



RESEARCH ARTICLE

RELATING VARIOUS PARAMETERS OF SELLA TURCICA IN SKELETAL CLASS I SUBJECTS HAVING DIFFERENT GROWTH PATTERNS: A CROSS SECTIONAL LATERAL CEPHALOMETRIC STUDY

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Abstract

Aim of the study: The purpose of this study was correlating various parameters of sella turcica in adult subjects with skeletal Class I having different growth patterns.

Materials and Method: Lateral cephalograms of 180 skeletal Class I subjects (90 males, 90 females), aged 18-25 years were selected by ANB angle, W angle, Yen angle, Beta angle and Wit's analysis. Subjects were categorised into three groups (average, horizontal and vertical) according to Jarabak's ratio and SN-GoGn angle. Length, depth, width, anteroposterior diameter, area and shape of sella turcica were assessed.

Result: Data were analysed using Shapiro-Wilkinson test, T test, onewayanova test, posthoc test and Chi square test. In total no. of Class I subjects for sella turcica size, statistically highly significant difference found for sella length and area ($p \leq 0.0001$) which was larger in males and Significant difference found for sella depth ($p \leq 0.03$) which was higher in males whereas width ($p \leq 0.001$) was more in females. Sella size between growth patterns revealed statistically highly significant difference ($p \leq 0.0001$) with more mean for vertical growth pattern subjects. Normal shape of sella turcica was more prevalent in all growth.

Conclusion: Gender difference was found for length, depth and area which was more in males and for width in females except for anteroposterior diameter. Statistically highly significant difference was found in vertical growth pattern subjects on comparing sella size between different growth pattern. Sexual dimorphism found for sella area more in males with average growth and sella depth which was more in females with vertical growth.

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Introduction:-

Sella turcica is a concave structure, this word is translated from Latin word sella meaning saddle and turcica - “of the Turks” which resembles a side view of the seat of Turkish saddle ^{[1][2]}. It is situated in the middle cranial fossa also known as pituitary fossa, there is significant literature which suggests that pituitary gland serves as a functional matrix for the skeletal unit of sella turcica ^[3].

In orthodontics, sella turcica is an important structure because it is hard tissue landmark which is located in the centre of hypophyseal fossa and demarcated by dense thin white line ^[1] and such landmark helps in evaluation of craniofacial morphology and to measure the position of the maxilla and mandible in relation to cranial base and themselves ^[4], centre of sella turcica was defined as S-point by Bjork (1947) ^[5] and is an important for cephalometric assessment as it is used with Nasion as a reference plane (SN plane) in various analysis. The anterior wall of sella turcica and the cribriform plate (laminar cribrosa) remain unchanged after age 5 years, which means that no further growth or remodelling will affect these areas of the cranial base ^[6].

The identification of various cephalometric landmarks and benefits gained from studying these structures range from assisting the orthodontist during diagnosis, as a tool to study growth in an individual through superimposition of structures on a longitudinal basis, and during evaluation of orthodontic treatment results as well.

The morphological shape of the sella was classified into five different variants other than that of the normal ^[7]. It might be of clinical importance when abnormal size of sella is found on lateral cephalogram. As sella turcica is an important region, and morphology may vary from individual to individual, establishing normal standards will aid in the process of eliminating any abnormality in the size or shape of sella turcica and growth of an individual can be assessed based on size of sella turcica at different age intervals.

In orthodontics, three skeletal types (Class I, II and III) identified based on the sagittal relation of the maxilla and mandible. There are many studies in the literature which have evaluated the correlation between the sagittal skeletal malrelation and the sella turcica. However, few studies highlighted correlation of sella turcica morphology and vertical relationship. Position, shape and size of sella turcica may affect the cephalometric assessment as well but need to be investigated extensively. Therefore, the present study is carried out to assess and relating sella turcica in skeletal Class I subjects having average, horizontal and vertical growth patterns.

Materials and Method:-

The present study was carried out in the Department of Orthodontics and Dentofacial Orthopaedics, Government Dental College & Hospital, Ahmedabad. The ethical clearance was obtained from the Institutional Ethics Committee.

Inclusion criteria:

1. Pretreatment lateral cephalograms of 180 Gujarati subjects with age group of 18-25 years (mean age-21.5) were selected.
2. Skeletal Class I subjects were chosen by

Parameters for skeletal Class I	Mean value
ANB angle	0-4°
W angle	51-56°
Yen angle	117-123°
Beta angle	27-35°
Wit's analysis	Males- 0 mm Female - -1 mm

Subjects were categorised into three groups according to Jarabak's ratio and SN-GoGn angle [sella- nasion to gonion-gnathion] (C. Steiner 1953):

$$\text{Jarabak's ratio} = \frac{\text{posterior facial height (S-Go)}}{\text{anterior facial height (N-Me)}} \times 100$$

SN-GoGn angle: formed by the intersection of SN and GoGn plane.

Jarabak's ratio	SN-GoGn	Group	Subgroups
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	angle			
62-65 %	26-38°	Average growth pattern (N=60)	A	A1-30 males A2-30 females
> 65%	< 26°	Horizontal growth pattern (N=60)	B	B1-30 males B2-30 females
< 62%	>38°	Vertical growth pattern (N=60)	C	C1-30 males C2-30 females

Exclusion criteria:

- Congenital and Craniofacial deformities.

Standardized lateral cephalograms in centric occlusion with lips relaxed and Frankfort horizontal plane parallel to floor (with Vatech PHT 30 LFO smart machine), a film to focus distance of 150 cm and a film to median plane distance of 15 cm.

Sella turcica measurements

Ezdent-I ver.3.1.5.1 Console software for assessment of size - length, depth, width, anteroposterior diameter and area of sella turcica.

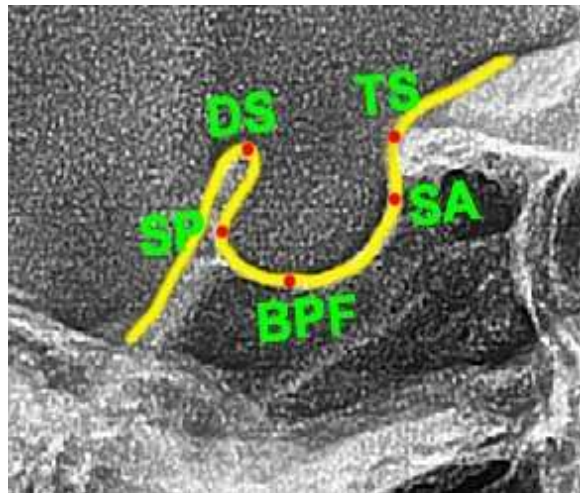


Fig. 1:- Sella turcica landmarks.

DS (Dorsum sella): the most posterior point on the internal contour of sella turcica.

TS (Tuberculum sella): anterior boundary of sella turcica.

BPF: Base of pituitary fossa. **SA:** sella anterior. **SP:** sella posterior.

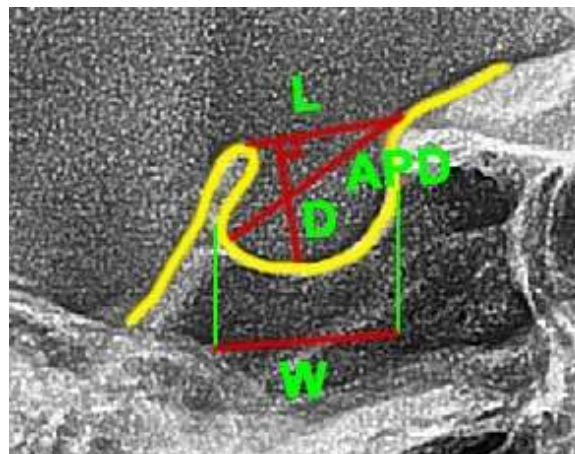


Fig. 2:- Sella turcica size parameters.

Length: Distance from tuberculum sella to tip of dorsum sella.

Depth: Perpendicular from length to the deepest point on the floor.

Anteroposterior diameter: Line drawn from tuberculum sella to the furthest point on the posterior inner wall of the fossa.

Area: Calculated by multiplication of anteroposterior diameter and depth of sella turcica. (Area = Anteroposterior diameter $\times$ Depth).

Width: Greatest antero-posterior dimension, as measured parallel to the FH plane, from sella anterior to sella posterior.

Shape of sella turcica

Study of **Axelsson 2004**^[7] was used to assess the shape of sella for six morphological variation - normal, oblique anterior wall, double contour of the floor, sella turcica bridge, irregularity in posterior part of sella and pyramidal shape of dorsum sella.

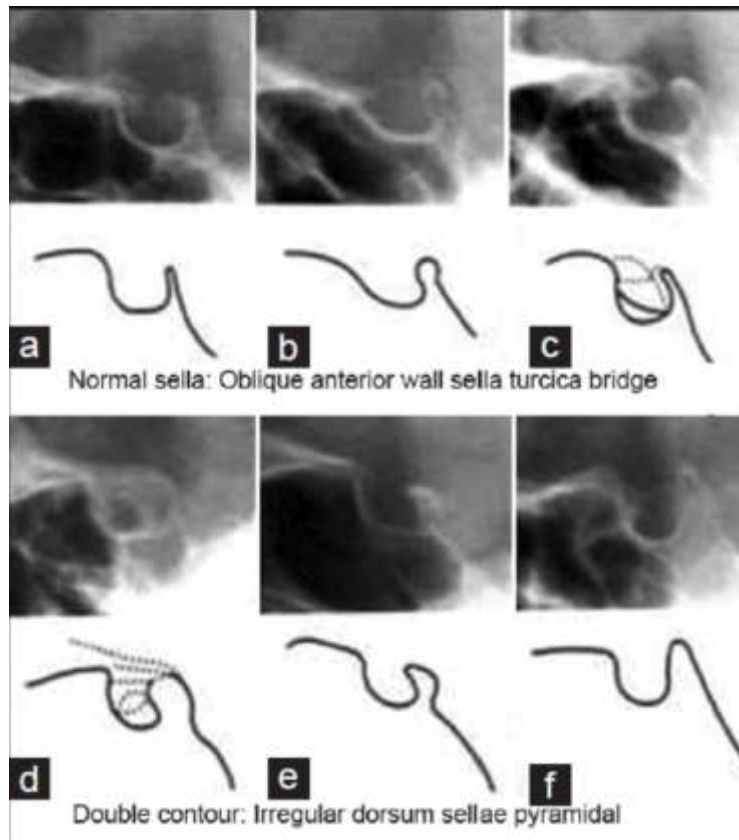


Fig. 3:- Shape of sella turcica.

Results:-

Data was analyzed using **SPSS 26.0** (SPSS Inc., Chicago, IL). Normality of the data was assessed using **Shapiro Wilkinson test**. **Inferential statistics** to find out the difference between the groups was done using **T test/Mann whitney U test** and **ONE WAY ANOVA TEST followed by POSTHOC TEST**. Analysis of proportion was done using **Chi square test**.

Table 1(a):- Descriptive Data - Average growth pattern (Group- A).

Parameters	Males (N=30)		Females (N=30)	
	Mean	SD	Mean	SD
Length	7.21	1.87	6.67	1.76
Depth	7.76	1.55	6.85	1.22
Anteroposterior	10.58	1.38	10.03	1.09

diameter				
Width	8.26	1.09	8.32	1.02
Area	83.02	21.92	69.95	17.67

Table 1(b):- Descriptive Data - Horizontal growth pattern (Group- B).

Parameters	Males (N=30)		Females (N=30)	
	Mean	SD	Mean	SD
Length	6.80	2.54	7.08	1.90
Depth	7.42	1.23	7.22	1.19
Anteroposterior diameter	10.03	1.74	10.25	1.32
Width	8.01	1.15	8.37	1.10
Area	75.37	20.78	74.70	17.90

Table 1(c):- Descriptive Data - Vertical growth pattern (Group- C).

Parameters	Males (N=30)		Females (N=30)	
	Mean	SD	Mean	SD
Length	8.39	1.72	8.05	1.62
Depth	7.67	1.29	8.20	0.99
Anteroposterior diameter	10.86	1.81	11.13	1.21
Width	8.64	1.27	8.49	1.22
Area	85.13	24.59	91.55	15.82

Table 2(a):- Descriptive Data for shape in Average growth pattern (Group- A).

Shape	Males (N=30)	Females (N=30)
Normal	24	23
Oblique anterior wall	0	3
Double contour of the floor	1	0
Sella turcica bridge	4	2
Irregularity in posterior part of sella turcica	0	1
Pyramidal shape of dorsum sella	1	1

Table 2(b):- Descriptive Data for shape in Horizontal growth pattern (Group- B).

Shape	Males (N=30)	Females (N=30)
Normal	15	21
Oblique anterior wall	2	1
Double contour of the floor	1	0
Sella turcica bridge	8	4
Irregularity in posterior part of sella turcica	0	3
Pyramidal shape of dorsum sella	4	1

Table 2(c):- Descriptive Data for shape in Vertical growth pattern (Group- C).

Shape	Males (N=30)	Females (N=30)
Normal	22	19
Oblique anterior wall	1	0
Double contour of the floor	0	1
Sella turcica bridge	4	8
Irregularity in posterior part of sella turcica	1	2
Pyramidal shape of dorsum sella	2	0

Table 3(a):- Gender comparison for size in group A (Average growth pattern).

Parameters	Males (N=30)		Females (N=30)		T test/Mann whitney U test
	Mean	SD	Mean	SD	P value
Length	7.21	1.87	6.67	1.76	0.25
Depth	7.76	1.55	6.85	1.22	0.76
Anteroposterior diameter	10.58	1.38	10.03	1.09	0.82
Width	8.26	1.09	8.32	1.02	0.91
Area	83.02	21.92	69.95	17.67	0.01*

*P<0.05 is statistically significant

T test /Mann Whitney U test analysis of mean values between the groups (Males vs Females) regarding size variables reported significant difference with respect to Area only (p<0.05) among the Average growth pattern group.

Table 3(b):- Gender comparison for size in group B (Horizontal growth pattern).

Parameters	Males (N=30)		Females (N=30)		T test/Mann whitney U test
	Mean	SD	Mean	SD	P value
Length	6.80	2.54	7.08	1.90	0.77
Depth	7.42	1.23	7.22	1.19	0.83
Anteroposterior diameter	10.03	1.74	10.25	1.32	0.89
Width	8.01	1.15	8.37	1.10	0.83
Area	75.37	20.78	74.70	17.90	0.92

*P<0.05 is statistically significant

T test /Mann Whitney U test analysis of mean values between the groups (Males vs Females) regarding size variables did not report significant difference with respect to all the variables (p>0.05) among the Horizontal growth pattern group.

Table 3(c):- Gender comparison for size in group C (Vertical growth pattern).

Parameters	Males (N=30)		Females (N=30)		T test/Mann whitney U test
	Mean	SD	Mean	SD	P value
Length	8.39	1.72	8.05	1.62	0.65
Depth	7.67	1.29	8.20	0.93	0.04*
Anteroposterior diameter	10.86	1.81	11.13	1.21	0.67
Width	8.64	1.27	8.49	1.22	0.85
Area	85.13	24.59	91.55	15.82	0.23

*P<0.05 is statistically significant

T test /Mann Whitney U test analysis of mean values between the groups (Males vs Females) regarding size variables reported significant difference with respect to Depth only (p<0.05) among the Vertical growth pattern group.

Table 4:- Gender comparison for size in total no. of sample.

Parameters	Males (N=90)		Females (N=90)		T test/Mann whitney U test
	Mean	SD	Mean	SD	P value
Length	7.46	0.67	7.26	0.57	0.0001*
Depth	7.61	0.14	7.42	0.56	0.03*
Anteroposterior	10.49	0.34	10.47	0.47	0.56

diameter					
Width	8.30	0.25	8.39	0.07	0.001*
Area	81.17	4.19	78.73	9.26	0.0001*

*P<0.05 is statistically significant

T test /Mann Whitney U test analysis of mean values between the groups (Males vs Females -overall) regarding size variables reported significant difference with respect to all the variables ($p < 0.05$) except Anteroposterior diameter ($P > 0.05$).

Table 5(a):- Gender comparison for shape in average growth pattern (group A).

Shape	Males (N=30)	Females (N=30)	Chi square test P value
Normal	24 (80%)	23 (76.7%)	0.003*
Oblique anterior wall	0	3 (10%)	
Double contour of the floor	1 (3.3%)	0	
Sella turcica bridge	4 (13.4%)	2 (6.7%)	
Irregularity in posterior part of sella turcica	0	1 (3.3%)	
Pyramidal shape of dorsum sella	1 (3.3%)	1 (3.3%)	

*P<0.05 is statistically significant

Chi square test analysis reported significant difference between the groups (Males vs Females) regarding various shapes ($p < 0.05$) in Average growth pattern.

Table 5(b):- Gender comparison for shape in horizontal growth pattern (group B).

Shape	Males (N=30)	Females (N=30)	Chi square test P value
Normal	15 (50%)	21 (70%)	0.0001*
Oblique anterior wall	2 (6.7%)	1 (3.3%)	
Double contour of the floor	1 (3.3%)	0	
Sella turcica bridge	8 (26.7%)	4 (13.4%)	
Irregularity in posterior part of sella turcica	0	3 (10%)	
Pyramidal shape of dorsum sella	4 (13.4%)	1 (3.3%)	

*P<0.05 is statistically significant

Chi square test analysis reported significant difference between the groups (Males vs Females) regarding various shapes ($p < 0.05$) in Horizontal growth pattern.

Table 5(c):- Gender comparison for shape in vertical growth pattern (group C).

SHAPE	Males (N=30)	Females (N=30)	Chi square test P value
Normal	22 (73.4%)	19 (63.4%)	0.002*
Oblique anterior wall	1 (3.3%)	0	
Double contour of the floor	0	1 (3.3%)	
Sella turcica bridge	4 (13.4%)	8 (24%)	
Irregularity in posterior part of sella turcica	1 (3.3%)	2 (6.7%)	
Pyramidal shape of dorsum sella	2 (6.7%)	0	

*P<0.05 is statistically significant

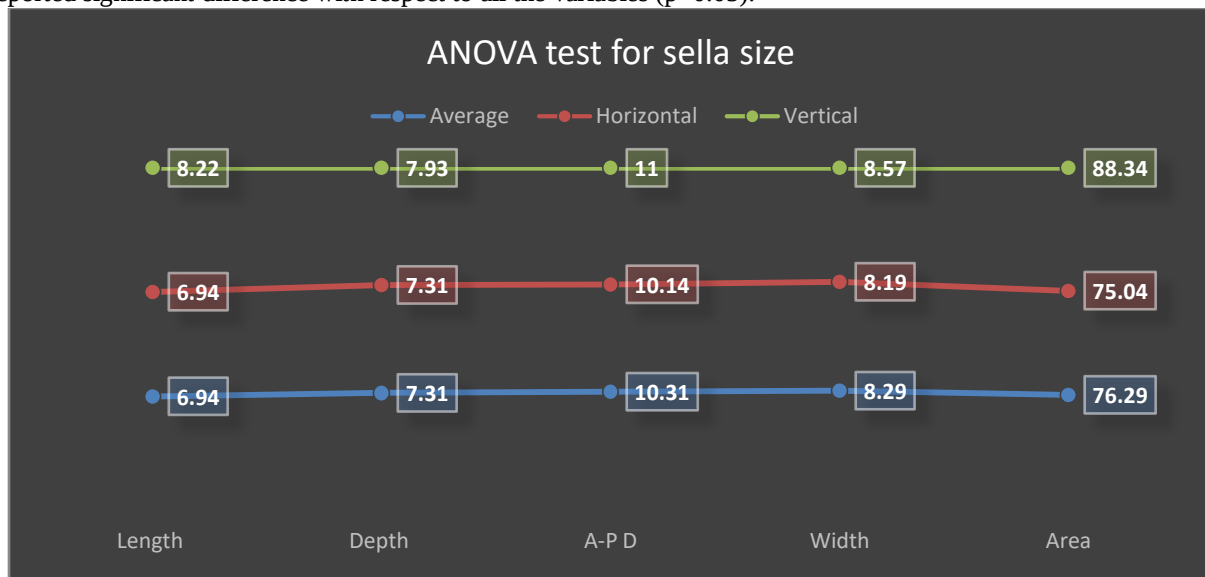
Chi square test analysis reported significant difference between the groups (Males vs Females) regarding various shapes ($p < 0.05$) in Vertical growth pattern.

Table 6 and Graph:- ANOVA test for sella size.

Parameters	Average (N=60)		Horizontal (N=60)		Vertical (N=60)		One wayanova P value
	Mean	SD	Mean	SD	Mean	SD	
Length	6.94	0.27	6.94	0.13	8.22	0.17	0.0001*
Depth	7.31	0.45	7.31	0.09	7.93	0.26	0.0001*
Anteroposterior diameter	10.31	0.27	10.14	0.10	11	0.13	0.0001*
Width	8.29	0.03	8.19	0.18	8.57	0.07	0.0001*
Area	76.29	6.73	75.04	0.33	88.34	3.24	0.0001*

*P<0.05 is statistically significant

One-way ANOVA test analysis of mean values between the groups (Average vs Horizontal) regarding size variables reported significant difference with respect to all the variables (p<0.05).

**Table 7:-** Comparison for size (Average vs Horizontal).

Parameters	Average (N=60)		Horizontal (N=60)		T test/Mann whitney U test P value
	Mean	SD	Mean	SD	
Length	6.94	0.27	6.94	0.13	0.98
Depth	7.31	0.45	7.31	0.09	0.98
Anteroposterior diameter	10.31	0.27	10.14	0.10	0.002*
Width	8.29	0.03	8.19	0.18	0.004*
Area	76.29	6.73	75.04	0.33	0.31

*P<0.05 is statistically significant

T test /Mann Whitney U test analysis of mean values between the groups (Average vs Horizontal) regarding size variables reported significant difference with respect to Anteroposterior diameter and Width (p<0.05).

Table 8:- Comparison for size (Average vs Vertical).

Parameters	Average (N=60)		Vertical (N=60)		T test/Mann whitney U test P value
	Mean	SD	Mean	SD	
Length	6.94	0.27	8.22	0.17	0.0001*
Depth	7.31	0.45	7.93	0.26	0.0001*

Anteroposterior diameter	10.31	0.27	11	0.13	0.0001*
Width	8.29	0.03	8.57	0.07	0.0001*
Area	76.29	6.73	88.34	3.24	0.0001*

*P<0.05 is statistically significant

T test /Mann Whitney U test analysis of mean values between the groups (Average vs Vertical) regarding size variables reported significant difference with respect to all the variables (p<0.05).

Table 9:- Comparison for size (Horizontal vs Vertical).

Parameters	Horizontal (N=60)		Vertical (N=60)		T test/Mann whitney U test
	Mean	SD	Mean	SD	P value
Length	6.94	0.13	8.22	0.17	0.0001*
Depth	7.31	0.09	7.93	0.26	0.0001*
Anteroposterior diameter	10.14	0.10	11	0.13	0.0001*
Width	8.19	0.18	8.57	0.07	0.0001*
Area	75.04	0.33	88.34	3.24	0.0001*

*P<0.05 is statistically significant

T test /Mann Whitney U test analysis of mean values between the groups (Horizontal vs Vertical) regarding size variables reported significant difference with respect to all the variables (p<0.05).

Table 10:- (Average vs Horizontal)– comparison for shape.

Parameters	Average (N=60)	Horizontal (N=60)	Chi square test P value
Normal	47 (78.3%)	36 (60%)	0.41
Oblique anterior wall	3 (5%)	3(5%)	
Double contour of the floor	1 (1.6%)	1 (1.6%)	
Sella turcica bridge	6 (10%)	12 (20%)	
Irregularity in posterior part of sella turcica	2 (3.3%)	3 (5%)	
Pyramidal shape of dorsum sella	2 (3.3%)	5 (8.3%)	

*P<0.05 is statistically significant

Chi square test analysis did not report any significant difference between the groups (Average vs Horizontal) regarding various shapes (p>0.05).

Table 11:- (Horizontal vs Vertical) –comparison for shape.

Shape	Horizontal (N=60)	Vertical (N=60)	Chi square test P value
Normal	36 (60%)	41 (68.3%)	0.35
Oblique anterior wall	3(5%)	1 (1.6%)	
Double contour of the floor	1 (1.6%)	1 (1.6%)	
Sella turcica bridge	12 (20%)	12 (20%)	
Irregularity in posterior part of sella turcica	3 (5%)	3 (5%)	
Pyramidal shape of dorsum sella	5 (8.3%)	2 (3.3%)	

*P<0.05 is statistically significant

Chi square test analysis did not report any significant difference between the groups (Horizontal vs Vertical) regarding various shapes (p>0.05).

Table 12:- (Average vs Vertical) – comparison for shape.

Shape	Average (N=60)	Vertical (N=60)	Chi square test P value
Normal	47 (78.3%)	41 (68.3%)	0.32
Oblique anterior wall	3 (5%)	1 (1.6%)	
Double contour of the floor	1 (1.6%)	1 (1.6%)	
Sella turcica bridge	6 (10%)	12 (20%)	
Irregularity in posterior part of sella turcica	2 (3.3%)	3 (5%)	
Pyramidal shape of dorsum sella	2 (3.3%)	2 (3.3%)	

***P<0.05 is statistically significant**

Chi square test analysis did not report any significant difference between the groups (Average vs Vertical) regarding various shapes ($p>0.05$).

Table 13:- Comparison for shape in total no. sample for group A, B and C.

Shape	Average (N=60)	Horizontal (N=60)	Vertical (N=60)	Chi square test P value
Normal	47 (78.3%)	36 (60%)	41 (68.3%)	0.27
Oblique anterior wall	3 (5%)	3 (5%)	1 (1.6%)	
Double contour of the floor	1 (1.6%)	1 (1.6%)	1 (1.6%)	
Sella turcica bridge	6 (10%)	12 (20%)	12 (20%)	
Irregularity in posterior part of sella turcica	2 (3.3%)	3 (5%)	3 (5%)	
Pyramidal shape of dorsum sella	2 (3.3%)	5 (8.3%)	2 (3.3%)	

***P<0.05 is statistically significant**

Chi square test analysis did not report any significant difference between the groups regarding various shapes ($p>0.05$).

Table 14:- Gender comparison for shape in total no. of sample.

Shape	Males (N=90)	Females (N=90)	Chi square test P value
Normal	61 (67.8%)	64 (71.1%)	0.32
Oblique anterior wall	3 (3.3%)	4 (4.6%)	
Double contour of the floor	2 (2.3%)	2 (2.3%)	
Sella turcica bridge	16 (17.8%)	14 (15.5%)	
Irregularity in posterior part of sella turcica	1 (1.1%)	6 (6.7%)	
Pyramidal shape of dorsum sella	7 (7.8%)	2 (2.3%)	

***P<0.05 is statistically significant**

Chi square test analysis did not report any significant difference between the groups regarding various shapes ($p>0.05$).

Discussion:-

Sella turcica is a concave structure (depression), located in the intracranial surface of sphenoid bone, containing the pituitary gland and bounded anteriorly by the tuberculum sellae and posteriorly by the dorsum sellae. The development of pituitary gland and sella turcica occurs through a complex process.

Malformations in the facial area have been associated with abnormalities of the sella turcica which can be attributed to the fact that the craniofacial complex is primarily derived by migration of neural crest cells to branchial arches, which migrate from the tuberculum sellae to the frontonasal, maxillary and palatine fields through the sonic

hedgehog (SHH) gene pathway. Point mutations in the signalling pathway may result in deformities in the craniofacial region. Due to a common embryological origin, alterations in the sella turcica dimensions and morphology may be linked to skeletal aberrations^[26]. Thus, the focus of this study was to find an association between sella turcica shape and size with skeletal relations and to use it as a predictor of facial growth patterns.

Present cross-sectional study described various parameters of sella turcica on lateral cephalograms in skeletal Class I subjects having different growth patterns. Table 1(a), 1(b) and 1(c) showed descriptive statistics with mean and standard deviation for length, depth, width, anteroposterior diameter and area in average, horizontal and vertical growth pattern respectively. Mean value for sella turcica length, depth, width, anteroposterior diameter and area was more for vertical growth pattern in females and also in males except for sella depth which was more in average growth pattern in males.

Table 2(a), 2(b) and 2(c) showed descriptive data for variation in shape of sella turcica. Normal shape of sella turcica was found in more number of subjects in all growth pattern than other variants. Normal shape of sella turcica was more prevalent in average growth pattern for males and also in females.

T test/Mann Whitney U test was done for sella turcica size parameters in different growth pattern groups (A, B and C) to determine gender differences.

In average growth pattern, non-significant difference found for all parameters except for sella area ($p \leq 0.01$) which was statistically significant and larger in males [Table 3(a)].

There was non-significant difference for sella size parameters in horizontal growth pattern. [Table 3(b)] Whereas, R. rohira et al. (2015)^[14] found the sella turcica length in males of Class II hypodivergent group was significantly higher as compared to the females of the same group ($p = 0.038$).

Non-significant difference found for sella length, width, anteroposterior diameter and area in vertical growth pattern. Statistically significant difference for sella depth ($p \leq 0.04$) which was higher in females [Table 3(c)].

T test/Mann Whitney U test was done to determine gender differences for total no. of Class I subjects for sella turcica size parameters. Non-significant difference found for anteroposterior diameter. Statistically highly significant difference for sella length and area ($p \leq 0.0001$) which was larger in males. Boddeti SS et al. (2016)^[19] also found significant difference for length between gender which was more for males in skeletal Class I South Indians. Significant difference found for sella depth ($p \leq 0.03$) which was higher in males whereas width ($p \leq 0.001$) was more in females (Table 4). Chauhan p et al. (2014)^[13] observed significant difference in sella width among gender which was more in females in North Indian population. Kiran et al. (2017)^[21] observed that mean anteroposterior diameter and depth of sella turcica was higher in females and had significant difference in south Indian population. In study by Pankaj Akhare et al. (2018)^[5] showed significant difference for skeletal Class I, II and III in size of sella turcica between gender in which males had larger length, depth and diameter of sella than the females. Mukta Motwani et al. (2017)^[22] evaluated significant difference for length between genders which was more in males whereas depth and diameter had non-significant difference in sagittal skeletal pattern. Haritha Pottipalli Sathyanaratyana et al. (2013)^[12] study for sagittal skeletal relation showed that sella length had significant gender difference which was more in males for skeletal Class III, whereas depth and diameter had non-significant difference in south Indian population. Study by G. Magat (2018)^[25] found females had greater diameter of sella turcica than males ($p = 0.004$) for total no. of subjects whereas sella depth and diameter had non-significant difference with sagittal skeletal relation in Turkish individuals.

In the present study, sella turcica size parameters between growth patterns (group A, B and C - One way ANOVA test) revealed statistically highly significant difference ($p \leq 0.0001$) regarding length, depth, width, anteroposterior diameter and area with more mean for vertical growth pattern subjects (Table 6). This may be due to excessive growth of the posterior cranial fossa which articulates with the mandible through the temporomandibular joint, may result in hyperdivergence and so consequently, subject with vertical growth may also have more mean value for sella size parameters. Erum Afzal et al. (2019)^[26] found significant differences in length and depth of sella which was increased in hyperdivergent subjects compared to normodivergent and hypodivergent subjects.

T test/Mann Whitney U test was done for sella turcica size parameters between two growth pattern groups.

On comparing between average and horizontal growth pattern, non-significant difference was found for sella length, depth and area whereas there was significant difference found for sella width ($p \leq 0.004$) and anteroposterior diameter ($p \leq 0.002$) with more mean value in average growth pattern (Table 7).

When sella size compared between average and vertical growth pattern, statistically highly significant difference ($p \leq 0.001$) found for all variables with more mean value in vertical growth pattern subjects (Table 8). Erum Afzal et al. (2019) ^[26] also found statistically significant difference found for hyperdivergent subjects for sella turcica diameter in normo vs hyperdivergent subjects.

Statistically highly significant difference ($p = 0.0001$) found for size parameters between horizontal and vertical growth pattern subjects with more mean value in vertical growth pattern (Table 9).

Yasa et al. (2017) ^[20] study also showed that sella depth was higher in high angle than average angle individual ($p = 0.024$). Significant difference was found for sella diameter in low ($p = 0.004$) and high angle ($p = 0.005$) individuals which was larger than average angle individuals. Length of sella turcica was not different between groups ($p = 0.230$) but as study by Konwar et al. (2016) ^[17] found significant difference for length between high and low angle which was larger in low angle subject whereas depth and diameter had non-significant difference.

Chi-square test was done to investigate relationship of gender and growth pattern (group A, B and C) with shape of sella turcica.

In the present study, significant gender difference was found ($p \leq 0.003$) for sella turcica morphology in average growth pattern subjects. Morphological variation frequency for males- Normal shape (80 %), sella turcica bridge (13.4%), pyramidal shape of dorsum sella and double contour of the floor (3.3%) whereas oblique anterior wall and irregularity in posterior part of sella turcica was not found in any subject whereas for females- normal (76.7 %), oblique anterior wall (10%), sella turcica bridge (6.7%), irregularity in posterior part and pyramidal shape of dorsum sella (3.3%) however, double contour of floor was not found in any females subject [Table 5(a)].

However, statistically highly significant gender difference found in horizontal growth pattern ($p \leq 0.0001$). For females- Normal shape (70 %), sella turcica bridge (13.4 %), irregularity in posterior part (10 %), oblique anterior wall and pyramidal shape of dorsum sella (3.3 %), double contour of floor not found in any subject whereas for males- normal shape (50%), sella turcica bridge (26.7%), pyramidal shape of dorsum sella (13.4%), oblique anterior wall (6.7%), double contour of floor (3.3%) and irregularity in posterior part was not found in any subject [Table 5(b)].

In vertical growth pattern, significant difference found for gender ($p \leq 0.002$). For males- normal shape (73.4 %), sella turcica bridge (13.4 %), pyramidal shape of dorsum sella (6.7%), oblique anterior wall and irregularity in posterior part (3.3%) however double contour of floor was not seen in any subject. For females- normal shape (63.4 %), sella turcica bridge (24 %), irregularity in posterior part (6.7 %), double contour of floor (3.3 %) whereas oblique anterior wall and pyramidal shape of dorsum sella not found in any subject [Table 5(c)].

In the present study, normal shape was in more number of males with average growth and other variation also but with horizontal growth.

When sella shape was compared between two growth pattern (Chi square test- Table 10,11 and 12 respectively).

Morphological variation frequency for shape between group A and B- normal shape (78.3%), sella turcica bridge (10%), irregularity in posterior part and pyramidal shape (3.3%) in average growth pattern whereas normal shape (60%), sella turcica bridge (20%), pyramidal shape (8.3%) and irregularity in posterior part (5%) in horizontal growth pattern however oblique anterior wall (5%) and double contour of floor (1.6%) was equal in both growth pattern (Table 10).

Between group B and C- normal shape (60%), pyramidal shape (8.3%) and oblique anterior wall (5%) in horizontal growth pattern whereas normal shape (68.3%), pyramidal shape (3.3 %) and oblique anterior wall (1.6%) in vertical growth pattern whereas double contour of floor (1.6 %), sella turcica bridge (20 %) and irregularity in posterior part (5%) was equal in horizontal and vertical growth pattern (Table 11).

Between group A and C- normal shape (78.3 %), sella turcica bridge (10%), oblique anterior wall (5%) and irregularity in posterior part (3.3%) in average growth pattern whereas normal shape (68.3%), sella turcica bridge (20 %), irregularity in posterior part (5%) and oblique anterior wall (1.6%) however pyramidal shape (3.3%) and double contour of floor (1.6 %) was equal in both growth patterns (Table 11).

In our study, normal shape of sella was more prevalent as compared to other variants which were more in average followed by vertical and horizontal growth pattern. Non-significant difference found for sella shape in total no. of Class I subjects between group A, B and C, double contour of the floor of sella was equal which was 1.6% in all growth patterns.

Yasa et al (2017) ^[20] found that sella turcica had majority of normal morphology which was more for high angle (65%). Oblique anterior wall was equal in number in low and average angle individual whereas pyramidal shape was equal in average and high angle individuals. Sella turcica bridge was found to be most common among low skeletal growth pattern.

On assessing the morphology of sella turcica of high and low angle individual by Konwar et al (2016) ^[17] 80% of the subjects had normal sella and 20% of the subjects had variation for low angle group subjects. When it was assessed between gender, normal shape was 5.7% higher in males (83.7%) as compared to females (78.0%) but the difference also not reach statistically significant.

Erum Afzal, Mubassar fida (2019) ^[26] evaluated non-significant difference between sella shape and vertical pattern. Frequency for sella shape- 38.8 % of subjects had normal sella morphology followed by oblique anterior wall (16.6 %), bridging (15.5%), double contoured (14.4 %), pyramidal shape (10 %) and irregularity in posterior part (4.4 %).

In our study, total no. of Class I subjects comparison for sella shape between males and females (Chi-square test) revealed that normal shape was more prevalent in females (71.1 %) than males (67.8 %). Morphological variation frequency sequence in females (28.9%) which include sella turcica bridge (15.5 %), irregularity in posterior part (6.7%), oblique anterior wall (4.6%) and pyramidal shape (2.3%) whereas for males, other variation (32.2%) in which sella turcica bridge (17.8%), pyramidal shape (7.8%), oblique anterior wall (3.3%) and irregularity in posterior part (1.1%). However, equal percentage of females and males had double contour of floor (2.3%) (Table 14). Nagraj et al. (2015) ^[32] also found morphology of sella was normal in 46.5 % subjects whereas 53.5 % subjects had other morphological variation in total no. of subjects with different sagittal relation. Whereas, Kiran et al. (2017) ^[21] found non-significant difference, in the majority of the males (70.0%) and females (67.7%) had normal sella shape in South Indian population. However, morphology of the sella turcica appeared to be normal in the majority of subjects (60%) and variation in the morphology was found in 40% of individuals in different sagittal skeletal relation by Shreshtha et al. (2018) ^[24] but non-significant gender difference for shape between skeletal Classes.

But study by G magat, S Ozcan Sener (2018) ^[25] seen normal morphology in 39% subjects whereas other morphological variations in 61% in skeletal Class I, II and III. The pyramidal shape was 15.5%, double contour floor was 14.6%, and oblique anterior wall was 14.4%. The irregular dorsum sella and sella turcica bridge were observed in 8.6% and 8.0%, respectively.

Yassir et al. (2010) ^[10] found that Class I had highest percentage of normal sella turcica (70%) among iraqi individual and had five morphological variations. For the total sample, normal shape was more compared to other variables which was higher in females (80.6 %) than males (71.4%). Haritha Pottipalli Sathyanarayana et al (2013) ^[12] study showed that 75% of the Class I South Indian subjects had normal morphology whereas the remaining 25% had variations in the shape, lowest being pyramid like shape of the dorsum sellae in 2%, oblique anterior wall and double contour of the floor in 3%, bridging of sella turcica in 5% and irregularity (notch like depression) in the posterior surface of the dorsum sellae in 12% of subjects. Boddeti SS et al. (2016) ^[19] also evaluated that 62.5% of patients had normal sella and 37.5% of the patients had variations in skeletal Class I patients. Pankaj Akhare et al. (2018) ^[5] study showed that 77.6% had normal shape whereas 32.4% had morphological variation for skeletal Class I subjects. morphology of the sella turcica appeared to be normal in the majority of subjects (69 %), with 31% of subjects showing variation- An irregular dorsum sella was found in 10.6 %, while an oblique anterior wall in 8.3 %, a double-contoured sella turcica in 5.6 % and sella turcica bridging in 6.5% subjects in skeletal Class I, II, and III subjects. S. Sinha et al. (2019) ^[28] also observed normal shape of the sella was more compared to other variants followed by bridging of sella turcica, irregular dorsum sella, oblique anterior wall, pyramidal shaped sella and least

frequency was seen in double contour of floor for skeletal Class I subjects. Alkofide (2007) ^[9] study showed that morphology of the sella turcica appeared to be normal in shape in 66.7 percent in total no. with skeletal Class I, II and III Saudi subjects. Variation in morphological frequency- an irregular dorsum sella was found in 11.1%, while an oblique anterior wall in 9.4 %, double-contoured sella in 8.9%, pyramidal shape in 2.8% and sella turcica bridge in 1.1%.

The variation in size and shape of the sella turcica may be attributed to ethnic background, geographic variation, genetic influence, evolutionary changes along with skeletal anteroposterior and vertical jaw relationship.

Limitation:

In the present cross sectional lateral cephalometric study, skeletal Class I subjects with different growth patterns based on Jarabak's ratio and SN-GoGn angle were considered. Class II and Class III skeletal type along with other growth pattern parameters were not taken into account.

Conclusion:-

Following conclusions were drawn from the study:

1. On comparing sella length, depth, width, anteroposterior diameter and area between average, horizontal and vertical growth pattern, statistically highly significant difference was found with more mean value in vertical growth pattern subjects.
2. Furthermore, significant difference with more mean for anteroposterior diameter and width in average growth, whereas statistically high significant difference with more mean was found for sella size in vertical growth pattern when analysed between two groups.
3. Sexual dimorphism was not found with horizontal growth. Whereas gender difference was found for sella area which was more in males with average growth and sella depth which was more in females with vertical growth.
4. In total no. of Class I subjects, gender difference was found for length, depth and area which was more in males and for width in females except for anteroposterior diameter.
5. Normal shape of sella turcica was more prevalent in all growth patterns and frequency distribution of percentage for sella shape varies with growth pattern except double contour of floor which was equal in all.
6. Gender difference was found regarding growth pattern for sella turcica shape, but pyramidal shape was equal in percentage with average growth (3.3%). However, irregularity in posterior part in males and double contour of floor in females was not seen in average and horizontal growth whereas oblique anterior wall also in males with average growth but in females with vertical growth pattern.
7. Non-significant gender difference was found in total no. of Class I subjects in morphological variation of sella turcica shape except for double contour of floor which was equal in number.

Various acquired sella parameters which can be used to have an approximate idea about it, which may help the orthodontist for diagnosis and treatment planning when faced with a problem in aberration of sella turcica on the lateral cephalogram, and this may help them to distinguish between pathological and normal physiological variation.

Further, longitudinal study with larger sample size and three-dimensional analysis may provide precise and accurate information about sella turcica morphology.

References:-

1. **Perović T, Blažej Z, Jovanović I, Cvetković M.** Morphometric analysis of the sella turcica in subjects with different vertical growth patterns-a cephalometric study. *Homo: Internationale Zeitschrift für die Vergleichende Forschung am Menschen*. 2021 Jul 14;72(3):215-227.
2. **Swapna Ramesh Chavan and A. S. Katti and N. G. Herekar.** A Study on the Shape of Sella Turcica. *Indian Journal of Anatomy*. 2017;6(1):59-63.
3. **Tiwari A., Srengalakshmi.** The Size of the Sella Turcica in Skeletal Class I, Class II, and Class III using FACAD Software-South Indian Population Study. *Indian Journal of Public Health Research & Development*. 2020 Jul 1;11(7).
4. **Neha, Mogra S, Shetty VS, Shetty S.** Sella size and jaw bases-Is there a correlation???. *Contemporary clinical dentistry*. 2016 Jan;7(1):61.

5. **Akhare P, Wajekar P, Shenoy U, Banerjee S, Hazare A, Karia H, Bhattacharya S.** The shape and size of the sella turcica in skeletal class I, II & III patients of Central India population. *Journal Of Applied Dental and Medical Sciences*. 2018;4:2.
6. **Saad A, Hamid WU.** Assessment and comparison of dimensions of Sella turcica in skeletal class I and skeletal class II cases. *Pakistan oral and dental journal*. 2005 June;25(1).
7. **Axelsson S, Storhaug K, Kjær I.** Post-natal size and morphology of the sella turcica. Longitudinal cephalometric standards for Norwegians between 6 and 21 years of age. *The European Journal of Orthodontics*. 2004 Dec 1;26(6):597-604.
8. **Choi WJ, Hwang EH, Lee SR.** The study of shape and size of normal sella turcica in cephalometric radiographs. *Imaging Science in Dentistry*. 2001;31(1):43-9.
9. **Alkofide EA.** The shape and size of the sella turcica in skeletal Class I, Class II, and Class III Saudi subjects. *The European Journal of Orthodontics*. 2007 Oct 1;29(5):457-63.
10. **Yassir YA, Nahidh MN, Yousif HA.** Size and morphology of sella turcica in Iraqi adults. *Mustansiria Dental Journal*. 2010;7(1):23-30.
11. **Chavan SR, Kathole MA, Katti AS, Herekar NG.** Radiological analysis of sella turcica. *Int J Recent Trends Sci Technol*. 2012;4(1):36-40.
12. **Sathyanarayana HP, Kailasam V, Chitharanjan AB.** The size and morphology of sella turcica in different skeletal patterns among South Indian population: A lateral cephalometric study. *Journal of Indian Orthodontic Society*. 2013 Oct;47(4_suppl1):266-71.
13. **Chauhan P, Kalra S, Mongia SM, Ali S, Anurag A.** Morphometric analysis of sella turcica in North Indian population: a radiological study. 2014 May;2(2): 521-526.
14. **Rohria R, Jain S.** Sellar dimension in skeletal class II subjects with different growth patterns. *Journal of Pierre Fauchard Academy (India Section)*. 2015 Mar 1;29(1):26-31.
15. **Valizadeh S, Shahbeig S, Mohseni S, Azimi F, Bakhshandeh H.** Correlation of shape and size of sella turcica with the type of facial skeletal class in an Iranian group. *Iranian Journal of Radiology*. 2015 Jul;12(3).
16. **Dr. Nishi Nikunj Kapasiawala, Dr. Nakul Ravi Raval and Dr. Amol Somaji Patil.** Comparative analysis of size of sella turcica with different skeletal patterns. *International Journal of Current Research*. 2016;8(11):11-15.
17. **Konwar SK, Singhla A, Bayan R.** Morphological (length, depth, and diameter) study of sella turcica in different mandibular growth patterns in Indians. *Int. J. Dent. Med. Spec*. 2016 Jul 1;3:4-9.
18. **Ravindranath VK, Karandikar G.** Sella Turcica: An Important Aid in Diagnosis and Treatment Planning. *Journal of Contemporary Dentistry*. 2016 Dec 1;6(3):181-3.
19. **Boddeti SS, Varma NS, Sasidhar YN, Ujwala T, Navya P, Pradesh A.** The S ize and the morphology of sella turcica in different skeletal patterns of south Indians: A lateral cephalogrametric study. *Int J Oral Health Med Res*. 2016;3(1):13-6.
20. **Yaşa Y, BÜYÜK KUTALMIŞ S, Benkli YA, Arslan A, TOPBAŞI NM.** The size and shape of the sella turcica in adolescent orthodontic patients with different vertical growth patterns. *Clinical Dentistry and Research*. 2017;41(1):3-9.
21. **Kiran C, Ramaswamy P, Santosh N., Smitha B., Satish A.** Radio-morphometric Analysis of Sella Turcica in the South Indian Population-A Digital Cephalometric Study. *Arab Journal of Forensic Sciences and Forensic Medicine*. 2017;1(5):517-523.
22. **Motwani MB, Biranjan R, Dhole A, Choudhary AB, Mohite A.** A study to evaluate the shape and size of sella turcica and its correlation with the type of malocclusion on lateral cephalometric radiographs. *IOSR J. Dent. Med. Sci*. 2017;16:126-32.
23. **Kashio H, Toriya N, Osanai S, Oka Y, Konno-Nagasaka M, Yamazaki A, Muguruma T, Nakao Y, Shibata T, Mizoguchi I.** Prevalence and dimensions of sella turcica bridging in Japanese female orthodontic patients. *Orthodontic Waves*. 2017 Sep 1;76(3):164-73.
24. **Shrestha GK, Pokharel PR, Gyawali R, Bhattarai B, Giri J.** The morphology and bridging of the sella turcica in adult orthodontic patients. *BMC oral health*. 2018 Dec;18(1):1-8.
25. **Magat G, Sener SO.** Morphometric analysis of the sella turcica in Turkish individuals with different dentofacial skeletal patterns. *Folia Morphologica*. 2018;77(3):543-50.
26. **Afzal E, Fida M.** Association between variations In sella turcica dimensions and morphology and skeletal malocclusions. *Journal of Ayub Medical College, Abbottabad*. 2019;31(2):172.
27. **Atilla AO, Ozturk T, Yagci A.** Comparison of cervical vertebral anomalies and sella turcica bridging in different growth stages with various vertical skeletal growth patterns. *Surgical and Radiologic Anatomy*. 2021 Jan;43(1):117-25.

28. **Sinha S, Shetty A, Nayak K.** The morphology of Sella Turcica in individuals with different skeletal malocclusions–A cephalometric study. *Translational Research in Anatomy*. 2020 Mar 1;18:100054.
29. **Kadam P, Sabharwal A, Patil AS, Sabane A, Bhosale V.** Study of patterns of sella turcica with different malocclusions. *International Journal of Orthodontic Rehabilitation*. 2019 Jul 1;10(3):112.
30. **Usman JD, Bello A, Bello SS, Abdulhameed A, Ammani T, Yunusa GH, Musa MA.** Cephalometric Assessment of the Sella Turcica in Children.
31. **Ravindranath VK, Karandikar G.** Sella Turcica: An Important Aid in Diagnosis and Treatment Planning. *Journal of Contemporary Dentistry*. 2016 Dec 1;6(3):181-3.
32. **Nagaraj T, Shruthi R, James L, Keerthi I, Balraj L, Goswami RD.** The size and morphology of sella turcica: A lateral cephalometric study. *Journal of Medicine, Radiology, Pathology and Surgery*. 2015 May 1;1(3):3-7.