





# Morphological Variations of Sella Turcica in Orthodontic Patients with Different Skeletal Patterns

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## Article Info.

Submitted: Aug 7, 2025

Accepted: Feb 2, 2026

## How to Cite?

Manandhar P, Thakur BP, Bajracharya K, Pradhan C. Morphological variations of sella turcica in orthodontic patients with different skeletal patterns. *Orthod J Nepal*. 2025;15(2):7-11.

**DOI:** <https://doi.org/10.3126/ojn.v15i2.82803>

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## ABSTRACT

**Introduction:** Sella turcica, located in the sphenoid bone, is an important structure in lateral cephalometric analysis. There is a close association of the sella turcica with craniofacial bone development. This landmark is related to the development of the maxillomandibular complex and malocclusions and is commonly used for orthodontic diagnosis and management. It is important for an orthodontist to have a knowledge about morphology of sella turcica and its association with different skeletal patterns. The purpose of this study was to identify the association between sella turcica variations and Skeletal Class I, II and III malocclusions.

**Materials and Methods:** A cross-sectional study was conducted from 1<sup>st</sup> May, 2024 to 31<sup>st</sup> October, 2024 on a total of 366 lateral cephalogram records of patients with three different skeletal patterns visiting Samaj Dental Hospital for their orthodontic treatment. The lateral cephalograms were traced digitally using the Webceph software and classified into three groups as skeletal class I, II and III. Shape of sella turcica was assessed. The association between these variations and different skeletal patterns were analysed using the Statistical Package for Social Sciences.

**Results:** Among 366 participants, the mean ANB angle was 3.79°, with standard deviation of 2.95°. The study showed that the association between skeletal class and sella turcica morphology was statistically significant (p-value = 0.001). The association between sella turcica morphology and sex of the participants was not statistically significant (p-value = 0.093).

**Conclusion:** There is an association between sella turcica morphology and different skeletal patterns.

**Keywords:** Lateral Cephalogram, Morphology, Sella Turcica

## INTRODUCTION

Sella turcica is a saddle-shaped structure located in the middle cranial fossa on the intracranial surface of the body of the sphenoid bone.<sup>1</sup> It consists of two anterior and two posterior clinoid processes, the tuberculum

sellae and the pituitary or hypophyseal fossa.<sup>2</sup> The anterior border of the sella turcica is represented by the tuberculum sellae and the posterior border by the dorsum sellae.<sup>3</sup> During embryological development, the neural crest cells are involved in the formation

and development of the anterior part of sella turcica, and its posterior part develops from the mesodermal cells. The size and shape of the sella turcica change during growth. Bone deposition occurs on the anterior portion of the sella turcica, while resorption occurs on the posterior part of the sella floor and posterior wall. Bone deposition occurs at the tuberculum sellae, and resorption at the posterior boundary of the sella turcica.<sup>3,4</sup>

Sella turcica houses the pituitary gland in the cranial base.<sup>5</sup> Any abnormality of the pituitary gland may present as a change in the shape of the sella turcica. A deviation from the normal size and shape of the sella turcica due to malformation may suggest an undiagnosed underlying condition and could indicate a pathological disorder.<sup>6,7</sup> Sella turcica is also involved in the migration of the neural crest cells to the frontonasal and maxillary areas.<sup>3</sup> Thus, its embryological development is associated with the development of craniofacial bones and teeth.

In orthodontics, the sella point, positioned at the centre of the sella turcica, is among the most frequently used landmarks in cephalometric analysis. These craniofacial landmarks help assess the positions of the maxilla and mandible in relation to the cranium and to each other.<sup>3</sup> Sella turcica is related to the development of the maxillomandibular complex and malocclusions.<sup>8</sup> The morphology of sella turcica may vary from individual to individual. Thus, the knowledge about the structure of the sella turcica is beneficial in evaluating cranial morphology and also helps in assessing growth changes.<sup>2</sup> This can be used as an early predictive sign for orthodontic intervention, and correlating it with skeletal malocclusion can benefit both patients and clinicians.

This study is planned to assess the morphological shape of sella turcica in patients with different skeletal patterns and also compare sella turcica variations between genders. Therefore, lateral cephalometric records of the patients were divided into three groups according to skeletal patterns - Class I, II and III and the shape of the sella turcica were assessed.

## MATERIALS AND METHOD

This was a cross-sectional study conducted at Samaj Dental Hospital from 1<sup>st</sup> May, 2024 to 31<sup>st</sup> October, 2024. Before the start of the study, ethical approval (Reg. No. 123-2024) from Nepal Health Research Council was

obtained on 30<sup>th</sup> April 2024. Patients visiting Samaj Dental Hospital for their orthodontic treatment were selected for the study. Patients were counselled about the research, and written consent was taken.

Lateral cephalograms of the patients were taken by trained radiographic technicians in a standardized manner. A total of 366 lateral cephalograms of the patient were randomly selected according to the inclusion and exclusion criteria

### The inclusion criteria were:

1. The radiographs that had the clearest reproduction of the sella turcica area were selected.
2. Age above 18 years. As studies have shown that the morphology of the sella turcica does not change significantly after 12 years.<sup>8,9</sup> Remodelling of the sella turcica continues up to 16-18 years of age.<sup>10</sup> To eliminate growth-related changes in the post-pubertal period, patients who completed their growth processes were included in the study.

### The exclusion criteria were:

1. History of previous maxillofacial surgery or orthognathic surgery
2. Any sign of a syndrome, cleft lip-palate or craniofacial anomaly.

The reference points Nasion, Point A and Point B were traced digitally using the Webceph software. Radiographs were categorized based on the sagittal skeletal relationship using Steiner's analysis and Wits' appraisal. Skeletal bases were classified according to the ANB angle: Skeletal Class I (angle 2° to 4°), Skeletal Class II (>4°), and Skeletal Class III (<2°).

Lateral cephalogram with the same skeletal pattern in Steiner's analysis and Wits' appraisal were selected for the study. The outline of the sella turcica consisted of the tuberculum sella, floor, dorsum sella, anterior and posterior clinoid processes (Fig. 1). The shape of sella turcica was assessed according to the method described by Axelsson et al.<sup>11</sup> The classification was done into 6 groups (Fig. 2):

- a. Normal sella turcica
- b. Oblique anterior wall
- c. Double contour of the floor
- d. Irregularity in the posterior part of the sella turcica
- e. Sella turcica bridge
- f. Pyramidal shape of dorsum sella

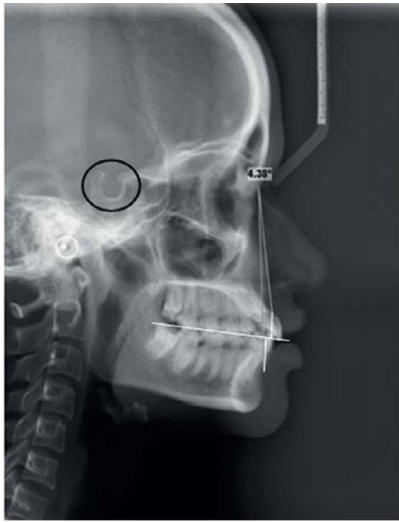


Fig. 1: Webceph software for cephalometry for measurement of ANB angle, Wits' appraisal and shape of sella turcica

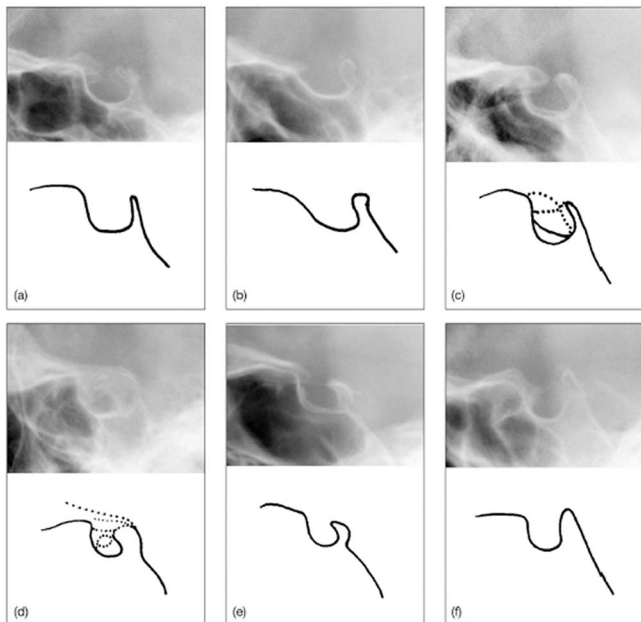


Fig. 2: Different morphology of sella turcica described by Axelsson et al. a. Normal sella turcica b. Oblique anterior wall c. Double contour of the floor d. Irregularity in the posterior part of the sella turcica e. Sella turcica bridge f. Pyramidal shape of dorsum sella

Data collected were entered in Microsoft Office Excel, and the analysis of the data was done using Statistical Package of Social Sciences (SPSS). The Mean and standard deviation of the ANB angle were calculated. Kolmogorov-Smirnov and Shapiro-wilk test were done to test the normality of distribution. Chi-square test was used to test statistically significant difference between the association of morphological variations of sella turcica and skeletal patterns. The association between study parameters and gender was checked with the help

of the Chi-square test, setting the level of significance at 5%. After 1 month, 10% of the sample were selected by a random sampling method, and Cohen's kappa statistic was used to assess inter-observer reliability. The Cohen's Kappa value  $>0.7$  shows substantial agreement between the observers.

## RESULT

A total of 366 patients participated in the study, of which 238 (65%) of the participants were female and 128 (35%) were male (Table 1). The mean ANB angle was  $3.79^\circ$  with a standard deviation of  $2.95^\circ$ .

Table 1: Distribution of participants by sex (n=366)

	Frequency	Percent
Female	238	65
Male	128	35
Total	366	100

Table 2: Variation in Sella turcica morphology in different skeletal patterns (n=366)

Skeletal class	Sella turcica morphology						Total
	A	B	C	D	E	F	
Skeletal class I	72	18	12	11	15	13	141
Skeletal class II	57	16	10	26	28	21	158
Skeletal Class III	26	2	6	4	11	18	67
Total	155	36	28	41	54	52	366

Table 3: Chi-Square Test for association between Skeletal Classes and Sella turcica morphology

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	29.074 <sup>a</sup>	10	.001
Likelihood Ratio	29.021	10	.001
N of Valid Cases	366		

\*p-value of  $<0.05$  is considered significant

Amongst the six variants of the sella turcica morphology, type A (Normal Sella Turcica) was mostly predominant in the participants (42.35%) regardless of gender and skeletal type. (Table 2). Sella Turcica Type C (Double

Contour of the Floor) was the least predominant amongst the participants (7.65%).

Within the skeletal Class I, type A was mostly predominant in the participants, whereas Type D was the least predominant. Type A was seen most commonly within the skeletal Class II, and Type C was seen least commonly. Similarly, Type A was the most common within the skeletal Class III, and Type B was the least common.

After the Chi-square test (Table 3), the association between skeletal class and Sella turcica morphology was found to be statistically significant with a p-value of 0.001.

**Table 4: Variation of sella turcica morphology in different sex (n=366)**

Sella turcica morphology							
Sex	A	B	C	D	E	F	Total
Female	97	28	20	31	35	27	238
Male	58	8	8	10	19	25	128
Total	155	36	28	41	54	52	366

**Table 5: Chi-Square Test for association between of sella turcica morphology in different sex**

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.433 <sup>a</sup>	5	.093
Likelihood Ratio	9.597	5	.087
N of Valid Cases	366		

\*p-value of <0.05 is considered significant

Type A morphology was mostly seen in both male and female, whereas type C was least seen in both sexes (Table 4). The association between sella turcica morphology and sex of the participants was not found to be statistically significant ( $p>0.05$ ) (Table 5).

## DISCUSSION

This prospective study showed the relation between the different skeletal types and sella turcica morphology. In this study, all five variations of the morphology of the sella turcica, along with the normal morphology as given by Axelsson et al.<sup>11</sup> was found. In this study, there was a statistically significant relation between the skeletal types and sella turcica morphology. 42.35% of

the participants had normal sella turcica and 57.65% had the variations. Among the variations, only 7.65% had a double contour of the floor.

Shape variation has been reported by many researchers. Morphological variations of sella turcica were found in 46.9% in a study by Kucia A et al.<sup>12</sup> Axelsson et al.<sup>11</sup> studied the morphology in a Norwegian sample and found 75% of the subjects had a normal morphology while the remaining subjects showed an abnormal morphology.<sup>4</sup> According to Alkofide EA et al.<sup>5</sup>, approximately 67% of the subjects appeared to have a normal shaped sella turcica, while 33% presented with different aberrations among Saudi population<sup>5</sup>. Sathyanarayana HP et al.<sup>2</sup> reported that 61% of South Indian subjects with different dentofacial skeletal patterns had normal morphology, and the remaining 39% had anatomical variants.<sup>6</sup> In context of Nepal, Dixit S et al.<sup>13</sup> revealed 59.2% of Nepalese population presented with normal Sella turcica shape. Similarly in 2018, in study done by Shrestha et al.<sup>14</sup> 60% of the participants had normal sella turcica morphology which was higher than this study.

In this study, the normal shape of sella turcica (42.35%) was mostly predominant in all skeletal classes. However, Patil K et al.<sup>8</sup> found Class I malocclusion occurs with normal anatomy whereas Class II and III malocclusions have been linked to sellar anomalies—findings that differ from the results of our study.

The irregular shape of the dorsum sella was most common in the patient population of Nepali origin (15%) in a study done by Shrestha et al.<sup>14</sup>, and similar findings were seen in the studies done by Alkofide EA et al.<sup>5</sup> (11.1%) and Sathyanarayana HP et al.<sup>2</sup>. But in our study sella turcica bridge was most commonly seen among the variations. Kucia et al.<sup>12</sup> and Abdel-Kader<sup>15</sup> observed cephalograms of patients for orthodontic treatment and noted only 2.5-3.5% for bridging in the study population. Meyer-Marcotty et al.<sup>16</sup> found the sella turcica bridge more commonly in Class II patients, which is similar to this study. Similarly, Marsan G et al.<sup>17</sup> found the sella turcica bridge more commonly in Class III patients (18%).<sup>7</sup>

Hale O et al.<sup>18</sup> showed there was a significant relationship between sella turcica variations and skeletal classes, and 40.4% of the participants had normal sella turcica morphology. These findings were similar to those of this study. There was no significant difference in the morphology of sella turcica between

genders in this study. Similar results were reported by Sathyanarayana HP et al., where 59% of males and 63% of females had normal sella morphology in South Indian patients.<sup>2</sup> A study done by Shrestha et al<sup>14</sup> also showed no significant difference between the morphology of the sella turcica and the genders. However, a study by Hale O et al.<sup>18</sup> showed a significant relationship between sella turcica variations and gender.

## CONCLUSION

There is a wide variation in the morphology of the sella turcica and it has been found to be significantly

associated with different skeletal patterns. This result can be used as a diagnostic tool to predict any skeletal malocclusion and for treatment planning.

**CONFLICT OF INTEREST:** None.

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