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Relation Between Sella Turcica Bridging And Canine Impaction- A Retrospective Cephalometric Study

Running Title:
Sella turcica bridging and Canine Impaction association

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ABSTRACT :
Objectives: To determine any possible association between sella turcica bridging and canine impaction.
Subjects and methods: Orthodontic records consisting of standard-quality lateral cephalograms and dental panoramic radiographs were selected. Thirty patients with impacted canines (19 females,11 females; mean age, 16.0 ± 22.3 years) and 30 controls with erupted canines (15 males, 15 females; mean age, 15.1 ± 24.1 years) were included in the study. Sella dimensions between the patients and the controls were compared by using Independent sample t test whereas the relation of sella bridging with impacted canines was analyzed using the chi-square test.
Results: In the results, significant statistical difference was found to be present among male subjects and female subjects in relation to mean sagittal interclinoid distance ($p<0.05$). On comparison of degree of calcification (Leonardi classification) in cases and control, occurrence of type I sella bridging was found to be 3 (10%) and 19 (86.4 %) in subjects (n=30) and control (n=30) respectively, type II sella bridging was observed in 21 (70%) subjects and 11 (34.4%) control respectively, type III sella bridging was observed in 6 (20%) subjects. Degree of calcification in cases with stratification in regards to gender

was studied using Leonardi ordinal scale classification. Occurrence of type I sella bridging was found to be 3 (27.3%) and 0 (0%) among male subjects and female subjects, type II sella bridging was seen in 6 (54.5 %) male cases and 15 (78.9 %) female cases and type III sella bridging was seen in 2 (18.2 %) male cases and 4 (21.1%) female cases respectively. Conclusions: The frequency of sella turcica bridging was increased in patients with canine impactions whereas sella turcica length, depth and diameter were reduced in patients with canine impactions. Sella length was increased in males than females in the impacted canines group. The chances of having partial or complete bridging in subjects with impacted canines were approximately 4 times greater than those with erupted canines.

KEY WORDS: Sella turcica bridging, Canine impaction, Cephalometric radiograph, Anterior clinoid process, Posterior clinoid process, Sphenoid bone.

1. INTRODUCTION

In the field of orthodontics, several cranial landmarks have been determined to act as reference points during the tracing of cephalometric radiographs. One of the frequently used cranial landmarks for tracing cephalometric radiographs is the sella point. This point is situated in the centre of the sella turcica and the turcica encloses and protects the pituitary gland in the cranial base.[1]

Sella turcica has a crucial role in orthodontics practice. One common morphologic variation of sella turcica is Sella Bridge. This irregular bridge is formed by amplified ossification of the duramater between the anterior and posterior clinoid processes of the sphenoid bone or when the sphenoid bone undergoes abnormal embryologic development. Thus, the Sella Bridge can be considered as a developmental anomaly.[2]

Up to 1.1-13 percent of the general population shows the occurrence of calcification of the interclinoid ligament or sella turcica bridging.[3] Maxillary canine impaction is a dental anomaly found in 1% to 2% of clinical situations commonly seen in female patients.[2] Common theories contributing to the etiology of maxillary canine impaction are guidance theory and the genetic theory.[4,5] Genetic abnormalities such as submerged deciduous molars, hypoplastic enamel, mandibular premolar aplasia, and diminutive maxillary lateral incisors are found in association with impacted maxillary canines according to genetic theory.[5,6] Conventional 2- dimensional and 3-dimensional imaging is most commonly used in detecting the position and the anticipated path of eruption of the permanent canines.[7,8]

There are very few studies conducted on the association between sella turcica bridging and canine impaction and hence further research needs to be conducted on this topic. Thus the objective of this study was to measure the dimensions of sella turcica in orthodontic patients and to determine any possible link between canine impaction and sella turcica bridging given the evidence for a genetic basis underlying both conditions.

2. MATERIAL AND METHODS

Pretreatment lateral cephalograms of 30 subjects with canine impaction and 30 subjects with normally erupted canines were selected for the study after retrospectively screening records of 330 orthodontic patients visiting the dental institute in the last 6 years. Diagnostic radiographic records for both the groups were assesed by a panel of four authors referring to the following inclusion criteria: good quality standardized lateral cephalograms with vivid reproduction of sella turcia and the absence of craniofacial anomalies and syndromes, history of trauma and previous orthodontic treatment. The study group consisted of 30 subjects (19

females,11 females; ages, 14-30 years; mean age, 16.0 ± 22.3 years) with impacted canines and the control group consisted of 30 subjects (15 males, 15 females; ages, 15-33 years; mean age, 15.1 ± 24.1 years) with normally erupted canines.
The contour of the pituitary fossa from the tip of the dorsum sellae to the tuberculum sellae was traced on acetate sheet in a dark room using a 0.5 mm lead pencil with conventional methods and measured manually by one observer so as to quantify the extent of a sella turcica bridge from each lateral cephalogram.
The linear dimensions were calculated as follows (Fig.1):
1. Interclinoidal distance: Distance measured from the tip of the dorsum sellae to that of the tuberculum sellae.
2. Depth of sella turcica: Distance of a line which is dropped perpendicular from the line above to the deepest point on the sella floor.
3. Anteroposterior diameter of sella turcica: Distance measured from the tip of the tuberculum sellae to the farthest point on the inner wall of the hypophyseal fossa.
The standard scoring scale developed by Leonardi et al[9] was used in order to assess and quantify the level of bridging. On the basis of sella dimensions, the bridging was classified into 3 groups as follows (Fig.2):
1. No calcification: This was assigned as type I, in which the length was either equal to or greater than three fourths of the diameter.
2. Partial calcification: This was assigned as type II, in which the length was equal to or less than three fourths of the diameter.
3. Complete calcification: This was assigned as type III, in which only the diaphragm sellae was visible on the radiograph.
SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc software was used to analyse the data. Statistical analysis was done by using tools of descriptive statistics such as Mean, and SD for representing quantitative data like age of study population, sella dimensions (interclinoid distance, sella depth, sella diameter). Qualitative / Categorical data like gender, degree of calcification were expressed in proportion/percentages. Student t test / Independent t test between two samples were used to compare means of experimental group and control group in relation to age, sella dimensions respectively. Probability of accepting alpha error was set at 5%, $p < 0.05$ considered as significant. Power of the study was set at 80%. Chi square test was used to find out difference between two or more proportions of gender, degree of calcification (Leonardi's classification)

3. RESULTS

The mean Age of the Study participants was 18.7+3.32 Years (Subjects- 19.23+3.14, Controls- 18.17+3.47). Among the subjects, there were 13 males (43.3%) and 17 Females (56.7%). Among the Controls, there were 14 Males (46.7%) and 16 Females (53.3%). Student Independent T test was used to compare the mean dimensions of the Sella Turcica between the Subjects and Controls (Table 1). The Mean Sagittal interclinoid distance and the Sella Diameter among the subjects with Impacted Canine was lesser than the controls and this difference was statistically significant (p=0.000). However, the mean Sella Depth between the Subjects and Controls was insignificant (p=0.220). On Analysis for Sex Dimorphism among the Subjects, while no significant difference was found in the Sella Depth and Diameter, the Sagittal Interclinoid distance among Females was reduced as compared to the males and this was statistically significant (p=0.006) (Table II).
Chi Square Statistics was used to analyse the degree of Sella Bridging in both the groups. Majority of the Subjects with impacted Canine displayed Type II Calcification (70%)

whereas among the Controls majority displayed a Type I calcification (63.3%). The overall proportion of interclinoid ligament calcification differed significantly among the groups (p=0.000) (Table III). On Gender wise analysis of the degree of Sella Bridging, 14 (73.7%) females and 63.6% males displayed Type II Calcification. None of the Females exhibited Type I Calcification, whereas 5 (27.3%) males exhibited Type I calcification. The overall proportion of interclinoid ligament calcification differed significantly among Males and Females (p=0.019) (Table IV).

4. DISCUSSION

This study is retrospective in nature and evaluated the linear dimensions of sella turcica and the relation of sella turcica bridging in patients with normally erupted canines vs canine impaction. It has been observed that the relocation of neural crest cells to maxillary, palatinal and frontonasal developmental fields resides in the sella turcica.[10] The development of the midface, the teeth and parts of sella turcica are obnoxiously affected by mutations in the homeobox, HOX or sonic hedgehog genes.[11] Hence formation of a sella bridge can result from disturbances at the developmental level which in turn can concurrently result in impacted canines.[2]

As per our study, the interclinoidal distance, sella depth and diameter was significantly decreased in patients with impacted canines when compared to the patients with normally erupted canines. Our findings are distinguishable from the study results of Batool Ali, Attiya Shaikh, and Mubassar Fida[2] who reported that the interclinoidal distance was minimized in patients with impacted canine whereas sella depth and diameter showed no notable differences between the study groups. Our results also vary considerably from the study conducted by Najim and Nakib[12] on an Iraqi sample with subjects extending from 13 to 25 years with the findings of decreased sella length in patients with malposed canine, whereas no significant differences in sella depth and diameter between the study groups. A reduced sella length in the surgical orthodontic group was observed by Jones[13] in his study conducted on a sample of fixed orthodontic and surgical-orthodontic patients. So also, no correlation was observed between the skeletal classes and sella dimensions in a study on Pakistani subjects with different skeletal malocclusions.[14]

In our study, an increased sella length was observed in males in the 'impacted canines' group stratified by gender, whereas an increased sella depth was observed in females in the 'control group' stratified by gender. On the other hand, a longitudinal study that was carried out on the sizes and morphologies of Norwegian subjects reported an increased sella length in male subjects compared with female subjects and no significant differences in depths and diameters.[15]

The results of our study also indicated an increased frequency of sella bridging in patients with impacted canines. In relation to the 80.6% frequency of partial and complete bridging reported by Batool Ali, Attiya Shaikh and Mubassar Fida[2] and 70% frequency reported by Najim and Nakib[12], our study demonstrated 90% frequency of partial and complete bridging in the subjects with impacted canines. The 20% frequency of complete calcification of sella in our study was greater than that observed by Leonardi et al[8, 9], who found complete sella bridges in only 16.7% and 18.4% of the subjects in their studies on palatally displaced canines. Likewise, other studies showed incidences of 16.7% in patients undergoing combined surgical orthodontic treatment[13], 18.6% in patients with craniofacial deviations[16], 18.7% in patients with premolar aplasia[9] and 33.3% in patients with dental transpositions.[3] In our study, there was no significant difference observed between the genders; however, Najim

and Nakib[12], reported increased sella bridging in male subjects compared with female subjects, in variation to our results.
A review of the literature advocated prevalence of impacted canines was greater in women than men.[17] However, a recent study could not highlight it[2], similarly in our study, risk of canine impaction was equal in both genders as sella bridging did not report predisposition for a particular gender. A striking connection between sella bridging and impacted canines suggests that factors influencing the development of sella turcica might also affect the development of the canines.[2] Certainly, as calcification in this region can or may come into sight during early childhood, it may act an assistance to the early diagnosis of some conditions or act as a diagnostic predictor of susceptibility for localized dental problems.[3] Indeed, the findings of our study designated that subjects with calcification in the region of sella are at probable risk of developing canine impaction. Thus careful monitoring is needed pertaining to the eruption timing of the canines in children diagnosed with complete calcification of sella turcica.[2] Moreover, although the majority of sella turcica bridges are detectable early in life, in few cases, calcification develops over time and can only be observed on lateral cephalometric radiographs taken at a later stage.[3] It is important to note that 'Sella turcica bridging', which is the radiological description of calcification of the clinoid processes in the absence of clear clinical signs or symptoms, should be considered as a normal variant of sella turcica anatomy[18], although many diseases can be associated with this phenomenon.

Limitations
Even though cephalometry is considered a major diagnostic tool, especially in orthodontics, because of its 2D nature, the information that it provides is limited. Recent advances in craniofacial imaging have made it possible to obtain 3D representation of craniofacial structures with CBCT's.

5. CONCLUSIONS

Careful interpretation of the findings led us to the following conclusions:

- The frequency of sella turcica bridging is increased in patients with canine impactions.
- Sella turcica length, depth and diameter are reduced in patients with canine impactions.
- Sella length was increased in males than females in the impacted canines group whereas the sella depth was increased in females than males in the group with normally erupted canines.
- The chances of having partial or complete bridging in subjects with impacted canines are approximately 4 times greater than those with erupted canines.

Declarations
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Competing interests
The authors declare they have no competing interests.

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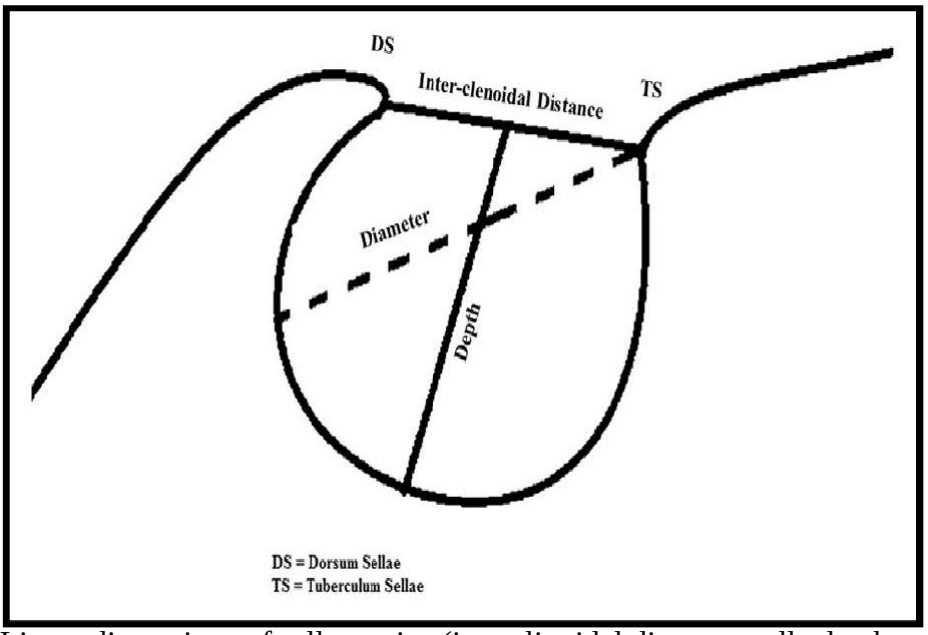
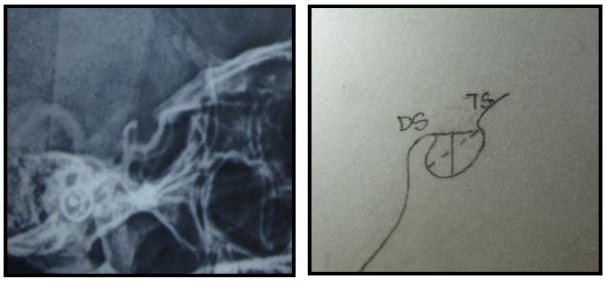
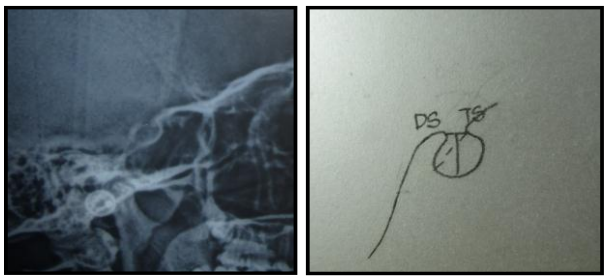


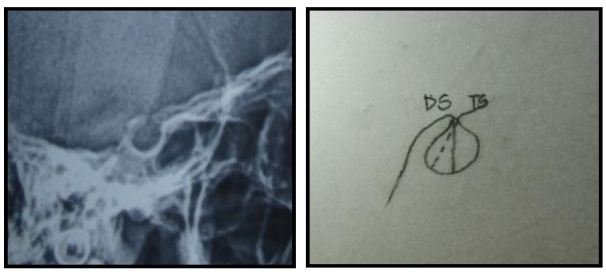
Fig. 1: Linear dimensions of sella turcica (interclinoidal distance, sella depth and sella diameter)



TYPE I CALCIFICATION



TYPE II CALCIFICATION



TYPE III CALCIFICATION

Fig.2: Different types of sella turcica bridging

Table I: Comparison of Sella dimensions (mm) among subjects and controls

Sella Dimensions (mean ±SD)			
STUDY GROUPS	**Sagittal interclinoid distance**	**Sella Depth**	**Sella Diameter**
Subjects	3.267 ± 2.02	5.52 ± 1.05	6.5 ± 1.34
Controls	5.4 ± 1.48	5.87 ± 1.13	7.88 ± 1.16
P value	0.000* (s)	0.220 (ns)	0.000* (s)
Independent Sample T Test, Significance at p<0.05 s= Significant, ns= Non-significant			

Table II: Comparison of Sella Turcica measurement (mm) in impacted canines (subjects) stratified by gender

Sella measurements	**Males (n=13)**	**Females (n = 17)**	**P value**
Sagittal interclinoid distance	4.39 ±2.15	2.41 ±1.45	0.006* (s)
Sella Depth	5.3 ± 1.05	5.65± 1.07	0.448 (ns)
Sella Diameter	6.37 ± 1.32	6.67 ± 1.38	0.538 (ns)
Independent Sample T Test , Significance at p<0.05**,** s= Significant, ns= Non-significant			

Table III: Comparison of degree of calcification (Leonardi classification) in cases and control

Sella Bridging n (%)					
Study groups	**Type I**	**Type II**	**Type III**	**Chi-square test**	**P value**
Subjects (n=30)	5 (16.7 %)	21 (70 %)	4 (13.3 %)	15.292	0.000* (Significant)
Controls (n=30)	19 (63.3%)	11 (36.7 %)	0 (0 %)		
Type I: No calcification; Type II: Partial calcification; Type III: Complete calcification. *Chi-square test; Significance at p<0.05**,** s= Significant					

Table IV: Comparison of degree of calcification (Leonardi classification)/ Sella bridging in cases with stratification in regards to gender

SELLA BRIDGING				
Study groups	**MALES (n=13)**	**FEMALES (n=17)**	**Chi-square test**	**P value**
TYPE I	5 (27.3 %)	0 (10.5%)	7.941	0.019 (Significant)
TYPE II	7 (63.6 %)	14 (73.7 %)		
TYPE III	1 (9.1 %)	3 (15.8 %)		
Type I: No calcification; Type II: Partial calcification; Type III: Complete Calcification. *Chi-square test; Significance at p<0.05, ns= Non-significant				