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Ahmet Karaman
Department of Orthodontics, Faculty of Dentistry, Istanbul aydın University,İstanbul Turkey., ahmeet.ka@hotmail.com

saadet cinarsoy cigerim Assistant Professor
Department of Orthodontics, Faculty of Dentistry, Van Yüzüncü Yıl University, Van, Turkey., saadetcinarsoy@live.com

Nourtzan Kechagia Research Assistant
Department of Orthodontics, Faculty of Dentistry, Istanbul Aydın University, Istanbul, Turkey., khynurcan@gmail.com

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ORIGINAL ARTICLE

Evaluation of the Relationship between Sella Turcica Bridging and Dental Anomalies

Ahmet Karaman*[1], Saadet Cinarsoy Cigerim[2], Nourtzan Kechagia[1]

[1]*Department of Orthodontics, Faculty of Dentistry, Istanbul Aydın University, Istanbul, Turkey*
[2] *Department of Orthodontics, Faculty of Dentistry, Van Yüzüncü Yıl University, Van, Turkey*
**Correspondence e-mail to: ahmeet.ka@hotmail.com*

ABSTRACT

Objectives: This study aims to evaluate the relationship between the morphological variations of Sella Turcica (ST) and dental anomalies. **Methods:** This study included 765 individuals between the ages of 13 and 35. ST morphology was examined in 3 groups as no calcification, partially calcified and completely calcified according to the interclinoid ligament (ICL) on lateral cephalometric films, and it was examined and evaluated in terms of its relationship to impacted canines (unilateral and bilateral), impacted teeth (except 3rd molars), root dilaceration, tooth deficiency (upper incisor lateral - lower and upper second premolar), supernumerary tooth and taurodontism. **Results:** The rates of supernumerary teeth, lateral and premolar tooth deficiency and root dilaceration in total calcification of ICL were significantly higher than those in ICL with no calcification. The rates of taurodontism, unilateral and bilateral impacted canine teeth and impacted teeth in ICL with no calcification were found to be significantly lower than those in the partial and total calcification of ICL. **Conclusion:** In this study, a statistically significant relationship was found between ST morphology and dental anomalies. Examination of sella turcica bridging (STB) variations in a large population will be guiding for the early detection of dental anomalies.

Key words: dental anomaly, sella turcica, sella turcica bridging

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INTRODUCTION

Sella turcica (ST) is an anatomical formation that is frequently used by orthodontists and accepted as a guide point in measurements made on lateral cephalometric x-rays.[1,2] The morphology of ST does not change significantly after the age of 12, and the tuberculum sellae which is the anterior part of ST remains stable from the age of 5 onwards.[3] The sella point is a cranial landmark for cephalometric tracing that was firstly defined by Björk. This point is located at the center of the sella turcica. ST consists of three parts including the tuberculum sellae anteriorly, the dorsum sellae posteriorly and the hollow floor between them.[4,5]

During embryological development, the formation of teeth and the formation and development of ST consist of common neural crest cells.[6] While the dorsum sellae cartilage, which will form the posterior part of ST, originates from the notochordal cartilage, the cartilage that forms the anterior part develops from neural crest cells.[7] The formation and development of the anterior part of the pituitary gland, ST and teeth differentiate through the sequential and reciprocal interaction of neural crest cells and dental epithelial progenitor cells with the neural crest-derived mesenchyme.[6-8] As a result of this mutual interaction, structures such as the facial skeleton and teeth are formed. Any disruption in this biological process may cause the formation of skeletal and dental anomalies, leading to malformations on the head and face.[8,9] This situation suggests the possibility of correlations between anatomical deviations in ST and craniofacial structure and dental anomalies.[9,10]

The calcification status of interclinoid ligaments (ICL) which is radiologically defined as ‘sella turcica bridging' (STB) should be considered as the normal morphology of ST anatomy in the absence of skeletal and dental anomalies.[10-12] However, skeletal and dental malocclusion may be associated with STB.[13] Among healthy individuals, the incidence of STBs varies between 1.1% and 13%.[14] This rate increases in severe skeletal malocclusions and dental anomalies.[4,10,12] STB is associated with multiple hereditary developmental syndromes such as Down syndrome, Gorlin-Goltz syndrome, Williams syndrome, Seckel syndrome and Axenfeld-Rieger syndrome and unilateral cleft lip and palate.[15,16]

This study aims to evaluate the relationship between morphological variations of ST and unilaterally-bilaterally impacted canine, impacted teeth, root dilaceration, tooth deficiency, supernumerary teeth and taurodontism.

METHODS

This study included 765 individuals between the ages of 13 and 35 who presented to Istanbul Aydın University and Van Yüzüncü Yıl University Faculty of Dentistry for treatment between 2012 and 2020. The research protocol was approved with the decision (2020/272) made at the Istanbul Aydın University meeting held by the Ethical Committee for Clinical Studies at the same university. In lateral cephalometric films, the anatomical and physiological integrity of ST was examined and evaluated in terms of its relationship to impacted canines (unilateral and bilateral), impacted teeth (except 3rd molars), root dilaceration, tooth deficiency (upper incisor lateral - lower and upper second premolar), supernumerary teeth and taurodontism.

For inclusion in this study, the records were required to include good and high-quality lateral cephalometric and panoramic radiographs without a congenital anomaly, syndromes or medical conditions and no prosthetic treatment or extraction before. Patients with low-resolution radiographs, orthodontic treatment or orthognathic surgery history, facial trauma, skull surgery, congenital craniofacial anomalies and syndromes or systemic diseases and patients with extracted teeth or prosthetic restorations were excluded from the study.

In the study, the classification determined by Leonardi et al.[17,18] was used to determine the degree of ST ICL calcification. The length of the sella turcica was measured as the distance between the tuberculum sella and the dorsum sella. The diameter of the sella turcica was measured from the tuberculum sella to the most posterior point on the inner wall of the pituitary fossa. A standardized scoring scale was determined by comparing the length and diameter measurements. The cephalometric radiographs were traced and measured manually by one observer (N.K.). Accordingly, 3 types were determined:

Type I: If the length measured between the tuberculum sella and the dorsum sella is greater than or equal to 3/4 of the diameter of the sella (no calcification)

Type II: If the length measured between the tuberculum sella and the dorsum sella is shorter than 3/4 of the diameter of the sella (ICL partial calcification)

Type III: If there is a visually identifiable contact between the tuberculum and the dorsum sella (ICL total calcification) (Figure 1).

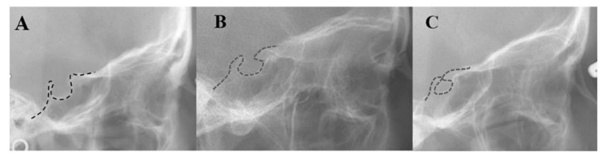

Figure 1. A: Normal sella turcica shape, B: Partial sella turcica bridge, C: Total sella turcica bridge

The participants in the study were divided into three groups as the Type I: no calcification (123 females, 154 males), Type II: partial calcification of ICL (172 females, 86 males) and Type III total calcification of ICL (109 females, 121 males) groups according to the details of the lateral cephalograms of the different morphological types of the sella turcica.

Determination of the morphological variations of ST on the lateral cephalometric films and evaluation of dental anomalies through the panoramic films were carried out by the same researcher (N.K.). To evaluate the method error, 150 patients were randomly selected after 4 weeks, and their x-rays were re-examined. The Kappa reliability test was applied between the first and second measurements, and accordingly, the agreement between the two measurement times was found to be 0.975 by the authors (N.K. and S.C.C.). These results showed that our analyses were repeatable.

Data analysis

The required sample size was calculated based on power analysis using the G*Power Software version 3.1.9.2 (Universität Düsseldorf, Germany) for a subscale with an alpha error probability of 0.05 and a power of 85%. The power analysis showed that a minimum of 410 participants was required for the study

Statistical analysis

While analyzing the findings obtained in the study, the IBM SPSS Statistics 22 (SPSS IBM, Turkey) program was used. The normality of the distributions of the parameters was analyzed using Kolmogorov-Smirnov test. The data analysis process involved descriptive statistical methods (mean, standard deviation, frequency), as well as one-way analysis of variance (ANOVA) to compare the quantitative data

Table 1. Distribution of parameters

		n	%
SELLA	No calcification	277	36.2
	ICLpartial calcification	258	33.7
	ICL total calcification	230	30.1
Supernumerary tooth	Absent	738	96.5
	Present	27	3.5
Lateral and Premolar tooth deficiency	Absent	687	89.8
	Lateral	48	6.3
	Premolar	30	3.9
Root dilaceration	Absent	562	73.5
	Present	203	26.5
Taurodontism	Absent	427	55.8
	Present	338	44.2
Impacted canine	Absent	630	82.4
	Unilateral	78	10.2
	Bilateral	57	7.5
Impacted teeth	Absent	589	77
	Present	176	23

Table 2. Distribution and standard deviation (SD) of the age and sex values of the sample

	Sella Turcica			
	Normal	**Partial**	**Total**	**p-value**
Age (Mean±SD)	18.58±3.04	18.53±4.08	18.40±4.35	0.871[a]
Sex n (%)				
Female	123 (44.4%)	172 (66.7%)	109 (47.4%)	0.000*
Male	154 (55.6%)	86 (33.3%)	121 (52.6%)	

[a]One-way ANOVA Test [a]Chi-squared test *Statistically significant (p<0.05)

on age between the sella groups. Chi-squared test was used to compare the qualitative data between the sella groups. The level of significance was accepted as p<0.05.

RESULTS

The study was conducted with a total of 765 cases, including 404 female and 361 male patients, with ages ranging from 13 to 35. The mean age of the patients was 18.51 ± 3.82 years (Table 1).

In the female patients, the prevalence of partial ICL calcification was found to be significantly higher than the prevalence of no calcification and the prevalence of total calcification (p= 0.000, Chi-square test, Table 2). There was no significant relationship between the age and sella turcica groups (p =0.871, one-way ANOVA, Table 2).

There was a statistically significant difference between the sella groups in terms of their incidence of supernumerary teeth, lateral and premolar tooth deficiency and root dilaceration (p<0.05, Chi-square test, Table 3). The rates of supernumerary teeth, lateral and premolar tooth deficiency and root dilaceration in the total ICL calcification group were significantly higher than those in the no ICL calcification group (p<0.05, Chi-square test, Table 3). There was also no significant difference in the incidence of supernumerary teeth, lateral and premolar tooth deficiency and root dilaceration between the no calcification and partial calcification groups or between the partial calcification and total calcification groups (p<0.05, Chi-square test, Table 3).

The rates of taurodontism, unilateral and bilateral impacted canine teeth and impacted teeth in the no ICL calcification group were found to be significantly lower than those in the partial ICL calcification and total ICL calcification groups (p<0.05, Chi-square test, Table 3). There was no significant difference in the incidence of taurodontism, unilateral and bilateral impacted canine teeth and impacted teeth between the partial and total ICL calcification groups (p<0.05, Chi-square test, Table 3).

DISCUSSION

STB occurs early in development and then undergoes ossification in early childhood.[7] Ossification may result from the complex embryology of the sphenoid bone or the physiological activities of chemical components involved in embryogenesis.[19] In the study by Camp et al.[20] examining the distance between the anterior and posterior clinoid processes on 110 skulls, they authors determined the rate of bone fusion between the anterior and posterior clinoid processes as 4.5% and mentioned the fusion of ST for the first time. Busch[21] reported 1.54% total calcification and 1.74% partial calcification in their measurements on 343 skulls. Platzer[22] examined the ST anatomy by direct inspection over 220 skulls and stated STB at a rate of 5.9%. Bergland[23] reported 6% STB in 225 skulls. Carstens[24] found 4.6% STB in their study, in which they examined 461 radiographic images. The radiographic finding of STB in lateral cephalometric films is accepted as a normal anatomic formation unless there is a clinical or radiological sign of an anomaly.[12] In healthy individuals, the incidence of STB varies from 1.1% to 13%, but this rate increases in severe skeletal malocclusions and dental anomalies.[14,19] Axelsson et al.[10] and Tetradis et al.[25] stated that total ICL calcification is more common

Table 3. Comparison of sella types and dental parameters

		Sella Turcica			
		No calcification n (%)	ICL partial calcification n (%)	ICL total calcification n (%)	p-value
Supernumerary teeth	Absent	273 (98.6)	248 (96.1)	217 (94.3)	0.036*
	Present	4 (1.4)	10 (3.9)	13 (5.7)	
Lateral and Premolar tooth deficiency	Absent	262 (94.6)	232 (89.9)	193 (83.9)	0.004*
	Lateral	9 (3.2)	16 (6.2)	23 (10)	
	Premolar	6 (2.2)	10 (3.9)	14 (6.1)	
Root dilaceration	Absent	218 (78.7)	187 (72.5)	157 (68.3)	0.027*
	Present	59 (21.3)	71 (27.5)	73 (31.7)	
Taurodontism	Absent	182 (65.7)	140 (54.3)	105 (45.7)	0.000*
	Present	95 (34.3)	118 (45.7)	125 (54.3)	
Impacted canines	Absent	248 (89.5)	212 (82.2)	170 (73.9)	0.000*
	Unilateral	17 (6.1)	26 (10.1)	35 (15.2)	
	Bilateral	12 (4.3)	20 (7.8)	25 (10.9)	
Impacted teeth	Absent	241 (87)	188 (72.9)	160 (69.6)	0.000*
	Present	36 (13)	70 (27.1)	70 (30.4)	

*Chi-square test, significant level at $p<0.05$

in women. Partial calcification was found to be also significantly higher in the women in our study. It has been stated in the literature that the morphology of ST varies in patients with craniofacial deformities.[6,7,18,19] Becktor et al.[19] found that craniofacial deformity is more common in patients with STB than in STB-free patients. According Axelsson et al.[26] deviations in the morphological types of ST are more common in Williams syndrome. Another study revealed that, in Meckel-Gruber syndrome, an irregularly shaped notochordal residue and a broad-based dorsum sella are observed.[7] In Turner's syndrome, ST has been reported to be larger than normal.[27] Meyer-Marcotty et al.[28] found that STB is more common in skeletal Class III patients than in skeletal Class I patients. Jones et al.[15] compared only orthodontic treatment cases to orthognathic surgery cases and found the rates of STB as 16.7% in the surgical group and 7.3% in the orthodontic group. Kimonis et al.[29] and Iwanaga et al.[30] reported that STB is one of the radiological findings of basal cell carcinoma and Gorlin-Goltz syndrome. Kjaer[31] stated that there is a link between changes in the morphology of ST and special groups such as cleft lip, a single median central incisor and spina bifida both in the prenatal and postnatal periods.

Intracranial calcifications that occur in patients with various dental anomalies reinforce a genetic etiology underlying this condition. Teeth develop by the interaction and differentiation of dental epithelial progenitor cells with the neural crest mesenchyme.[14] Since the anterior part of ST is mainly composed of neural crest cells in the early embryological period, it is thought that structural deviations in the anterior part also occur with some dental deviations in the facial skeleton.[7,14] Scribante et al.[14] and Leonardi et al.[17] found a correlation in their respective studies between interclinoid calcification and dental anomalies such as hypodontia, transposition, premolar deficiency and impacted canines. Leonardi et al.[18] determined a significant relationship between transposition and STB. Scribante et al.[14] stated that the partial and total calcification of the sella turcica significantly increased in patients with dental anomalies. Accordingly, partial calcification and total calcification in dental anomalies were respectively seen at rates of 56% and 13%.[14] Leonardi et al.[17] stated that dental anomalies were seen in partial calcification at a rate of 58.8% and in total calcification at a rate of 17.6%. In our study, the rates of lateral and premolar tooth deficiency, supernumerary tooth and root dilaceration in the total calcification group were found to be significantly higher than the other groups. In relation to the partial and total calcification of ICL, Scribante et al.[14] and Leonardi et al.[17] conducted studies investigating lateral and premolar tooth deficiency, and Divya et al.[32] studied the presence of supernumerary teeth. Leonardi et al.[17] reported the incidence of mandibular premolar tooth deficiency in total calcification as 18.7%, and Scribante et al.[14] reported the same value as 6%. In our study, the rate of premolar tooth deficiency in total calcification was found to be significantly higher at a rate of 6.1%, which was consistent with the findings of Scribante et al.[14] In our study, the rate of lateral tooth deficiency in total calcification was found to be 10%, significantly higher than the group with no calcification. Scribante et al.[14] reported the rate of lateral tooth deficiency as 9% in total calcification. Moreover, Alqahtani et al.[33] stated that lateral tooth deficiency is more common in STB. In our study, the incidence of supernumerary teeth in total calcification was found to be significantly higher than the group with no calcification at 5.7%. Divya et al.[32] identified the ratio of supernumerary teeth as 21.7% in total calcification. There is no study in the literature examining whether there is a relationship between root dilaceration and STB. Our study is the only study in the literature reporting a positive correlation between root dilaceration and STB, and the incidence of root dilaceration in total calcification was found as 31.7%, which was significantly higher than that in the group with no calcification. In our study, the rates of taurodontism, unilaterally and bilaterally impacted canines and impacted teeth in the no calcification group were found to be significantly lower than those in the partial and total calcification groups. Many studies in the literature have reported that impacted canines are seen more commonly in cases of partial and total calcification.[14,17,34,35] The incidence of impacted canines in partial calcification was reported as 43.6% by Divya et al.[32] and 45.7% by Haji Ghadimi et al.[34] Ali et al.[35] found the incidence of impacted canines in partial calcification cases to be 54.8%, whereas this rate was 25.8% in cases of total calcification. Scribante et al.[14] reported the rates of palatinal impacted canines as 56% in cases of partial calcification and 13% in cases of total calcification. In our study, we separated the impacted canines as unilateral and bilateral, and as a result, in the total calcification cases, the rate of unilaterally impacted canines was found to be 15.2%, and the rate of bilaterally impacted canine was found to be 10.9%. In addition to impacted canines, when the correlation between impacted teeth and taurodontism and STB was evaluated, the significantly low level of these anomalies in the no calcification group positively supported the relationship between dental anomalies and STB. In line with this result, our study is the only study in the literature supporting the relationship of taurodontism and impacted teeth with STB.

A limitation of this study was the examination of a three-dimensional anatomical formation through two-dimensional lateral cephalometric films. For this purpose, cone-beam computed tomography, which provides three-dimensional imaging, can provide a more accurate result. However, in orthodontic patients, such imaging techniques are not indicated for routine use due to high-dose radiation exposure.[36]

As a diagnostic method, the morphological variations of ST shed light on certain pathologies. Morphological variations between the anterior and posterior walls of ST may be important for diagnosis. The emergence of STB at the early stage of development may be an early indicator of possible dental anomalies in later life. In this study, a statistically significant relationship was found between ST morphology and dental anomalies. Examination of STB variations in a large population will be guiding for the early detection of dental anomalies.

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