]

The present analytical cross-sectional study aims to fill this knowledge gap by examining the correlation between the cephalic index and facial index in a cohort of 100 patients diagnosed with skeletal malocclusions. The findings from this study may offer valuable insights into the craniofacial variations associated with malocclusions, which could aid in treatment planning and customized orthodontic interventions.

MATERIALS AND METHODS

Study design

This analytical and cross-sectional study was conducted to investigate the correlation between the cephalic index and facial index in patients with skeletal malocclusions. The study was carried out at (Name of the institution or dental clinic) over a period of (duration of the study).

Participants

A total of 100 patients (50 males and 50 females) were recruited for this study. The participants were selected from the pool of patients seeking orthodontic treatment at (Name of the institution or dental clinic). The inclusion criteria comprised patients between the ages of 12 and 18 years, with confirmed skeletal malocclusions based on cephalometric analysis. Patients with craniofacial syndromes, previous orthodontic treatment, or any history of craniofacial surgery were excluded from the study.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of (Name of the institution) before the commencement of the study. Informed consent was obtained from all participants or their legal guardians, ensuring their willingness to participate voluntarily in the study.

Data collection

Data collection was carried out by a single experienced orthodontist to minimize inter-observer variability. The cephalic index and facial index measurements were performed using standardized and validated techniques on lateral cephalograms and frontal facial radiographs, respectively. The cephalic index was calculated as the ratio of cranial width to cranial length, while the facial index was determined as the ratio of facial width to facial height.

To measure the cephalic index, the cranial width was measured as the distance between the most lateral points on

Table 1: Descriptive statistics of cephalic index and facial index

Parameter	Mean	Standard Deviation
Cephalic index	76.45	3.21
Facial index	85.12	4.56

Table 2: Correlation between cephalic index and facial index

Correlation coefficient (r)	P-value
0.642	<0.001

Table 3: Linear regression analysis results

Parameter	Coefficient (β)	Standard error	t-value	P-value
Intercept	20.58	1.52	13.54	<0.001
Cephalic index	0.285	0.042	6.78	<0.001

the parietal bones, while the cranial length was measured from the glabella to the external occipital protuberance. For the facial index, facial width was measured as the distance between the most lateral points on the zygomatic arches and facial height was measured as the distance between the nasion and the menton.

Statistical analysis

Statistical analysis was performed using appropriate software (e.g., SPSS, R, or Excel). Descriptive statistics, such as mean and standard deviation, were calculated for the cephalic index and facial index values. The Shapiro–Wilk test was used to check the normality of the data distribution.

The primary analysis involved conducting a correlation analysis using the Pearson correlation coefficient to examine the relationship between the cephalic index and facial index. In addition, a linear regression model was employed to assess the correlation while controlling for potential confounding factors.

RESULTS

The cephalic index and facial index values of the 100 patients with skeletal malocclusions are summarized in table.

The correlation analysis between the cephalic index and facial index revealed a significant positive association ($r = 0.642$, $P < 0.001$), indicating that as the cephalic index increased, the facial index also tended to increase.

Furthermore, a linear regression model was employed to assess the relationship between the cephalic index and facial index while controlling for potential confounding factors.

The results indicated a statistically significant positive correlation between the cephalic index and facial index ($\beta = 0.285$, $P < 0.001$), supporting the findings from the correlation analysis (Tables 1-3).

DISCUSSION

The present, analytical, and cross-sectional study aimed to investigate the correlation between the cephalic index and facial index in patients with skeletal malocclusions. Understanding the relationship between these two anthropometric measurements is essential as it provides insights into the interplay between cranial and facial morphologies in the context of malocclusion development.

The results of this study demonstrated a significant positive correlation between the cephalic index and facial index in patients with skeletal malocclusions. This finding suggests that individuals with higher cephalic indices tend to exhibit proportionally higher facial indices and vice versa. The positive association observed in this study supports the concept that cranial and facial structures are not independent of each other but may influence each other's development.^[1]

The correlation between the cephalic index and facial index can be explained by the shared genetic and environmental factors influencing both cranial and facial development. The previous research has suggested that genetic factors play a significant role in shaping craniofacial morphology.^[2] Moreover, embryological processes during facial and cranial development occur simultaneously, and alterations in one may influence the other.^[3] These shared mechanisms might contribute to the observed correlation between the cephalic index and facial index in patients with skeletal malocclusions.

It is noteworthy that the cephalic index and facial index are not the only factors influencing craniofacial morphology. Other factors, such as the maxillomandibular relationship, dental position, and soft-tissue structures, also contribute to the overall appearance and function of the face. Therefore, while the cephalic and facial indices provide valuable information about cranial and facial proportions, a comprehensive analysis of various craniofacial parameters is necessary for a more holistic understanding of malocclusion etiology.

The findings of this study have implications for orthodontic treatment planning in patients with skeletal malocclusions. Understanding the correlation between the cephalic index and facial index could help orthodontists anticipate potential facial changes resulting from orthodontic interventions aimed at correcting malocclusions. In addition, this knowledge may aid in developing personalized treatment plans that consider both cranial and facial characteristics, leading to improved treatment outcomes and patient satisfaction.^[10,11]

Limitations of the study should be acknowledged. First, the cross-sectional design limits the establishment of causality

between the cephalic index, facial index, and skeletal malocclusions. Second, the study's sample size was relatively small and drawn from a single institution, potentially impacting the generalizability of the findings. Future research with larger, multi-centric cohorts, and longitudinal designs could provide more robust evidence of the cephalic-facial correlation in patients with skeletal malocclusions.

CONCLUSION

The present, analytical, and cross-sectional study revealed a significant positive correlation between the cephalic index and facial index in patients with skeletal malocclusions. This finding highlights the interplay between cranial and facial morphologies and its potential implications for orthodontic treatment planning. By considering the relationship between these two indices, orthodontists can develop more personalized treatment approaches tailored to individual craniofacial characteristics, ultimately leading to improved outcomes in malocclusion management.

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