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Interrelation between Sella Turcica Bridging and Incidence of Maxillary Canine Impaction

Yahya Jaber Alshahrani[1,*], Jamal Abdullah Alsanea[2]

[1]Orthodontist, Ministry of Health, Riyadh, Saudi Arabia
[2]Private dental practitioner, Riyadh, Saudi Arabia
*Corresponding author: dr.yahya.alshahrani@gmail.com

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Abstract **Aims:** To perceive an interrelation between sella turcica bridging and maxillary canine impaction among impaction patients. **Methods:** Lateral cephalometric and Panoramic Radiographs of 50 subjects with impacted canines (25 buccal and 25 palatal) ware collected from Orthodontic clinics. The control group consisted of 25 orthodontic patients without a history of impaction. The size of Sella turcica (length, depth and diameter) was calculated and the bridging was gauged among the study groups. **Results:** Results were evaluated using independent sample t-test and chi-square test on SPSS software (P<0.05). The percentage of partial and complete calcification of sella among patients with palatal impaction were (4%) and (80%), respectively. Whereas, with buccal impaction were (0%) and (48%), respectively. The odds of having partial and complete bridging among the patients with impaction canines was 3 times higher than the control group (odds ratio, 3.210; 95% CI, 1.66-6.17). Gender wise comparison showed significantly reduced mean sagittal interclinoidal distance among females as compared to the male subjects (p=0.001). **Conclusions:** The occurrence of sella turcica bridge in patients with canine impaction is increased.Early detection of Sella Turcica bridge during the development phasemay alert clinicians to likely canine impaction in advanced life.

Keywords: *cephalogram, dental anomalies, impacted canine, sella turcica bridge*

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1. Introduction

Maxillary canines are vital for esthetic and in making good facial and smile appearance [1]. Maxillary canines are situated at the corners of the dental arch and shape the canine prominence for support of the alar base and the upper lip. Also, when the maxillary canines are properly placed and have good shape and size, these teeth appease front dental proportions and correct smile lines. Functionally, they bolster and support the dentition [2].

Dental anomalies can result from numerous factors, be it genetic, epigenetic, or environmental [3]. Maxillary canine impaction is a kind of dental anomaly found in 1% to 2% of clinical situations, with a higher prevalence rate in female patients. The cause of this anomaly could be various such asunderlying local, systemic, and genetic factors [4,5]. If canine impaction is leftuntreated, it maycontribute to toothmal positioning, rootresorption, toothmobility, arch-length discrepancy, and dentigerouscyst formation [6].

Cephalometric radiographs are extensively utilized in orthodontics to assess the growth, development and relationships of craniofacial and dental structures [7]. However, they also provide valuable diagnostic information related to the skull, face, and upper cervical spine [8]. Abundant studies have been executed to elucidate skeletal abnormalities and normal variants by utilizing cephalometric radiographs. Some of these investigations have clarified the ossification of the interclinoidal ligaments of the sella turcica. Soft tissue calcification of the interclinoid ligament is potentially related to the irregular osseous structure formation. This ossification of the interclinoid ligament leads to the bridging of the sella. This bridging can be complete or partial [9].

It has been stated that the sella turcica bridging or calcification of the interclinoid ligament of the sella turcica is linked with potential craniofacial deviations [10]. Recent findings also suggest that the bridging of the sella turcica is associated with palatally displaced canines [9,11].

Numerous studies have explored the prevalence of many dental anomalies, however only a few have addressed the link between dental anomalies and sella turcica bridging [12]. The earlier studies havepublicized positive Interrelations between sella turcica bridging and maxillary canine impactions [12,13,14]. Hence to validategenuine results, the outcomes of earlier studies need to be replicated. The null hypothesis of this study was that there is no interrelation between sella turcica bridging and maxillary canine impactions.

2. Methodology

This study was registered and ethical approval obtained from the Institute Review Board, Riyald Elm University, Riyadh, Saudi Arabia. An initial screening of the treatment records (Lateral cephalometric and Panoramic radiographs) of 1263 patients previously visited at Riyadh Elm University Hospital, Riyadh, Saudi Arabia, was carried out and 75 pretreatment records were randomly selected from the record and divided into three groups: Group C, the control group had 25 patients with pretreatment records showing normally erupted canine. Patients of Group B werehaving buccallyimpacted canines. Similarly, patients of Group P were having palatally impacted canines. In all the groups, the ages of the patients were between 15 and 45 years.

The inclusion criteria of this cross-sectional observational study were the history of no prior extraction of any permanent tooth, no history of trauma to any tooth or jaws before the start of orthodontic treatment, and all subjects should be in the permanent dentition stage. Whereas those patients with cleft lip and palate;craniofacial anomalies, syndromes or trauma; or with previous orthodontic treatment were excluded from the study.

2.1. Cephalometric Analysis

Pre-treatment digital lateral cephalograms of the study participants (both for control and study groups) were obtained from patients' files. All lateral cephalograms were then transferred to a computer installed with the software. Digital radiographs were calibrated by the use of ruler incorporated in the cephalostat while radiographic exposure. This ensured an accurate orientation of the radiograph, and avoidance of any magnification errors in linear measurements. The image copies of all lateral cephalograms were transferred without labelling them with personal information of patients to Onyxceph3 (Image Instruments GmbH, Chemnitz, Deutschland, 2011) cephalometric software program. The image augmentation features of the software, like brightness, contrast adjustment and magnification were utilized as needed to identify individual cephalometric landmarks as accurately as possible with the help of mouse/cursor.

2.2. Measurement of Sella Dimension

The linear dimensions shown in Figure 1 were measured as follows.

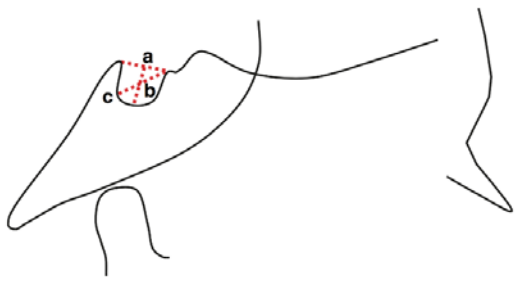

Figure 1. Reference lines of the sella turcica size according to Silverman FN ,1957. Where "a" is length of the sella; "b" is depth of the sella; and "c" is the diameter of the sella.

1. Interclinoidal distance: Distance from the tip of the dorsum sellae to that of the tuberculum sellae (point "a").
2. Depth of sella turcica: distance of a line dropped perpendicular from the line above to the deepest point on the sella floor (point "b").
3. The antero-posterior diameter of sella turcica: distance from the tip of the tuberculum sellae to the farthest point on the inner wall of the hypophyseal fossa (point "c").

2.3. Quantification of Sella Bridging

The assessment and quantification of level of bridging was carried out based on the standard scoring scale developed by Leonardi et al. (2006) On the basis of sellameasures the bridging was rated into three following types: Type I (No calcification): Where the length was either equal to or greater than three fourths of the diameter (Length of sella turcica ≥ ¾ diameter). Type II (Partial calcification): Where the length is less than three-fourths of the diameter (Length of sella turcica < ¾ diameter). Type III (Complete calcification): Where only the diaphragm sella was visible on the radiograph.

All the data pertaining to the linear dimensions of sella were automatically generated by the software recorded and subjected to statistical analysis.

2.4. Statistical Analysis

Statistical Package for Social Sciences (IBM-SPSS Version 22.0, IBM Corp, USA) software for Windows was used for the statistical analysis of the data. The frequency distribution tables and graphs were generated for the sella variables and subject characteristics. Sella dimensions were compared between the control group and buccally impacted canine groups, and between the control group and palatally impacted canine groups by using Independent sample t-tests. The chi-square test was applied to test the degree of calcification in control and study groups. The strength of the Interrelation between sella bridging and impacted canines was assessed by estimating the odds ratio. Subjects with partial and complete bridging were grouped in 1 category, and 35logisticyears period in Orthodontic clinics.

3. Results

Independent sample t-test comparing the mean sella diameter between the controls and buccally impacted canine groups showed significantly reduced distance among the subjects with buccally impacted canines (p=0.026). However, comparison of mean sagittal interclinoidal distance and sella depth between buccallyimpacted canine group and control group did not show any significant differences. The details are present in Table 1.

Similarly, a comparison of the mean interclinoidal distances between control and palatally impacted canine groups showed a significantly reduced distance among the subjects with palatally impacted canine (p=0.001). Additionally, sella diameter was found to be significantly reduced among subjects with palatally impacted canine (p=0.002). On contrary, sella depth did not show any

significant difference between control and subjects with palatally impacted canine (P=0.154) as shown in Table 2.

Table 1. Comparison of Sella dimensions (mm) among control and buccally impacted canine groups

Variables	Groups	N	Mean	SD	t	*P value**
Sagittal interclinoidal distance	Control	25	8.35	1.50	1.25	0.219
	Buccal	25	7.74	1.97		
Sella Diameter	Control	25	10.70	1.28	2.30	0.026**
	Buccal	25	9.73	1.68		
Sella Depth	Control	25	7.07	1.32	1.94	0.059
	Buccal	25	6.40	1.12		

*Independent sample t test; ** P<0.05.

Table 2. Comparison of Sella dimensions (mm) among control and palatal impacted canine groups

Variables	Groups	N	Mean	SD	t	*P value**
Sagittal interclinoidal distance	Control	25	8.35	1.50	4.60	0.001**
	Palatal	25	6.02	2.04		
Sella Diameter	Control	25	10.70	1.28	3.1900	0.002**
	Palatal	25	8.98	2.37		
Sella Depth	Control	25	7.07	1.32	1.4500	0.154
	Palatal	25	6.38	1.96		

*Independent sample t test; ** P<0.05.

Table 3. Sella measurements (mm) stratified by gender

Variables	Gender	N	Mean	SD	t	*P value**
Sagittal interclinoidal distance	Male	31	8.34	1.77	3.65	0.001**
	Female	44	6.69	2.03		
Sella Diameter	Male	31	10.27	1.41	1.78	0.08
	Female	44	9.47	2.20		
Sella Depth	Male	31	6.64	1.44	0.12	0.902
	Female	44	6.60	1.60		

*Independent sample t test; ** P<0.05.

Gender wise comparison showed significantly reduced mean sagittal interclinoidal distance among females as compared to the male subjects (p=0.001). However, mean depths and diameters between the males and the female subjects were insignificant, as shown in Table 3.

The highest frequency of type II calcification 20 (80%) was observed in subjects with palatally impacted canine; whereas most subjects in the control group 17 (68%) and buccallyimpacted canine group 13 (52%) had type I calcification of sella ligaments. However, type III calcification was observed in just 1 subject (4%) with palatal impacted canine, whereas no subjects had type III calcification in the control and buccally impacted canine groups as shown in Table 4.Further computation of degree of sella bridging between genders male, (Type I= 58.8%) and female (Type II=72.5%) showed statistically significant difference (p= 0.017),as shown in Table 5.

The possibility of the interrelation between sella bridging and impacted canines was appraised by computing the odds ratio. The odds of having partial and complete bridging among the patients were 3 times greater than in the control group (odds ratio, 3.21; 95% CI, 1.66 -6.17), as shown in Table 6.

Table 4. Degree of calcification in among different groups

Group	Type I	Type II	Type III	*P value**
	n (%)	n (%)	n (%)	
Control	17 (68)	8 (32)	0 (0)	0.004
Buccal impaction	13 (52)	12 (48)	0 (0)	
Palatal impaction	4 (16)	20(80)	1(4)	

Key: Type I= No calcification; Type II=Partial calcification; Type III=Complete calcification.
P<0.05; *Chi-square test

Table 5. Sella bridging among study participants

Sella bridging	Male	Female	*P value**
	n (%)	n (%)	
Type 1	20 (58.8)	14(41.2)	0.017
Type 2	11(27.5)	29(72.5)	
Type 3	0(0)	1(100)	

Key: See Table 4

4. Discussion

The findings of this study suggest that sella diameter was significantly reduced in patients with buccallyimpactedcanines while interclinoidal distance as well as sella diameter were sigbnificantly reduced in patients with palatally impacted canines against the control group. Hence the hypothesis of this study was rejected.

Table 6. Logistic Regression analysis

		B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I.forEXP(B)	
								Lower	Upper
Step 1[a]	Groups	1.166	.334	12.185	1	0.000	3.21	1.668	6.179
	Constant	-2.104	.694	9.195	1	0.002	0.122		
Variable(s) entered on step 1: Groups									

We used lateralcephalogram to assess sella bridging because it is routinely used radiograph in orthodontics for diagnosis, treatment planning and assessment of skeletal maturation [15]. An increased frequency of partial sella bridging was observed in patients with impacted canines. Ali et al found that the correlation with canine impaction was high as they observed54.8% of the their study subjects had partial bridging and 25.8% had complete bridging [14]. Whereas, 80.6% frequency of partial and completebridging by Dhanapal et al was observed [16] and 70% frequency reported by Najim and Nakibwhich [17]. All these studies findings are well in line with our findings in which 80% of the study subjects had partial calcification withpalatally impacted canine.

This highly developedrelationship between sella bridging and palatally impacted canines advocates that elements affecting the development of sella turcica might also affect the development of the maxillary canines. Sella bridging underlines the possibility of future palatal canine impactions, particularly in children with a history of canine impaction in their parents or siblings and who are undergoing phase one orthodontic treatment. The sella turcica is the key area for the exodus of neural crest cells to maxillary, frontonasal, and palatinal developmental units. Besides,it is known that the canines and sella turcica are developed from a common embryology; hence, variations at the developmental level may result in a sella bridge that can concurrently lead to impacted canines [18,19]

The clinical understanding for these outcomes is that sella bridging poses the jeopardy of future palatal canine impactions, particularly in children with a history of canine impaction in their parents or siblings and who are experiencing phase 1 orthodontic treatment. Careful nursing is required for the eruption timing of the maxillary canines in children diagnosed with complete calcification of sella turcica is recommended.

The limitations of this study is that it was a retrospective study, so there might have been some cases that were inadvertently omitted. The sample size was just 75. A larger sample size would have probably provided a better understanding of the incidence of Sella Turcica bridge and a more generalized result. Moreover, the sample size was selected only from the department of Orthodontics and the sampling procedure was not randomized. The sample mainly comprised of patients seeking orthodontic treatment, which signifies that they have malpositions that might have influenced the outcome of this study. In future, it would be interesting to use the 3D technologies which might give different findings and different numbers. Such studies are required to confirm the findings of the current and the previous studies.

5. Conclusion

The following outcomes of this study can be interrelatedbetween sella turcica bridging with impacted canines:

- The incidence of sella turcica bridge in subject with canine impaction is increased.
- The linear dimensions of sella turcica can be used to envisage the canine impaction.
- Early advent of sella turcica bridge during growth can alert clinicians to possible canine impaction in later life.

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