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ASSOCIATION OF PALATALLY DISPLACED CANINES WITH SELLA TURCICA BRIDGING AND PONTICULUS POSTICUS IN ORTHODONTIC PATIENTS

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Abstract:

Objective: *To evaluate if there is an association between palatally displaced canines and sella turcica bridging, ponticulus posticus development.* ***Materials and methods:*** *There was a total of 70 patients in the control group with normally erupted canines and 35 patients in the cases group with palatally displaced canines. Pre-treatment records (Lateral Cephalogram and CBCT) of all patients were used to assess sella turcica bridging and palatally displaced canines. Independent sample t tests were used to compare sella dimensions between patients and controls, whereas chi-square test was used to compare the association between sella bridging and palatally displaced canines.* ***Results:*** *The prevalence of Type I bridging was 25.7% in the cases group, compared to 54.3% in the control group. The control group contained 32 subjects (45.7%) with sella turcica bridging (types II and III according to Leonardi et al), while the cases group had 26 subjects (74.3%) with this anomaly (types II and III combined). In participants with canine impaction, the frequency of sella bridging was substantially higher than in controls (P=0.006). In PDC patients, the sagittal interclinoidal distance was observed to be significantly reduced (P=0.002). Ponticulus posticus was seen in 22% of the cases group and 12% of the controls group. (chi-square P=0.006)* ***Conclusions:*** *Palatally displaced canine patients showed a higher prevalence of sella turcica bridging. The length of sella is reduced in these patients. The development of ponticulus posticus is also associated with the occurrence of PDCs.*

Key words: *Palatally displaced canines, Sella turcica bridging, ponticulus posticus*

Introduction

The maxillary canine is the second most common impacted tooth after third molars and its prevalence ranges from 1%–3%; however, it varies among different populations.[1] Two main theories are given which contribute to the palatal displacement of the canine i.e. guidance theory and genetic theory. The guidance theory states that malformed or missing lateral incisor causes the palatal displacement of the canine as the canine erupts along a long and tortuous path of eruption, the lateral incisor root serves as a guide for its eruption.[2] Genetic theory in contrast states that there are certain genetic

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factors involved in the palatal displacement of canine which is associated with other dental anomalies such as microdontia, submerged deciduous molars, hypoplastic enamel, peg-shaped lateral incisors, mandibular premolar aplasia, and missing third molars.[3]

The sella turcica is a depression located within the body of the sphenoid bone containing the pituitary gland in the middle cranial fossa. It has anterior and posterior clinoid processes, the tuberculum sella, and the pituitary fossa housing the pituitary gland, which starts to develop before the formation of the sella turcica.[4] The shape and size of sella differs in different people and is easily identified in the lateral cephalogram. The sella turcica bridge is the most commonly identified abnormality in orthodontic literature. This irregular bridge is caused by excessive ossification of the dura mater between the anterior and posterior clinoidal processes of the sphenoid bone or abnormal embryologic growth of the sphenoid bone.

Sella bridging occurs in 1.1% to 13% of the healthy people.[5] Multiple craniofacial or systemic developmental syndromes and disorders, as well as various local dental anomalies such as tooth transpositions and congenitally missing teeth, have been linked to the sella turcica bridge.[6,7] Many studies have reported a significant association between palatally displaced canine and sella turcica bridging.[8,9] The reason is that these structures have a common embryological origin i.e. neural crest cells. These neural crest cells play an important role in the development of the head and neck, orofacial region and cervical vertebrae. Thus the anomalies of cervical vertebrae can be associated with disorders of dentition and craniofacial region. The early detection of this bridging can give us a guide in the prediction of dental anomalies.

The ponticulus posticus (also known as the sagittal or arcuate foramen) is a common aberrant bony protrusion emerging from the atlas's superior articulating process, entirely or partially encircling the vertebral artery, and reaches the atlas posterior arch. It occurs in about (5.14% - 37.83%) of people.[10,11]

The rationale of our study was to find out if there is an association between palatally displaced canines and sella turcica bridging, ponticulus posticus development. There has not been any research done on orthodontic patients in Peshawar to see if there is an association between palatally displaced canines and the development of the ponticulus posticus. This will help us in the early detection of dental anomalies such as palatally displaced canines.

Materials and Methods

This cross-sectional study was carried out at Sardar Begum Dental College, Peshawar. There were total 70 patients in the control group without impacted canines and 35 patients in the cases group.

Ages ranged from 13 to 32 years in both the groups. In the study group, at least one maxillary canine should be palatally displaced. A canine is diagnosed to be impacted if the eruption time is passed by six months and there are no signs of eruption clinically and radiographically. Patients with congenital anomalies, syndromes, missing canines,

extractions and previous orthodontic treatment were excluded from the study.

Pre-treatment OPGs (orthopantomograms), lateral cephalograms and CBCTs (Cone-beam computed tomography) were used for assessment of palatally displaced canines, sella turcica bridging and ponticulus posticus development. Cephalograms were traced manually by the principal investigator, on acetate sheets with a 0.5-mm lead pencil using an illuminator. The Sella turcica was drawn as a U-shaped structure from the tip of the dorsum sellae to the tuberculum sellae as shown in figure 1.

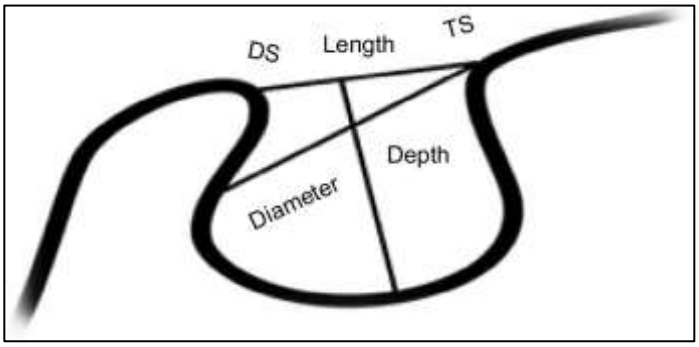

Figure 1. Linear dimensions of sella measurement

The linear dimensions were measured as follows.

1. **Interclinoidal distance: distance from the tip of the dorsum sellae to that of the tuberculum sellae.**
2. **Depth of sella turcica: distance of a line dropped perpendicular from the line above to the deepest point on the sella floor.**
3. **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.**

The basic scoring scale developed by Leonardi et al.[12] was used to measure and calculate the degree of bridging. On the basis of sella dimensions, the bridging was classified into 3 groups.

1. **Type I: No calcification, where the length was either equal to or greater than three fourths of the diameter.**
2. **Type II: Partial calcification, where the length was equal to or less than three fourths of the diameter.**
3. **Type III: Complete calcification, where only the diaphragm sellae was visible on the radiograph.**

Subjects with partial and complete bridging were grouped in 1 category.

On the atlas vertebrae, the degree of developed ponticulus posticus (shown in fig 2) was classified as follows:

1. **Class I: none (no bony emergence)**
2. **Class II: incomplete (partial bony emergence)**
3. **Class III: complete (full bone bridge)**

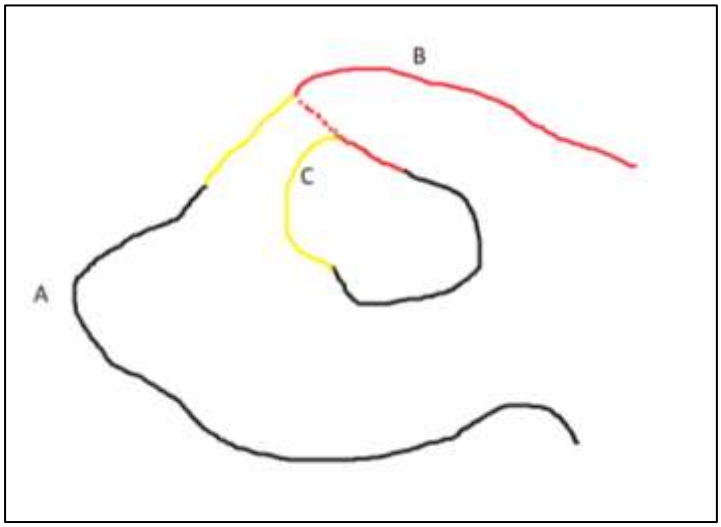

Figure 2. Degree of developed ponticulus posticus. A, Type I; B, Type II; and C, Type III; D, red line shows incomplete and yellow shows complete ponticulus posticus development

Statistical analysis

For statistical analysis SPSS software (version 25, IBM) was used. Chi-square test was used to compare the degree of sella calcification and ponticulus posticus development in both groups. The independent sample t test was used to evaluate differences in the mean sella dimensions between the patients and the controls. A P value of ≤ 0.05 was considered statistically significant.

Results

The degree of sella calcification is given in Table 1. The prevalence of Type I bridging was 25.7% in the cases group, compared to 54.3% in the control group. The control group contained 32 subjects (45.7%) with sella turcica bridging (types II and III according to Leonardi et al), while the cases group had 26 subjects (74.3%) with this anomaly (types II and III combined). There was a statistically significant difference between the two groups (P=0.006). Further classification of sella calcification is given in Table 2. Majority of the patients in the control group had Type I sella calcification (52.9%) whereas only 25.7% patients in the cases group had Type II calcification of sella. On the other hand, majority of the patients in the impacted canine group had type II sella calcification 60%. There was a statistically significant difference between the two groups (P=0.01).

Table 1: Comparison of sella bridging between cases and controls

Groups	Sella bridging		P value
	Calcification absent (Type I) n(%)	Calcification present (Type II and III combined) n(%)	
Cases	9 (25.7%)	26 (74.3%)	0.006*
Controls	38 (54.3%)	32 (45.7%)	

*Chi-square test, P≤0.05

Table 2. Degree of calcification between cases and controls

Groups	Sella bridging			
	Type I n(%)	Type II n(%)	Type III n(%)	P value
Cases (35)	9 (25.7%)	21 (60%)	5 (14.3%)	0.01*
Controls(70)	37 (52.9%)	30 (42.9%)	3 (4.3%)	

Type I, No calcification; Type II, partial calcification; Type III, complete calcification.

*Chi-square test, P≤0.05

The mean dimensions of sella turcica in cases and controls are given in table 3. Independent sample t test shows that the interclinoidal distance is shorter in the subjects with impacted canines in comparison with the subjects with normally erupted canines. The difference was statistically significant (P=0.002). The comparison of mean sella depth and anteroposterior diameter was not significant between the two groups.

Table 3. Comparison of mean sella dimensions between the two groups

	Sella dimensions		
Study group	Sagittal Interclinoidal distance	Sella depth	Sella diameter
Cases	4.8 ± 2.6	6.8 ± 1.2	8.9 ± 1.5
Controls	6.4 ± 2.4	7.4 ± 1.1	9.3 ± 1.8
P value	0.002*	0.26	0.23

*Independent sample t test, P≤0.05

Ponticulus posticus was seen in 22% of the cases group and 12% of the controls group. The difference between the groups was statistically significant. The comparison of degree of ponticulus posticus development between cases and controls is shown in table 4.

Table 4. Comparison of presence of ponticulus posticus among two groups

Groups	Sella bridging		P value
	Ponticulus posticus present	Ponticulus posticus absent	
Cases	77%	22%	0.006**
Controls	87%	12%	

*Chi-square test, P≤0.05

Discussion

In the absence of evident clinical signs or symptoms, calcification of the clinoid processes, also known as sella turcica bridging should be considered a normal variant of sella turcica morphology, despite the fact that numerous disorders can be linked to it. In this study we have evaluated the association between PDCs with sella turcica bridging and ponticulus posticus development.

Our results showed that sella turcica bridging and ponticulus posticus occurrence are associated significantly and positively with the occurrence of PDC. These results were consistent with the study done by Ghadimi et al.[9] which showed similar results. The prevalence values of sella turcica bridging observed in that study were 30.7% in the normal population, 60% in patients with PDC. According to our findings, patients with impacted canines had a shorter interclinoidal distance, but there were no significant variations in sella depth or diameter among the two groups. Our study results are in agreement with a study done on Pakistani orthodontic patients.[8] Najim and Nakib[13] in their study also showed that sella length was decreased in subjects with impacted canines but depth and diameter remained insignificant.

The occurrence of palatally displaced canine was significantly associated with occurrence and completion of arcuate foramen (ponticulus posticus). A study done by Lenoardi et al.[14], reported a higher prevalence of complete and incomplete ponticulus posticus 34.2% in the PDC group compared to 15.8% in the control group. Another study also highlighted the association of dental transpositions with the development of incomplete and complete ponticulus posticus.[15]

The anterior part of sella turcica, the pituitary gland, and the dental epithelial progenitor cells are all derivatives of neural crest cells.[16] Due to the common embryological origin of these structure i.e. neural crest cells which has a major role in the development of head and neck structures and

dental development. Hence any alterations at the developmental level can result in a sella bridge that can simultaneously lead to impacted canines. In addition, mutations in the homeobox, HOX, or sonic hedgehog genes also have a negative impact on the development of the midface, dentition, and parts of the sella turcica.[17]

The arcuate foramen may compress the neurovascular structures that pass through it, causing a vertebrobasilar insufficiency. It is a condition comprising of symptoms like neck pain, cervical migraine, vertigo, chronic tension headaches, shoulder and arm pain, neurosensory-type hearing loss, and, in some cases, even loss of postural muscle tone and consciousness.[10,18,19] As a result, orthodontists should look for this anomaly on cephalographs.

This study had some limitations which include small sample size, limited age range and specific ethnicity. Another limitation is the growth status which differs in boys and girls. It might be claimed that age ranges should reflect such disparities because same-age boys and girls can differ in terms of growth and hormonal condition. The role of age and gender should be studies with respect to this topic.

Conclusions

1. **There is a strong association between PDC and sella turcica bridging.**
2. **The length of sella is reduced in patients with palatally displaced canines.**
3. **The development of ponticulus posticus is positively associated with the occurrence of PDCs.**

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