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RESEARCH ARTICLE

CORRELATION BETWEEN SELLA TURCICA BRIDGING AND PALATAL CANINE IMPACTION, AND ITS ASSOCIATION WITH SECTORAL AND ANGULAR VALUES IN SOUTH INDIAN POPULATION

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ABSTRACT

Objectives: To correlate sella turcica bridging and canine impaction and to associate the impaction with angular and sectoral parameters.

Materials and Method: Pre-treatment cephalometic and panoramic radiographs of the selected patients were obtained. Group 1 consisted of 25 patients with palatally impacted canines. Group 2 (control group) consisted of 25 subjects with normally erupted canines.The data obtained is analysed and compared between the groups.

Results: there was a reduced interclinoidal distance among the subjects with impacted canines (P = 0.009). The comparison of mean depths and diameters between the subjects and the controls was found to be insignificant. The highest frequency of type II calcification was reported in 19 patients (76%) with impacted canines. Type III calcification of the interclinoid ligament was observed in (20%) subjects with impacted canines, whereas no subjects had type III calcification in the control group. There was a positive correlation between inter clinoidal distance and angle and a negative correlation between inter clinoidal distance and sectoral values.

Conclusion: The frequency of sella turcica bridging is increased in patients with palatal canine impactions. Sella turcica length is reduced in patients with palatal canine impactions. There is no significant difference in the size of sella between males and females. The chances of having partial or complete bridging of sella turcica in subjects with palatally impacted canines are approximately greater than those with normally erupted canines.

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INTRODUCTION

A canine can be palatally impacted if an additional space is available in the maxillary bone. This space can be provided either by an excessive growth in the base of the maxillary bone, space created by agenesis or peg-shaped lateral incisors, or stimulated eruption of the lateral incisor or the first premolar. In these conditions the canine is free to "dive" in the bone and to become palatally impacted. A dysplasia in the maxillary-premaxillary suture can also modify the direction of the maxillary canine's eruption (Bishara, 1992). The two Common theories contributing to the etiology of maxillary canine impaction are guidance theory and the genetic theory. According to the genetic theory, impacted maxillary canines are considered as a dental anomaly of genetic origin (Becker, 1981). Adrian Becker gave an alternative scenario, the 'guidance theory', in which the presence of other dental abnormalities such as submerged deciduous molars, mandibular premolar aplasia, hypoplastic enamel, and microdontia of maxillary lateral incisors or peg laterals causes environmental conditions which result in palatal displacement of the canines (Becker, 1995; Peck, 1994). Early detection and timely intervention of impacted canines can considerably reduce the treatment time, expense, and complexity of the treatment. A cephalometric evaluation of the craniofacial morphology is a part of treatment planning in orthodontic practice. Therefore, the clinician should be aware of the normal morphology of the skeletal structures and its variations. One common morphologic variation of sella turcica is the sella bridging or reduced interclinoidal distance. Abnormal embryologic development of the sphenoid bone or exaggerated calcification of the dura mater between the anterior and posterior clinoidal processes of the sphenoid bone results in this irregular bridge formation. Hence, the sella bridge can be considered as a developmental anomaly. The frequency of sella bridging ranges from 1.1% to 13% in subjects with varying ethnic origin (Baccetti, 1998). The dimensions of sella turcica vary from 5 to 16 mm in the anteroposterior diameter

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and from 4 to 16 mm for the vertical depth. Studies have linked the sella turcica bridge to multiple hereditary systemic disorders and various developmental syndromes affecting the craniofacial region. It has also been found that many local abnormalities such as tooth transposition, hypodontia, agenesis of teeth and missing mandibular second premolars have associations with sella bridging (Turpin, 1994). Since sella bridging is considered as a developmental and genetic anomaly, variations in the genetic makeup of different populations with varying ethnic origin might lead to different results. Hence, the findings of previous studies should be replicated in a different population with varying racial backgrounds to establish authentic results. In this study, the dimensions of sella turcica and the association of sella bridging between subjects with impacted and normaly erupted canines and its association with angular and sectoral values were evaluated. These parameters have not been previously studied in south Indian population.

MATERIALS AND METHODS

- Pretreatment cephalometic and panoramic radiographs of the selected patients were obtained. Group 1 consisted of 25 patients with palatally impacted canines. Group 2 (control group) consisted of 25 subjects with normally erupted canines.
- The data obtained was analysed and compared between the groups.

Inclusion Criteria

- Patients with impacted maxillary canines diagnosed using OPG and IOPA (SLOB technique)
- Age group 14-30 years
- Good quality standardized lateral cephalograms and OPG

Exclusion Criteria

- Cleft lip and palate patients
- Craniofacial anomalies and syndromes
- Previous orthodontic treatment

Ethical Clearance

The study protocol was reviewed and ethical clearance was provided by the 'Ethical Committee' of A.J Institute of Medical Sciences.

Methodology

- Lateral cephalograms and OPG of the selected patients was recorded using KODAK 8000C Machine (69 Kvp, 12 mA, 2 and 12 sec respectively) and tracings done by a single examiner.
- Linear measurements of sella turcica were done on lateral cephalogram of the selected patients.
- Angular and sectoral values were measured on the OPG.

Linear Dimensions of Sella Turcica Fig. 1

Interclinoidal Distance: Distance from the tip of the dorsum sellae to that of the tuberculum sellae.

Depth of Sella Turcica: Distance of a line dropped perpendicular from the line above to the deepest point on the sella floor.

Anteroposterior Diameter of Sella Turcica: Distance from the tip of the tuberculum sellae to the farthest point on the inner wall of the hypophyseal fossa.

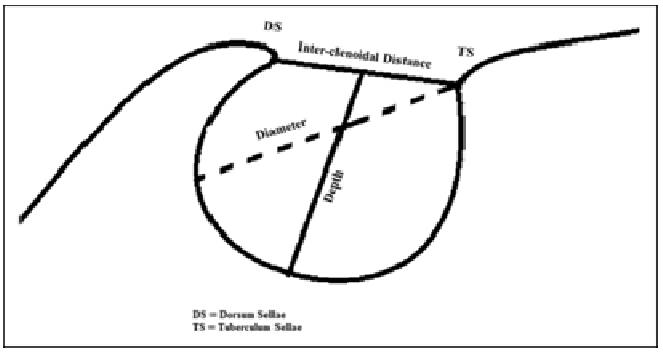


Fig 1. Linear measurements of sella turcica

On the basis of sella dimensions, the bridging is classified into 3 types

- **No Calcification:** This is rated as type I, where the length is either equal to or greater than three fourths of the diameter.
- **Partial Calcification:** This is rated as type II, where the length is less than three fourths of the diameter.
- **Complete Calcification:** This is rated as type III, where only the diaphragm sellae was visible on the radiograph.

Sector Location: (Fig-2)

Sector I: Area distal to line tangent to distal heights of contour of lateral incisor crown and root.
Sector II: Area mesial to sector I, but distal to bisector of lateral incisor's long axis.
Sector III: Mesial to sector II, but distal to mesial heights of contour of lateral incisor crown and root.
Sector IV: All areas mesial to sector III.

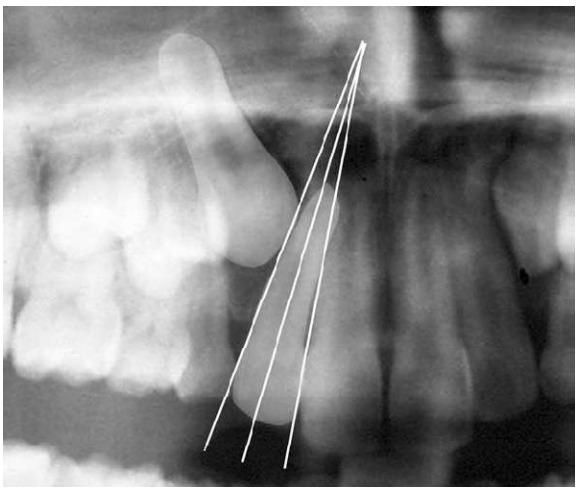


Fig. 2. Sectoral location

Angular Measurement: Fig-3

Angle formed between impacted/erupted canines to bicondylar line is measured.

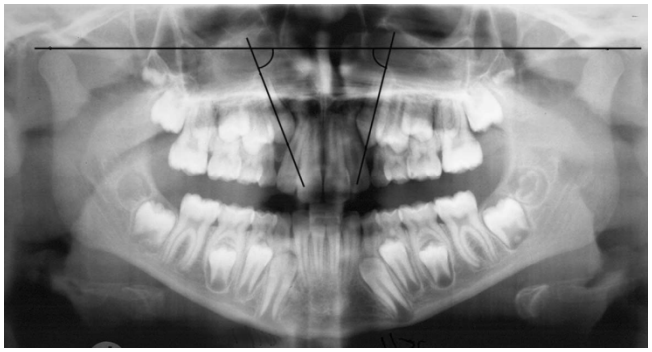


Fig. 3. Angular measurement

Statistical Analysis

Statistical analysis was performed using statistical package for social sciences (SPSS) version 14. Comparison of variables between study and control groups and between the genders were done by student t test. The degree of calcification and significance of sella bridging in cases and controls was done using Chi-square test. Pearson correlation was performed to assess the correlation between interclinoidal distance and angle. The correlation between inter clinoidal distance and sector was calculated using spearman's correlation. P value was considered at 0.05 level.

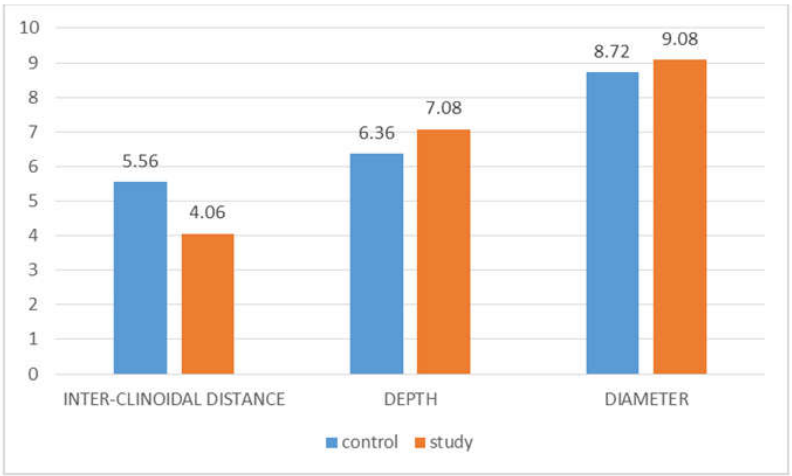
The highest frequency of type II calcification was reported in 19 patients (76%) and type I calcification was reported in 1 patient (4%), whereas 9 patients(36%) in the control group showed type I calcification of sella ligaments. Type III calcification of the interclinoid ligament was observed in (20%) subjects with impacted canines, whereas no subjects had type III calcification in the control group. Chi-square statistics were calculated for evaluating the degree of sella bridging in both groups, (Table 4) and the overall proportion of interclinoid ligament calcification differed significantly ($P < 0.0029$). When the degree of sella bridging between the sexes in the patients was evaluated, no significant difference ($P = 0.197$) was noted (Table 5).

The correlation between inter clinoidal distance and angle was calculated using pearson correlation. There was a positive correlation between interclinoidal distance and angle with the correlation coefficient of $r = 0.032$. i.e) as inter clinoidal distance increases angle increases. The correlation was weak and statistically not significant ($p= 0.866$). The correlation between inter clinoidal distance and sector was calculated using spearman's correlation. There was a negative correlation between inter clinoidal distance and sector with the correlation coefficient of $r= -0.196$. i.e) as the inter clinoidal distance increases, sector value decreases. The correlation was weak and statistically not significant ($p=0.299$).

Table 1. Difference in sella dimensions between study group and control group

	group	n	Mean	Std. Deviation	Std. Error Mean	P value (t test)
Inter-Clinoidal Distance	control	25	5.56	1.850	.370	.009*
	study	25	4.06	2.012	.402	
Depth	control	25	6.36	1.075	.215	.051
	study	25	7.08	1.441	.288	
Diameter	control	25	8.72	1.339	.268	.384
	study	25	9.08	1.552	.310	

* Statistically significant at 0.05 level



Graph 1. Difference In sella dimensions between study group and control group

RESULTS

The difference in dimensions of sella turcica in the subjects and the controls are shown in (Table 1). Student t tests comparing the mean interclinoidal distances between the groups showed a reduced length among the subjects with impacted canines ($P = 0.009$). The comparison of mean depths and diameters between the subjects and the controls was found to be insignificant. The patient group was further analyzed for sex dimorphism, which showed no statistically significant difference in sella dimensions (Table 2-3).

DISCUSSION

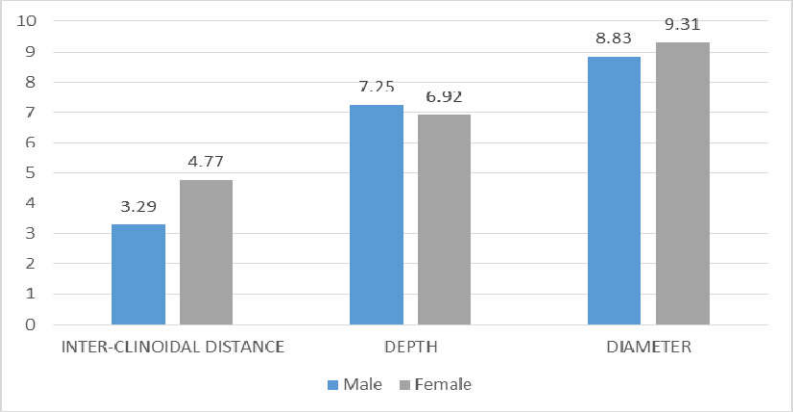
The sella turcica is the prime area for the migration of neural crest cells to maxillary, palatinal, and frontonasal developmental fields (Hong, 2015). Mutations in the homeobox, HOX, or sonic hedgehog genes influence the development of the midface, the teeth, and parts of sella turcica negatively (Duverger, 2008) According to the above theories, the canines and sella turcica share a common embryologic origin. Therefore, alterations at the developmental level can result in a sella bridge that can

simultaneously lead to palatally impacted canines. According to this study, the interclinoidal distance was reduced in patients with impacted canine, whereas sella depth and diameter showed no significant differences between the study groups.

significant differences in depths and diameters (Axelsson, 2004). The results of a study done by Francis, 1948, reports a larger dimensions of sella in female subjects. The difference in results might be due to racial variations and different ethnic origins of the study populations.

Table 2. Difference in sella dimensions between sexes in study group

	sex	n	Mean	Std. Deviation	Std. Error Mean	P value
Inter-clinoidal distance(mm)	M	12	3.29	1.982	.572	.065
	F	13	4.77	1.833	.508	
Depth	M	12	7.25	1.603	.463	.582
	F	13	6.92	1.320	.366	
Diameter	M	12	8.83	1.850	.534	.457
	F	13	9.31	1.251	.347	



Graph 2. Difference in sella dimensions between sexes in study group

Table 3. Difference in sella dimensions between sexes in control group

	sex	n	Mean	Std. Deviation	Std. Error Mean	P value
Inter-clinoidal distance	M	11	5.73	1.679	.506	0.698
	F	14	5.43	2.027	.542	
Depth	M	11	6.82	1.250	.377	0.057
	F	14	6.00	.784	.210	
Diameter	M	11	9.27	1.272	.384	0.066
	F	14	8.29	1.267	.339	

Table 4. Degree of calcification in cases and controls (n %)

Study groups	Type I	Type II	Type III	Chi-square test	p-value (chi-squre test)
Subjects (n = 25)	1 (4 %)	19 (76%)	5 (20%)		
Controls (n = 25	9 (36%)	16 (64%)	0 (0%)	11.66	0.0029*

Type I, No calcification; Type II Partial calcification; Type III, complete calcification

Table 5. Sella bridging in subjects

Sella bridging	male (n = 12)	female (n = 13)	Chi-squre test	p- value(chi-squre test)
Type I	0	1		
Type II	8	11	3.24	0.197
Type III	4	1		

The results agree with those of Najim and Nakib, 2011, on Iraqi sample with subjects ranging from 13 to 25 years of age with maxillary malposed canines. A study conducted on a sample of fixed orthodontic and surgical-orthodontic patients showed sella bridging in the surgical orthodontic group indicating that an altered morphology of sella can be seen in patients with abnormalities in craniofacial region (Jones, 2005). A study done on Pakistani subjects with different skeletal malocclusions found no correlation between the underlying skeletal pattern and sella dimensions (Shah, 2011). A longitudinal study conducted on the sizes and morphologies of Norwegian subjects reported an increased sella length in male subjects compared with female subjects, with no

The results of this study shows that the size of sella in subjects with palatally impacted canines was similar between the males and females. The results of this study also demonstrated an increased frequency of sella bridging or reduced interclinoidal distance in patients with palatally impacted canines. A study done by Warford, 2003, states that, to predict occurrence of maxillary canine impaction, it appears to depend almost solely on the sector location of the cusp tip of the erupting canine. As shown by the predictive values, the more mesial the cusp tip location, the greater is the chance of that canine to be impacted. The greatest probability of impaction was found in sectors III and IV. Angulation of the maxillary canine formed with bicondylar line does not significantly add to the predictive

value of sector location. In sector I, most teeth will not become impacted, so the role of angle in predicting impaction is not clinically significant.

Table 6. Correlation between interclinoidal distance and angle

		ANGLE
Inter-clinoidal distance(mm)	Pearson Correlation	.032
	Sig. (2-tailed)	.866

Table 7. Correlation between interclinoidal distance and sectoral values

		Sector
Inter-clinoidal distance(mm)	Correlation Coefficient	-.196
	Sig. (2-tailed)	.299

Table 8. Sectoral Values of Impacted Canines

Sector	n
I	4
II	12
III	2
IV	12

Likewise, in sectors III and IV, where most teeth will become impacted, the small increase that angle contributes to probability for eruption was not clinically significant. Only in sector II would angulation have potential significance in predicting impaction of the canine. Angulation of the impacted canine with bicondylar line was higher for nonimpacted teeth, with a mean of 75.12° compared with 63.20° for impacted teeth. The median sector for impacted teeth was II compared with I for nonimpacted teeth (Warford, 2003). In this study, sectoral evaluation of the palatally impacted canines showed that 40% of impaction had sector location II and 40% in sector IV. The analysis of subjects with Type III calcification of interclinoidal ligament when correlated with sector location showed that 80% incidence of impaction in sector IV. The correlation between inter clinoidal distance and angle was calculated using pearson correlation which showed a positive correlation i.e; as inter clinoidal distance increases angle increases. Although, the correlation was weak and statistically not significant. The correlation between inter clinoidal distance and sector was calculated using spearman's correlation which showed a negative correlation between inter clinoidal distance and sectoral values i.e; as the inter clinoidal distance increases, sector value decreases. The correlation was weak and statistically not significant. Sector location provides the greater influence on the prediction of impaction, with canine location in the more mesial sectors substantially predictive. The probabilities of predicting impaction are much the same, whether or not angulation is considered (Warford, 2003). Thus, sella bridging highlights the risk of future palatal canine impactions, especially in children with a family history of maxillary canine impaction in their parents or siblings and who are undergoing phase 1 orthodontic treatment. The results of this study suggest that careful monitoring is needed for the eruption timing of the maxillary canines in children diagnosed with complete calcification of sella turcica, mesial sectoral location and reduced angular values.

Conclusion

The following conclusions were drawn from this study,

- The frequency of sella turcica bridging is increased in patients with palatal canine impactions.
- Sella turcica length is reduced in patients with palatal canine impactions.
- Sex does not influence the dimensions of sella and the ossification of the interclinoid ligament.
- The chances of having partial or complete bridging in subjects with palatally impacted canines are greater than those with erupted canines.

The correlation between inter clinoidal distance and intercondylar angle made with the long axis of the palatally impacted canine calculated using pearson correlation showed a positive correlation between inter clinoidal distance and angle. The correlation was weak and statistically not significant. The correlation between inter clinoidal distance and sectoral values of the palatally impacted canines calculated using spearman's correlation showed a negative correlation between inter clinoidal distance and sectoral values. The correlation was weak and statistically not significant.

Aknowledgement

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