



ORIGINAL ARTICLE

The morphology of sella turcica in cleft and non-cleft individuals

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KEYWORDS

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Abstract *Aims and Objectives:* The aim of the study was to analyze the morphology and expedient the linear dimensions of Sella Turcica among cleft and non-cleft Indian individuals, and then to determine whether differences exist between different study groups.

Materials and methods: The lateral cephalogram of 300 patients (150 cleft and 150 non-cleft), aged 18 to 30 years who reported for various treatments of malocclusions were studied.

Result: The normal morphology of the sella turcica were seen in 85 of the 150 non-cleft individuals which was highest (56.66%) in the non-cleft group, however in the cleft group it was seen in only 16 of the 150 individuals (10.6%). Sella turcica bridge were seen in 10% of the non-cleft subjects, whereas in the cleft group it was seen in 38% of the individuals. A significant difference was seen in the linear measurements of the sella turcica of cleft and non-cleft individuals.

Conclusion: The normal morphology of the sella turcica was seen in the majority of the non-cleft individuals. The cleft individuals showed an increased incidence of sella turcica bridging with reduced linear measurements of the sella as compared to the non-cleft individuals.

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1. Introduction

Assessment of the craniofacial structures using lateral cephalogram is one of the essential diagnostic parts of the Orthodontic diagnosis and treatment. The identification of various landmarks is essential, as these points help in analyzing the relative positions of the maxilla and the mandible in relation to themselves or to the cranium. These reference points assist the Orthodontist during diagnosis and in the estimation of Orthodontic treatment results (Alkofide, 2007).

The magnetic resonance imaging had shown that the stationary morphology of pituitary gland as shown in the various textbooks of anatomy are not true, the gland inside the Sella

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keeps changing its shape and size over the life of an individual. Hence, the study of normal morphology of sella as well as the pituitary gland is very essential to detect any anomaly. A study conducted on imaging of Sella reveals that anomaly in the shape of sella may cause pathology or abnormality to the gland, which may lead to the irregular release of glandular hormones; thyroid stimulating hormones; prolactin; follicular stimulating hormone; growth hormones, etc. (Elster, 1993). A study conducted on the individuals having burgeon sella and on pituitary adenoma (Alkofide, 2001) has revealed that an abnormal sella region could be as a result of some other disease which is present and is undetected (Kjaer et al., 2002). (Alkofide 2001; Kjaer et al., 2002).

The various other morphology of sella was described based on the presence of concavity or the flatness of the silhouette of the floor of the sella, the angles produced by the outline of the tuberculum sella, the shape of both the clinoid processes and their fusion which is often known as 'Sella Turcica Bridge'. The maximum riffs to be seen in sella are those of the clinoid processes, which includes the posterior, anterior along with middle (which can only be seen sometimes) (Becktor et al., 2000).

Anatomical, as well as radiographic studies, have revealed the incidence of bridging at about 4.6% to 6%. The bridging of sella can be categorized based on the method of fusion of the posterior and anterior clinoid processes. The A type sella bridge shows ribbon like fusion, and B type shows meeting or superimposing of the posterior and anterior processes through the extension of the bone over pituitary fossa (Jones et al., 2005). The morphological shape of the sella was recently classified into five different variants other than that of the normal. They are named as the double contour of the floor of sellae, oblique anterior wall, pyramidal shape of dorsum sellae, irregularity in the posterior part of the dorsum sellae and the sella bridging (Axelsson et al., 2004).

However, congenital malformations seem to be a more frequent cause of an altered morphology of the sella turcica. In fact, the Gorlin-Goltz syndrome (basal cell carcinoma) showed bridging of sella as radiographic finding, in presence of the calcified falx cerebri. The abnormal morphology of sella or the bridging of sella can be seen in the subjects with other syndromes and disorders. The abnormal morphology of sella in such individuals can be attributed to the syndromes (Leonardi et al., 2006).

The study of human craniofacial dysmorphology is successful in achieving an increased interest. However, certain cephalometric landmarks are present which depicts average development and growth of sella. To describe the anomaly occurring in different craniofacial syndromes and aberrations, the understandings of normal standards are highly essential (Axelsson et al., 2004). The empty sella syndrome (ESS) is a condition characterized by an enlarged sella turcica, atrophy of the pituitary body, increased aeration of the sella turcica area, a defect of the posterior clinoid processes, and demineralization of the floor of the sella turcica (Venable, 1977).

Recent studies demonstrated that alterations of sella turcica morphology can be related to canine impaction, tooth transposition, teeth agenesis and in individuals with severe craniofacial deviations. Hence, the aim of this study is to analyze the morphology and expedient the linear dimensions of sella turcica among cleft lip and palate and non-cleft individuals and then to determine whether differences exist between study groups.

2. Materials and methods

Based on a previous study, the sample size was calculated with 95% confidence level and 90% power, the sample size was found to be 150 in each group (Alkofide, 2007).

2.1. Cleft and palate group

The inclusion criteria were:

- (1) 150 Indian ethnicity with UCLP or BCLP,
- (2) 18–30 years of age,
- (3) ANB < 0',
- (4) agreeing to give the consent.

The exclusion criteria were:

- (1) Those who had incomplete clefts, associated anomalies, severe facial asymmetry, a history of trauma.
- (2) previous orthopaedic treatment, maxillofacial, orthognathic, or reconstructive surgery.
- (3) The individuals whose radiographs were not clear for interpretation.
- (4) Subjects not willing to be a part of study.

2.2. Non-cleft and palate group:

The inclusion criteria were:

- (1) 150 Indian ethnicity,
- (2) 18–30 years of age,
- (3) ANB < 0',
- (4) agreeing to give the consent.

The exclusion criteria were:

- (1) Those who had clefts, associated anomalies, severe facial asymmetry, a history of trauma.
- (2) previous orthopaedic treatment.
- (3) previous plastic, maxillofacial, orthognathic, or reconstructive surgery.

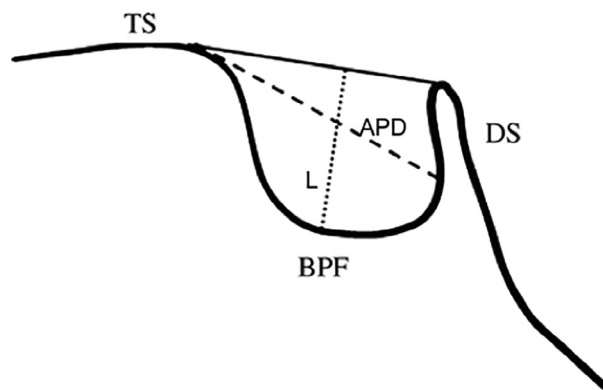


Fig. 1 DS – Dorsum Sella; TS – Tuberculum Sella; L – Length; BPF – Base of the Pituitary Fossa; D – Depth; APD – Anteroposterior diameter.

Table 1 Frequency distribution of shape of Sella Turcica.

Sella type	Cleft individuals (%)	Non-cleft individuals (%)
Normal Sella Turcica	16 (10.67)	85 (56.66)
Oblique Anterior Wall	22 (14.67)	17 (11.33)
Sella Turcica Bridge	57 (38)	15 (10)
Double Contour	12 (8)	8 (5.33)
Irregular Dorsum Sella	26 (17.33)	15 (10)
Pyramidal Shape	17 (11.33)	10 (6.66)
Total	150	150

- (4) The individuals whose radiographs were not clear for interpretation
 (5) Subjects not willing to be a part of study.

The standardized lateral cephalograms used for the study were taken from the orthodontic departmental archives. These digital lateral skull radiographs were taken with Planmeca Pro-max (Helsinki, Finland). This radiographic system uses a charge coupled device sensor chip as an image receptor. The exposure parameters for the digital cephalograms were 68 kV, 5 mA and 18.7 s. The above mentioned lateral cephalograms were traced on 0.003-inch acetate paper with a 2H lead pencil under optical illumination. All tracings were done by the same operator in order to avoid inter-operator errors.

The tuberculum and dorsum sella, the floor of sella turcica and posterior and anterior clinoid processes were drawn which configures the sella turcica. The methods of Silverman (1957) and Kislign (1966) were used to measure the direct measurements such as diameter, depth and length of sella (Silverman, 1957; Kislign, 1966). Distance from the tip of the dorsum sella (DS) to the tuberculum sella (TS) was measured and defined as the length (L) of sella. The perpendicular drawn through the above-defined line towards the floor of sella was measured and defined as the depth (D) of the sella turcica. The third line was drawn from the tuberculum sella to the point which is furthest located on the posterior inner wall of the fossa and this was measured as the anteroposterior diameter (APD) of the sella (Fig. 1). The statistical comparisons were

done using the Mann–Whitney *U* test and $p < 0.05$ was considered as statistically significant. SPSS version 22.0 was used.

3. Result

3.1. Shape of sella turcica (Table 1):

3.1.1. Non-cleft and palate group:

The normal morphology of the sella turcica was seen in 85 of the 150 individuals which were highest (56.66%) in the study group. The different variations in the morphology were seen in the other 65 individuals; an oblique anterior wall was present in 11.33% of the subjects, an irregular dorsum sella and sella turcica bridge was seen in 10% of the subjects, pyramidal shaped sella was seen in 6.66% and 5.33% of the subjects had double-contoured sella turcica.

3.1.2. Cleft and palate group

The majority (38%) of the individuals in this group had the bridging of sella turcica followed by irregular dorsum sella which was seen in 26% of the individuals. This was followed by oblique anterior wall sella (14.67%) and pyramidal shaped sella (11.33%). The normal sella turcica was seen in 16 out of 150 individuals (10.67%) and the least frequency is seen was that of double contoured sella, which was in only 8% of the cleft individuals.

3.2. Size of sella turcica

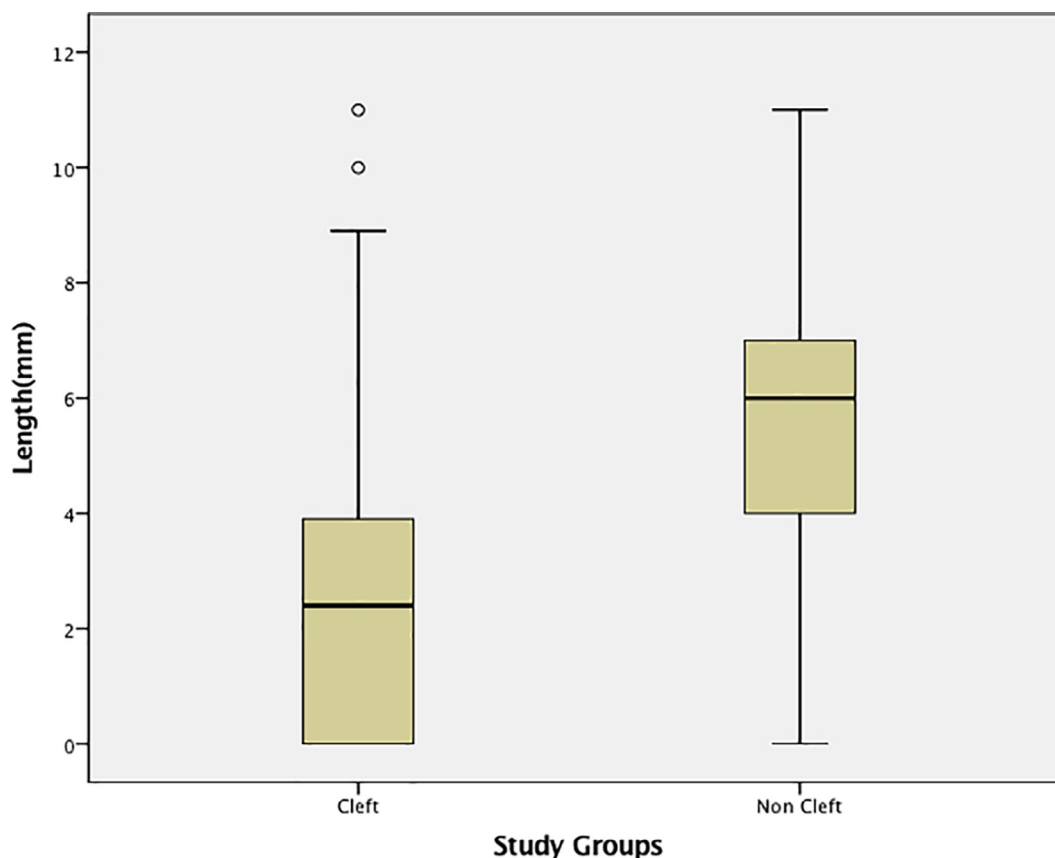
The linear dimensions of sella showed a significant difference between the cleft and the non-cleft individuals (Table 2). The mean length of sella turcica in the cleft individuals was 2.56 mm (± 2.60) and in the non-cleft individuals, it was 5.87 mm (± 2.51), ranging from 0 to 11 mm in both the groups (Graph 1). The mean depth of sella turcica in the cleft individuals was 5.17 mm (± 1.57), ranging from 1 to 10 mm and in the non-cleft individuals the same measurement was 6.79 mm (± 1.33), ranging from 4 to 10 mm (Graph 2). The last linear measurement, the mean diameter of sella turcica in the cleft individuals was 6.66 mm (± 1.82), ranging from 1 to 12.4 mm and in the non-cleft individuals, the same measurement was 10.47 mm (± 1.74) and ranging from 3 to 14 mm (Graph 3)).

Table 2 Comparison of length, depth and diameter between the cleft and non-cleft patients.

Group	N	Mean (SD)	Range	Median (Q1-Q3)	Mann whitney U test	
					U statistic	p-value
Length	Cleft	150	2.56 (2.60)	0–11	2.4 (0–3.98)	3947.50 < 0.001*
	Non Cleft	150	5.87 (2.51)	0–11	6 (4–7)	
Depth	Cleft	150	5.17 (1.57)	1–10	5.1 (4.28–6)	4566.50 < 0.001*
	Non Cleft	150	6.79 (1.33)	4–10	7 (6–8)	
Diameter	Cleft	150	6.66 (1.82)	1–12.4	6.7 (5.7–7.7)	1467.50 < 0.001*
	Non Cleft	150	10.47 (1.74)	3–14	10 (10–12)	

N: Sample size; SD: Standard Deviation.

* $p < 0.05$ statistically significant, $p > 0.05$ non significant.



Graph 1 Distribution chart in length(mm) of sella turcica among cleft and non cleft individuals.

4. Discussion

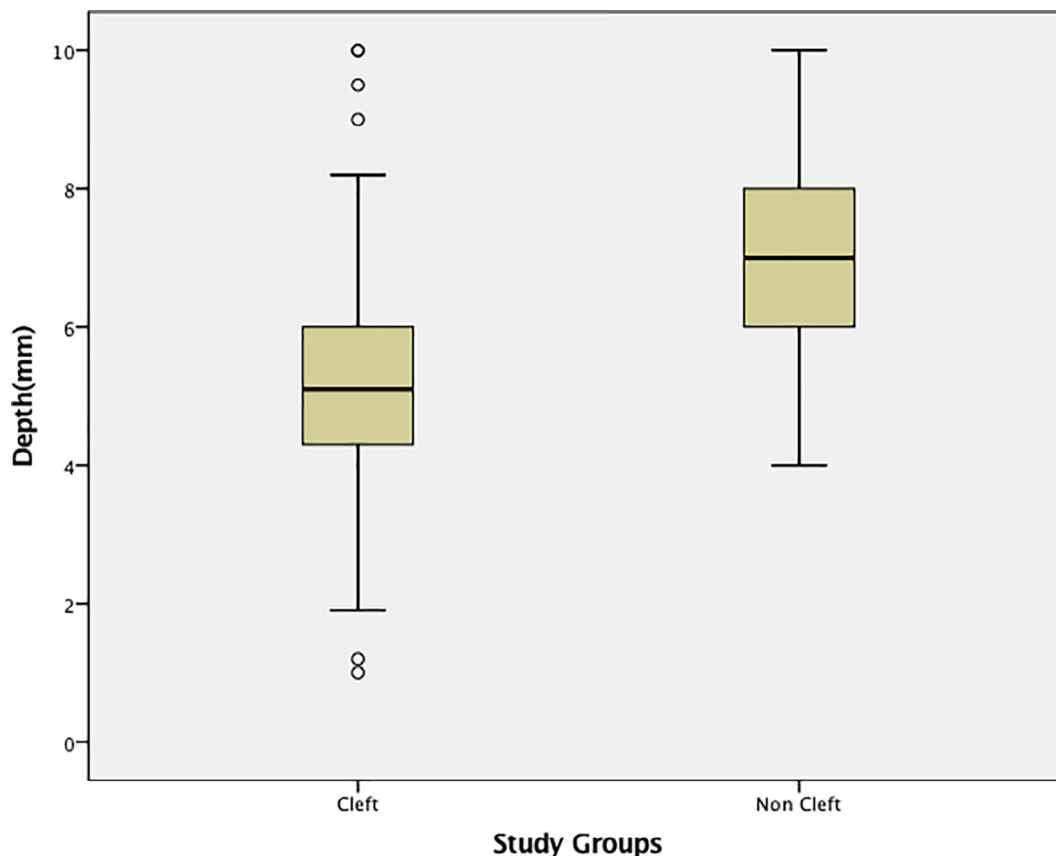
Based on the presence or absence of cleft lip and/or palate (unilateral or bilateral), the lateral cephalometric radiographs of 150 individuals from each group (total 300 subjects) with the age range of 18–30 years were studied. The analyses of each lateral cephalometric radiograph were done and the sella turcica was measured to determine the shape as well as the linear dimensions of diameter, depth, and length.

This study showed that in non-cleft individuals, the normal morphology of the sella turcica was seen in the majority of the sample group followed by an oblique anterior wall sella. The sella turcica with irregular dorsum sella and bridging sella turcica was next in the order of frequency which was seen in equal proportion followed by the pyramidal shaped sella and the least frequency was seen that of double contoured sella. The majority in the cleft group had the bridging of sella turcica followed by irregular dorsum sella. This was followed by oblique anterior wall sella and pyramidal shaped sella. The normal sella turcica were next in order of frequency and the least frequency was seen that of double contoured sella.

Many researchers in the past have reported the variations in the shape of the sella turcica (Gordon and Bell, 1922; Camp, 1924; Teal, 1977; Kantor and Norton, 1987; Tetradis and Kantor, 1999). The Saucer-shaped or flattened, oval and circular are different morphological classifications of Sella turcica

which were given by Bell and Gordon after examining children's radiographs of the age of 1–12 years. Their study showed that the majority of the sella turcica was either an Oval-shaped Sella or a Circular Sella. The morphological shape of sella turcica as 'J-shaped Sella' was explained by Hasan et al. (2016) and Davidoff and Epstein (1950) whereas Fournier and Denizet (1964) introduced the term 'Omega Sella'. However, Kier (1969) referred to these terminologies as radiological myths (Hasan et al. 2016; Davidoff and Epstein, 1950; Fournier and Denizet, 1964; Kier, 1969). The various other morphology of sella were given on the presence of either the concavity or the flatness of the silhouette of the floor of the sella, the angles produced by the outline of the tuberculum sella, the shape of both the clinoid processes and their fusion which is often known as 'Sella Turcica Bridge' (Becktor et al., 2000; Choi et al., 2001). Recent studies demonstrated that alterations of sella turcica morphology can be related to canine impaction (Baidas et al., 2018), tooth transposition (Leonardi et al., 2011) and teeth agenesis (Scribante et al., 2017). (Baidas et al., 2018; Leonardi et al., 2011; Scribante et al., 2017).

In this study, the majority of the non-cleft individuals had the normal shape of the sella which was approximately seen in 57%, whereas the variation was observed in the remaining 43% of the subjects. This data is in close approximation to the study done by Alkofide (2007), Axelsson et al. (2004) and Shah et al. (2011), where normal sella turcica was seen



Graph 2 Distribution chart in depth(mm) of sella turcica among cleft and non cleft individuals.

in approximately 67% of the individuals. (Alkofide, 2007; Axelsson et al., 2004; Shah et al., 2011). However, Valizadeh et al. (2015) and Chauhan et al. (2017) reported it to be as low as 24.4% and 28% respectively and Yassir et al. (2010) reported it to be as high as 76.15%. (Valizadeh et al., 2015; Chauhan et al., 2017; Yassir et al., 2010).

The presence of oblique anterior wall of the sella was seen in 11.33% in the non-cleft group and 14.67% in the cleft group as compared to 3.84% by Yassir et al. (2010), 9.4% of the individuals by Alkofide (2007), 20% by Valizadeh et al. (2015), 23% by Chauhan et al. (2017) and 26% by Axelsson et al. (2004). (Yassir et al., 2010; Alkofide, 2007; Valizadeh et al., 2015; Chauhan et al., 2017; Axelsson et al., 2004). The irregular dorsum sellae was found in 10% of the studied non-cleft group and 17.33% of the cleft group against 5.38% by Yassir et al. (2010), 11% as reported by Alkofide (2007) and Axelsson et al. (2004), 15.6% by Valizadeh et al. (2015) and 18% by Chauhan et al. (2017). (Yassir et al., 2010; Alkofide, 2007; Axelsson et al., 2004; Valizadeh et al., 2015; Chauhan et al., 2017).

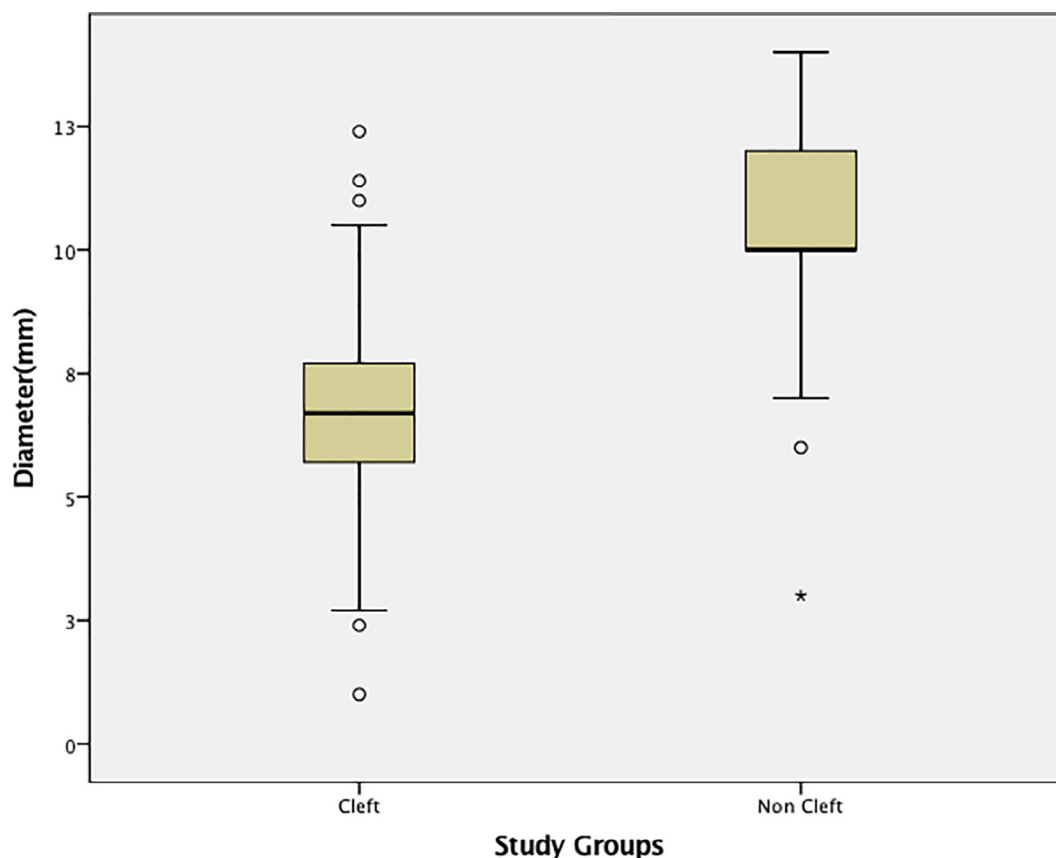
The bridging of sella turcica was seen in 10% of the non-cleft individuals, which is well within the range of 5.5–22 percent of the individuals as reported by Axelsson et al. (2004), Chauhan et al. (2017), Camp (1924), Kantor and Norton (1987) and Tetradis and Kantor (1999) and 23.3% by Valizadeh et al. (2015). However, Alkofide (2007) reported that only 1.1% and Yassir et al. (2010) reported only 0.76% of the individuals had the bridging of sella turcica. (Axelsson

et al., 2004; Chauhan et al., 2017; Camp, 1924; Kantor and Norton, 1987; Tetradis and Kantor, 1999; Valizadeh et al., 2015; Alkofide, 2007; Yassir et al., 2010).

The bridging of sella turcica was seen in 38% of the cleft individuals which goes in accordance with the study of Beكتور et al. (2000), who reported that the increase in the frequency of the individuals with the sella turcica bridge indicates deviations in the craniofacial morphology. Leonardi et al. (2006) reported that there is an increased probability of dental anomaly to be seen in the adolescents who had bridging of sella turcica. (Beكتور et al., 2000; Leonardi et al., 2006).

The finding of pyramidal shaped sellae was 6.66% in the non-cleft group and 11.33% in the cleft group as compared to 11.1% by Valizadeh et al. (2015), 5% by Axelsson et al. (2004), 3.84% by Yassir et al. (2010) and 2.8% by Alkofide (2007). (Valizadeh et al., 2015; Axelsson et al., 2004; Yassir et al., 2010; Alkofide, 2007). The least frequency was that of the double contoured sella which was present in 5.33% of the non-cleft individuals and 8% in the cleft group compared to 8.9% reported by Alkofide (2007), 8.46% by Yassir et al. (2010), 7% by Chauhan et al. (2017) and 3% by Axelsson et al. (2004). This value was almost similar to that of by Valizadeh et al. (2015) who had 5.6% of the population with double contoured sellae. (Alkofide, 2007; Yassir et al., 2010; Chauhan et al., 2017; Axelsson et al., 2004; Valizadeh et al. (2015).

A significant difference between the linear measurements of sella i.e. diameter, depth, and length between cleft and non-



Graph 3 Distribution chart in diameter(mm) of sella turcica among cleft and non cleft individuals.

cleft individuals were also seen. The results of this current study can be highly informative in assessing the correlation of the morphology of sella turcica and the craniofacial deviations. The younger age group may be included to study the age-related changes in the morphology of sella.

5. Conclusion

Significant differences were observed in the morphology of Sella Turcica between individuals with and without cleft lip and palate. Variations in the morphology are also observed within the cleft group. The abnormal growth and development of oral structures, in this case, cleft lip and palate, may have an effect on the morphology of cranial structures, i.e. morphology of sella turcica. Further study is suggested to correlate the relationship between the types of oral cleft and different craniofacial structures in different population.

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