Association of Sella Turcica Bridge and Ponticulus Posticus with Palatally Impacted Canine and Hypodontia

Vania Prima Amelinda[1]*, Nia Ayu Ismaniati[2], Maria Purbiati[2]

1. Orthodontic Residency Program, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia.
2. Department of Orthodontics, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia.

Abstract

Calcification of sella turcica is known as sella turcica bridge (STB), and calcification of first cervical vertebra of the spine is known as ponticulus posticus (PP). STB and PP might be able to predict the occurrence of palatally impacted canine and hypodontia. Sella turcica, neck and shoulder skeletal development, and dental epithelial cells share a common embryonic origin.

The purpose of the present study was to investigate the association between STB and PP and the association of each of these with palatally impacted canine and hypodontia.

This cross-sectional study was performed on the lateral cephalograms of 51 Deutero-Malayid patients, who were divided into three groups. The first group comprised 17 cephalograms of palatally impacted canine patients, the second group comprised 17 cephalograms of hypodontia patients, and the third group comprised 17 cephalograms of control patients. The type of STB and PP (no calcification, partial calcification, and complete calcification) was evaluated on each lateral cephalogram. The associations of STB with palatally impacted canine and hypodontia, PP with palatally impacted canine and hypodontia, and STB with PP were analyzed using an independent Chi-square test and Kendall correlation. The calcification of STB and PP in palatally impacted canine and hypodontia patients was increased compared with control patients.

There was a significant association of STB and PP with palatally impacted canine and hypodontia, which showed an average positive correlation. However, there was no significant association between STB and PP. Calcification of STB and PP is frequently found in palatally impacted canine and hypodontia patients. The very early appearance of STB and PP during development should alert clinicians to possible impacted canine and hypodontia later on life.

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Introduction

Lateral cephalogram is one of the most important radiographs in orthodontics and is used for assessing dental and skeletal patterns to devise an appropriate treatment plan. Besides its main function, lateral cephalogram shows other information regarding the skull, face, and first cervical vertebrae. One of the landmarks on lateral cephalogram that is always used by orthodontists is sella turcica, which serves an important function in the analysis of the relationship between the maxilla, mandible, and cranium base. Variations in sella turcica have been associated with severe craniofacial deviations and dental anomalies; a variant form of sella turcica is known as sella turcica bridge (STB), which is described as a calcification of the anterior and posterior clinoid processes.[1,2,3,4]

Another landmark on lateral cephalogram associated with dental anomalies is ponticulus posticus (PP), which is defined as an abnormal calcification of the first cervical vertebrae of the spine and can be routinely detected in a lateral cephalogram. A PP embracing the vertebral artery and suboccipital nerve can cause migraines, headaches, and neck and shoulder pain. Although orthodontists are not concerned with the management of cervical spine anomalies, as healthcare professionals, it is their responsibility to record or refer the anomaly if needed.[5]

Corresponding author:
Nia Ayu Ismaniati
Department of Orthodontic s
Faculty of Dentistry, Universitas Indonesia,
Jakarta, Indonesia.
E-mail: vaniachiya@gmail.com

Both STB and PP are laid down in cartilage at an early stage of development and ossify during early childhood; thus, early appearance should alert orthodontists to possible dental anomalies later on in life. This may occur since sella turcica, neck and shoulder skeletal development, and tooth formation share a common gene and are influenced by the neural crest. Therefore, it is reasonable to assume that any disturbance of the neural crest might interfere with one or more system under its influence.[6,7,8]

Among dental anomalies, palatally impacted canine and hypodontia were chosen for the present study because they are influenced by a common genetic origin. Palatally impacted canine and hypodontia can cause several problems such as midline shift, root resorption, unfavorable appearance, malocclusion, and other damage. Treatment of palatally impacted canine and hypodontia is usually expensive and multidisciplinary; thus, early diagnosis may reduce the time, cost, and complexity of treatment. [9,10,11,12] Research in the literature represents different ethnic and racial groups; however, no studies have been conducted in the Deutero-Malayid race. Therefore, the objective of this study was to investigate the association of sella turcica bridge and ponticulus posticus with palatally impacted canine and hypodontia in the Deutero-Malayid race.

Materials and methods

This study has been approved by ethical comitte and author anonyme the patient's information. This cross-sectional study was performed on lateral cephalograms of 51 Deutero-Malayid patients from the Department of Orthodontics, Universitas Indonesia. The consecutive sampling method was used and the patient cephalograms were divided into three groups. The first group consisted of 17 cephalograms of palatally impacted canine patients, the second group consisted of 17 cephalograms of hypodontia patients, and the third group consisted of 17 cephalograms of control patients without any dental anomalies.

Palatally impacted canine, hypodontia, and control patients were diagnosed using lateral cephalogram and panoramic radiogram and confirmed with medical records. The inclusion criteria of the present study were the requirement for a good quality lateral cephalogram radiograph and being a patient of Deutero-Malayid race aged over 14 years old. The exclusion criteria were patients with cleft lip and palate, craniofacial anomaly or syndrome, severe craniofacial deviation that required ortho-surgery treatment, and history of facial trauma.

After carefully selecting the lateral cephalograms using the above-mentioned criteria, all radiographs were manually traced using a 0.5-mm pencil and an acetate sheet. Sella turcica was measured by tracing the tip of the dorsum sella to the tuberculum sella. In order to measure STB, the length and diameter of sella were calculated.

- Sella length: distance from the tuberculum to the dorsum sella.
- Sella diameter: longest distance between the tuberculum and the farthest point on the inner wall of sella.

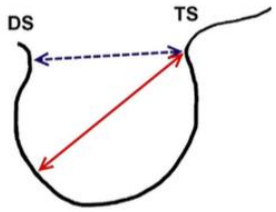

Figure 1. Linear dimensions of sella Turcica (Ghadimi, 2017)[8].

A standardized scoring scale of STB comprised sella length and diameter, which is divided into three types as follows: Type I: no calcification (if the length of sella turcica was greater than or equal to three-quarter diameter); Type II: partial calcification (if the length of sella turcica was less than three-quarter diameter), and Type III: complete calcification (if the cephalogram showed the diaphragm sella or contact between the tuberculum and dorsum sella).[13]

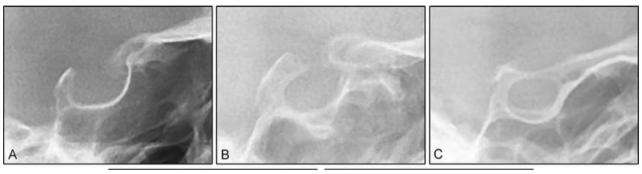

Figure 2. Examples of sella turcica calcification. A. Type I calcification; B. Type II calcification; C. Type III calcification (Ghadimi, 2017)[8].

For PP, a standardized scoring scale was also divided into three types: Type I: no

calcification (no bony bridge was observed); Type II: partial calcification (partial bony bridge was observed), and Type III: complete calcification (complete bony bridge was observed).[5]

Figure 3. Examples of ponticulus posticus calcification. A. Type I calcification; B. Type II calcification; C. Type III calcification (Ghadimi, 2017)[8].

Figure 4. Illustration of traced ponticulus posticus that define the difference calcification. Red was partial calcification and purple was complete calcification (Ghadimi, 2017) [8].

Statistical analysis

To evaluate the reliability of this study, ten lateral cephalometric radiographs were randomly selected and traced. The traced cephalographs were evaluated with inter-reliability test between the author and experienced orthodontist who was considered more accurate. The intra-reliability test was performed by the same author with a one–week interval between the tracing. The percentage of three types of STB and PP on each group were calculated. Data were analyzed using SPSS 22.0 version with Kappa to evaluate the reliability of the present study, and an independent Chi-square test was performed to determine the association of STB with PP and of each of these with palatally impacted canine and hypodontia. Correlation between each variable was evaluated using Kendall correlation. Statistical tests were considered significant if $p<0.05$ with a 95% confidence interval.

Results

Type of STB and PP on each group are shown in Tables 1 and 2, respectively.

Group	Type I STB	Type II STB	Type III STB	Total
	n (%)	n (%)	n (%)	n (%)
Control	14 (58.4)	3 (12.5)	0 (0.0)	17 (33.3)
Impacted canine	5 (20.8)	11 (45.8)	1 (33.3)	17 (33.3)
Hypodontia	5 (20.8)	10 (41.7)	2 (66.7)	17 (33.3)
Total	24 (100)	24 (100)	3 (100)	51 (100)

Table 1. Type of Sella Turcica Bridge (STB) on Each Group.

Group	Type I PP	Type II PP	Type III PP	Total
	n (%)	n (%)	n (%)	n (%)
Control	14 (50.0)	1 (6.2)	2 (28.6)	17 (33.3)
Impacted canine	7 (25.0)	7(43.8)	3 (42.8)	17 (33.3)
Hypodontia	7 (25.0)	8 (50.0)	2 (28.6)	17 (33.3)
Total	28 (100)	16 (100)	7 (100)	51 (100)

Table 2. Type of Ponticulus Posticus (PP) on Each Group.

A Chi-square test showed that STB type II and III (partial and complete calcification) were more frequent in control impacted canine group compared control group (Table 3). There was a significant association of STB with palatally impacted canine ($P = 0.002$). Kendall correlation analysis showed an average positive correlation between STB and palatally impacted canine with $r = 0.533$, which is range from 0.3-0.6.

Type STB	Control group	Impacted canine group	Correlation coefficient (r)	p-value
	n (%)	n (%)		
Type I	14 (82.4)	5 (29.4)	0.533	0.002
Type II	3 (17.6)	11 (64.7)		
Type III	0 (0.0)	1 (5.9)		
Total	17 (100)	17(100)		

Table 3. Association of Sella Turcica Bridge with palatally impacted canine.

A Chi-square test showed that STB type II and III (partial and complete calcification) were more frequent in hypodontia group than in control group (Table 4). there was a significant association between STB and hypodontia ($P = 0.002$). Kendall correlation analysis showed an average positive correlation between STB and hypodontia with $r = 0.424$, which is range from 0.3-0.6.

Type STB	Control group n (%)	Hypodontia group n (%)	Correlation coefficient (r)	*p*-value
Type I	14 (82.4)	5 (29.4)	0.424	0.002
Type II	3 (17.6)	10 (58.8)		
Type III	0 (0.0)	2 (11.8)		
Total	17 (100)	17(100)		

Table 4. Association of Sella Turcica Bridge with Hypodontia.

A Chi-square test showed that PP type II and III (partial and complete calcification) were more frequent in control impacted canine group than in control group (Table 5). There was a significant association between PP and palatally impacted canine (p = 0.03). Kendall correlation analysis showed an average positive correlation between PP and palatally impacted canine with r = 0.533, which is range from 0.3-0.6.

Type PP	Control group n (%)	Impacted canine group n (%)	Correlation coefficient (*r*)	*p*-value
Type I	14 (82.3)	7 (41.2)	0.533	0.03
Type II	1 (5.9)	7 (41.2)		
Type III	2 (11.8)	3 (17.6)		
Total	17 (100)	17(100)		

Table 5. Association of Ponticulus Posticus with palatally Impacted Canine.

A Chi-square test showed that PP type II and III (partial and complete calcification) were more frequent in hypodontia group than in control group (Table 6). There was a significant association of PP with hypodontia (P = 0.036). Kendall correlation analysis showed an average positive correlation between PP and hypodontia with r = 0.424, which is range from 0.3-0.6.

Type PP	Control group n (%)	Hypodontia group n (%)	Correlation coefficient (r)	*p*-value
Type I	14 (82.4)	7 (41.2)	0.424	0.036
Type II	1 (5.9)	8 (47.1)		
Type III	2 (11.8)	2 (11.8)		
Total	17 (100)	17(100)		

Table 6. Association of Ponticulus Posticus with Hypodontia.

A Chi-square test showed that STB and PP do not have a significant association with p value = 0.061, which is more than 0.05 (Table 7).

Patient		Normal without PP n (%)	with PP n (%)	*p*-value
Normal STB	without	17 (60.7)	7 (30.4)	0.061
With STB		11 (39.3)	16 (69.6)	
Total		28 (100)	23 (100)	

Table 7. Association of Sella Turcica Bridge with Ponticulus Posticus.

Discussion

This study evaluated the association of sella turcica bridge and ponticulus posticus with palatally impacted canine and hypodontia. In this study, we also examined the association between sella turcica bridge and ponticulus posticus in comparison to normal subjects. Palatally impacted canine and hypodontia were chosen because they are genetically linked but have different phenotypic expression. The subjects of the present study were patients of the Deutero-Malayid race, who were used to confirm a previous study regarding the association between STB and dental anomalies in the Caucasian race. The inclusion criteria were patients aged 14 years or older, since the development of the canine usually finishes at 12 or 13 years of age; and all the teeth except the third molars have usually erupted by this time.[14,1,8]

STB and PP were significantly increased in patients with palatally impacted canine and hypodontia versus those in control group. STB was observed in 12 (70.5%) subjects with palatally impacted canine and hypodontia. PP was observed in 10 (58.8%) subjects with palatally impacted canine and hypodontia. Conversely, STB and PP was only seen in three (17.6%) subjects in control group. Chi-square statistics confirmed that there was a significant association of STB and PP with palatally impacted canine and hypodontia. This may be due to the fact that the formation and development of sella turcica, neck and shoulder skeletal development, and dental epithelial cells share a common gene and involvement of neural crest cells. These results are in agreement with the previous studies where sella turcica bridge was frequently found in patients from a Caucasian race with dental anomalies.[4,13, 8]

There was no statistically significant association (P > 0.05) between STB and PP. This may be a result of many different genes involved in the development of STB and PP in

addition to those related to the neural crest. The average correlation of STB and PP with impacted canine and hypodontia may have contributed slightly to the association between STB and PP. Many orthodontists have difficulty determining when the canine impaction and hypodontia will occur, which affects the timely prevention of this dental condition. This study may help better planning of preventive treatment to appropriately manage palatally impacted canine and hypodontia.

Conclusions

STB and PP in palatally impacted canine and hypodontia patients were increased as compared with control patients. Our data demonstrated a significant association of sella turcica bridge and ponticulus posticus with palatally impacted canine and hypodontia. However, a significant association was not found between sella turcica bridge and ponticulus posticus. The very early appearance during development of STB and PP should alert clinicians to possible palatally impacted canine and hypodontia in life later. There may be other dental anomalies that deserves further studies.

Declaration of Interest

The authors report no conflict of interest.

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