Evaluation of the sella turcica shape in lateral cephalometric radiographs in relation to skeletal class I, class II, and class III occlusion: a single-center cross-sectional study

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Abstract

***Background and aim*: The sella turcica's shape is crucial for orthodontic diagnosis, as its variations can indicate underlying pathologies or craniofacial abnormalities. This study aimed to evaluate the shape of the sella turcica in lateral cephalometric radiographs across skeletal Class I, II, and III occlusions.**
Methods and material: This prospective study analyzed lateral cephalometric radiographs of 300 patients aged 15 and older who visited an Oral and Maxillofacial Radiology Clinic between 2009 and 2012. The patients were divided into three groups based on skeletal occlusion (Class I, II, III) using the ANB angle. Sella turcica shapes were classified into six categories according to Axelsson's criteria: normal shape, oblique anterior wall, double contour of the floor, sella turcica bridge, irregularity in the posterior part of the sella turcica, and pyramidal shape of the dorsum sellae. Two maxillofacial radiologists evaluated the radiographs. Data were analyzed using the Chi-square test in SPSS software (version 25) with a significance level set at $p < 0.05$.
***Results*: The normal shape of the sella turcica was observed in 58% of Class I, 53.68% of Class II, and 52.12% of Class III occlusion cases, with an overall prevalence of 54.6%. No significant association was found between occlusion type and sella turcica shape ($P = 0.269$).**
***Conclusion*: In conclusion, the normal shape of the sella turcica was the most prevalent in this study, followed by irregularity and the oblique anterior wall shapes. No significant association was observed between the sella turcica shape and skeletal occlusion types (Class I, II, and III).**

Keywords: adolescent; cephalometry; sella turcica/diagnostic imaging.

Introduction

Lateral cephalometric radiography is a common imaging technique in dentistry, providing a lateral view of the skull and aiding in orthodontic diagnosis and treatment planning (1). A key anatomical landmark in this view is the sella turcica, a U-shaped, saddle-like deression in the sphenoid bone. It consists of the tuberculum sellae, hypophyseal fossa, and dorsum sellae. The tuberculum sellae and dorsum sellae are elevated on both sides, forming the middle and posterior clinoid processes. The hypophyseal fossa, located centrally, serves as the site for the pituitary gland (2, 3).
A detailed analysis of the sella turcica on cephalograms used for orthodontic or craniofacial planning is essential to detect any deviations from normal, which may indicate local or systemic pathology (4). Abnormalities in the pituitary gland can affect the shape of the sella turcica. Hormonal imbalances may disrupt endocrine function, leading to systemic consequences for growth, metabolism, reproduction, and other physiological processes (5). Furthermore, alterations in the morphology of the sella

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turcica have been linked to conditions such as canine impaction, tooth transposition, agenesis, and severe craniofacial deviations (6).

Considering the normal variations of the sella turcica in individuals and populations, efforts have been made to classify its shape, outlining the different normal and possible variations (7). The classification by Camp divides the normal shape of the sella turcica into three groups: flat, oval, and circular, with the oval type being the most common and the flat type the least common (8). Later, other researchers contributed to this classification, and the most recent and widely recognized one was proposed by Axelsson in 2004. Axelsson classified the sella turcica shape into six categories: oblique anterior wall, pyramidal shape of dorsum sella, sella turcica bridge, double contour of floor, irregularity in the posterior part of dorsum sella, and normal sella turcica (9).

Assessing the morphology of the sella turcica and potential pituitary gland abnormalities is essential for diagnosing and managing endocrine disorders. A thorough understanding of the region's anatomy is crucial in these diagnostic processes (5). Furthermore, it has been reported that the diameter of the sella turcica can be used to evaluate skeletal patterns of the craniofacial complex. However, this finding warrants further exploration across different ethnic groups, including the Iranian population, as previous studies have reported controversial results (6, 10, 11). Therefore, this study aimed to evaluate the shape of the sella turcica in standard lateral cephalometric radiographs in relation to skeletal Class I, Class II, and Class III occlusion. It is hypothesized that variations in the shape of the sella turcica are associated with different skeletal classeifications.

Methods and material

Study Design and Sample Selection

This prospective study analyzed the lateral cephalometric radiographs of patients visiting an Oral and Maxillofacial Radiology Clinic between 2009 and 2012. Initially, over 1000 patient radiographs were evaluated.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Patients aged 15 years or older.
- Patients with complete dental and medical records available for review.
- **Exclusion Criteria:**
- Patients with congenital craniofacial disorders, syndromes, or facial asymmetries.
- Individuals with a history of orthodontic treatment or maxillofacial surgery.

Grouping and Classification of Skeletal Occlusion

The patients were classified into three skeletal occlusion groups (Class I, Class II, and Class III) based on the ANB angle measured from their lateral cephalometric radiographs. The classification criteria were as follows:

- **Skeletal Class I:** ANB angle between 0° and 4°.
- **Skeletal Class II:** ANB angle greater than 4°.
- **Skeletal Class III:** ANB angle less than 0°.

The ANB angles and tracings were measured using AutoCAD software (version 2025; Autodesk, Inc., San Francisco, CA, USA). to ensure consistency and accuracy. The classification was verified by two independent observers (a maxillofacial radiologist and the researcher) to enhance the reliability of the results.

Final Sample

The final sample consisted of 300 individuals, with 100 individuals in each occlusion group (Class I, Class II, and Class III). The samples were selected to equal the number of patients in each group.

Evaluation of Sella Turcica Shape

After grouping, all lateral cephalometric radiographs were analyzed for the shape of the sella turcica. The shape classification followed Axelsson's 2004 criteria, which divided sella turcica into six distinct forms:

1. Normal or natural shape.
2. Oblique anterior wall.
3. Double contour of the floor.
4. Sella turcica bridge.
5. Irregularity in the posterior part of the sella turcica
6. Pyramidal shape of dorsum sellae.

Each occlusion group (Class I, Class II, and Class III) was separately evaluated for the shape of the sella turcica. Two maxillofacial radiologists performed this classification.

Data analysis

Data were analyzed using the Chi-square test to compare the distribution of sella turcica shapes across skeletal classes (Class I, II, III). The analysis was performed with SPSS software (version 25; IBM Corporation, Armonk, NY, USA), and a p-value of < 0.05 was considered statistically significant.

Results

Five individuals from the Class II group and six individuals from the Class III group were excluded from the study due to the absence of any recognizable sella turcica shape corresponding to the classifications outlined by Axelsson. Thus, the final sample consisted of 100 individuals in Class I, 95 in Class II, and 94 in Class III.

The distribution of Sella Turcica Shapes across skeletal Classes I, II, and III is summarized in Table 1. The overall average percentage of normal sella turcica was 54.6%. Irregularity was observed in 13.48% of all individuals, while oblique shapes were seen in 11.67%. The rarest form of sella turcica, the bridge, was observed in 2.78% of all individuals. The double contour of the floor shape was seen in 6.67%, and the pyramidal shape was found in 10.11% of the total sample.

The Chi-square test indicated no statistically significant difference in the distribution of morphological shapes of the sella turcica across different occlusion types ($P = 0.269 > 0.5$).

Table 1. Distribution of Sella Turcica Shapes Across Skeletal Classes I, II, and III.

Shape	Class I (n=100, Percentage)	Class II (n=95, Percentage)	Class III (n=94, Percentage)
Normal	58 (58%)	51 (53.68%)	49 (52.12%)
Irregularity	15 (15%)	8 (8.42%)	16 (17.02%)
Bridge	2 (2%)	3 (3.15%)	3 (3.19%)
Double contour floor	5 (5%)	8 (8.42%)	7 (7.44%)
Oblique	14 (14%)	13 (13.68%)	8 (8.51%)
Pyramidal	6 (6%)	12 (12.63%)	11 (11.7%)
Bridge	2 (2%)	3 (3.15%)	3 (3.19%)

Discussion

The middle cranial base stabilizes after age eight and is a reliable reference for studying facial development. The Sella turcica is commonly examined to assess craniofacial morphology and developmental changes. The S point, its deepest part, is a cephalometric reference in orthodontics to evaluate the maxillary position relative to the cranial base. Measuring its distance from the anterior cranial base aids in diagnosing and treating dentofacial anomalies (11, 12). This study aimed to assess the shape of the sella turcica in lateral cephalometric radiographs in relation to skeletal Class I, Class II, and Class III occlusion. It was found that there was no significant difference in the distribution of sella turcica morphological shapes among different occlusion types. Therefore, the initial hypothesis was rejected.

Consistent with the current study, Poorsoleiman et al (11). evaluated the relationship between sella turcica morphology and malocclusion and found no correlation. Although their study included a broader age range (8–30 years), similar results were observed. Axelsson et al. (9). concluded that the sella turcica reaches its final shape by the end of childhood and remains unchanged after puberty, except for the bridge shape, which can develop over time and stabilize by age. Therefore, the study included patients over 15 to ensure a fully established sella turcica morphology. This result is similar to the findings obtained by Alkofide et al. (7) and Shah et al. (13). Their study concluded that the saddle shape is independent of gender and occlusion type.

However, Valizadeh et al (10) and Lekavičiūtė et al. (14). found a significant correlation between facial skeletal pattern and sella turcica morphology. This discrepancy in findings may be due to differences in sample size, age range, measurement methods, selection criteria, and statistical analysis techniques.

The normal shape of the sella turcica was observed in 54.6% of the studied population. Consistent with the current study, Nerukar et al. (15) found that the normal type was the most frequent shape in patients with Class III occlusion. Similarly, Poorsoleiman et al. (11) found that the normal shape was the most prevalent in their study.

After normal shape, the most common shape observed in the study was irregularity, found in 13.48% of the population. However, in individuals with Class II skeletal occlusion, its prevalence was unusually low, at 8.48%. The third most common shape was the oblique anterior wall, present in 11.67% of individuals, with an unusually low prevalence of 8.51% in Class III occlusion patients. Axelsson et al. (9) found the oblique anterior wall to be the second most common shape (13%) and irregularity as the third most common (11%), which differs from this findings. Alkofide et al.'s (7) study observed irregularity as the second most common shape (11.1%) and the oblique anterior wall as the third most common (9.4%), which is comparable to present results. In Shah et al.'s study, irregularity was the second most common shape (16.7%), while the pyramidal shape (7.8%) was the third most common, a shape not commonly observed in other studies. Yassir et al.'s (16) study found irregularity as the third most common shape (5.38%) and the double-contoured floor as the second most common shape (8.46%), which aligns with our results for irregularity. Valizadeh et al.'s (10) study on an Iranian population revealed that the most common shape was normal (24.4%), followed by irregularity (15.6%) and sella turcica bridging (23.3%). In Shah et al.'s (13) study, irregularity in Class II occlusion patients was higher (26.6%) than in the current study (8.48%), with racial differences potentially explaining the discrepancy.

The oblique shape in the study was found in 11.67% of individuals, similar to Axelsson et al.'s (9) findings (13%). However, it was less prevalent in Class III occlusion patients (8%), which aligns with the results from Shah et al. (13) (6.7%). The pyramidal shape, first introduced by Axelsson in 2004, was found in 10.11% of our population, higher than in Alkofide et al.'s (7) study (2.8%) and Yassir et al.'s (16) (3.84%). In Valizadeh et al.'s (10) study, the oblique anterior wall was found in 20% of cases and the pyramidal shape in 11.1%, similar to the findings in the present study.

The study shows a stronger association between the pyramidal shape and occlusion type, particularly in Class I (6%), Class II (12.63%), and Class III (11.7%) patients, suggesting further investigation is needed regarding its relationship with skeletal occlusions.

The bridge shape, a rare form, was observed in 2.78% of our population, similar to findings from Becktor et al. (17). Accurate bridge identification is only possible through autopsy studies, and the results align with previous studies that find real bridges in no more than

6% of the general population (17). Lastly, the double-contoured floor shape was found in 6.67% of the population, similar to findings in previous studies (7, 9, 10, 13, 16,18).

This study provides valuable insights into the morphology of the sella turcica in relation to skeletal Class I, II, and III occlusion types. However, the study has limitations, including a small sample size and a lack of investigation into the relationship between sella turcica shapes and craniofacial syndromes. Future research should consider expanding the sample size to explore connections to other craniofacial disorders and incorporating larger sample sizes and advanced imaging techniques to enhance measurement precision and provide deeper insights into the clinical implications of sella turcica morphology.

Conclusion

In conclusion, the most frequent shape of the sella turcica observed in this study was the normal shape, followed by irregularity and oblique anterior wall shapes. No significant relationship was found between the shape of the sella turcica and skeletal occlusion types (Class I, II, and III).

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