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Araştırma/ Research Article

RELATIONSHIP BETWEEN SELLA TURCICA BRIDGING AND MAXILLARY IMPACTED CANINES AND MAXILLARY PARAMETERS

SELLA TURSİKA KÖPRÜSÜ İLE ÜST GÖMÜLÜ KANİN VE MAKSİLLA ARASINDAKİ İLİŞKİ

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ABSTRACT

Aim: To evaluate the relationship between the cases of normal sella turcica, partial and total sella turcica bridging (STB) and unilaterally and bilaterally impacted canines and maxillary parameters.
Material and Methods: The sample of the study was divided into three groups according to the calcification status of the sella turcica. A total of 260 patients (80 normal sella turcica,102 partial bridging and 78 total bridging cases) were included in the study. Maxillary cephalometric measurements were performed. The results were evaluated on the significance level of $p<0.05$.
Results: There was no significant relationship between sex and impacted canine teeth and the STB groups. The relationship between the STB groups and impacted canines was also not significant. There were no significant differences based on age and effective midface length (Co-A) among the impacted canine groups, while these groups had significantly different values of maxillary base length (ANS-PNS), the angle of the maxillary plane (PP/SN) and middle third facial height (N-ANS). A statistically significant relationship was found between the STB groups and the variables of Co-A, ANS-PNS, PP /SN and N-ANS.
Conclusions: The Co-A, ANS-PNS, PP/SN and N-ANS cephalometric measurements were found to be higher in partial STB. Furthermore, the mean ANS-PNS, PP/SN and N-ANS values of the unilaterally impacted canine teeth were higher than those of the bilaterally impacted canine teeth. The relationship between the STB groups and the impacted canine variables was not statistically significant.
Keywords: Sella turcica, Sella turcica bridging, Impacted canine, Maxilla

ÖZ

Amaç : Normal sella tursika, parsiyel ve tam sella tursika köprüsü (STB) ile tek taraflı ve bilateral üst gömülü kanin dişler ve maksilla arasındaki ilişkiyi değerlendirmektir.
Gereç ve Yöntem: Çalışma sella tursikanın kalsifikasyon durumuna göre üç gruba ayrılmıştır. Çalışmaya toplam 260 hasta (80 normal sella tursika, 102 parsiyel ve 78 tam köprü) dahil edilmiştir. Maksiller sefalometrik ölçümler yapılmıştır. Sonuçlar $p<0.05$ anlamlılık düzeyinde değerlendirilmiştir.
Bulgular: Cinsiyet ve gömük kanin dişler ile STB arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır. STB grupları ile gömük kanin diş değişkenleri arasındaki ilişki de istatistiksel olarak anlamlı değildir. Gömük kanin diş grupları maksiller palatal düzlem (ANS-PNS), maksiller düzlem açısı (PP / SN), orta yüz yüz uzunluğu (N-ANS) değişkenleri ile anlamlı ilişkili bulunmuşken, yaş ve efektif orta yüz uzunluğu (Co-A) açısından anlamlı farklılık göstermemiştir. STB grupları ile Co-A, ANS-PNS, PP / SN ve N-ANS değişkenleri arasında istatistiksel olarak anlamlı bir farklılık bulunmuştur.
Sonuç: Parsiyel STB'de Co-A, ANS-PNS, PP / SN ve N-ANS sefalometrik ölçümleri daha yüksek olduğu bulunmuştur. Ayrıca, tek taraflı gömük kanin dişlerin ortalama değerleri ANS-PNS, PP / SN, N-ANS değerleri , bilateral gömük kanin dişlerinden daha fazla bulunmuştur. STB grupları ile gömük kanin diş değişkenleri arasındaki ilişki istatistiksel olarak anlamlı bulunmamıştır.
Anahtar Sözcükler : sella tursika, sella tursika köprüsü,gömük kanin, maksilla

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INTRODUCTION

The sella turcica consists of a saddle-shaped bony structure including the tuberculum sellae forming its anterior wall and the dorsum sellae forming its posterior wall. The pituitary (hypophyseal) fossa is surrounded by two anterior and two posterior clinoid processes.[1] These clinoid processes are connected to each other by the interclinoid dural layer, the interclinoid ligament or a horizontal layer of dura mater, which is defined as the fibrous ligament.[2] Studies have shown that the morphology of the sella turcica does not show any significant change after the age of 12, and the anterior wall of the sella turcica is stable after 5 years of age.[3]

Sella turcica bridging is a common morphological variation of the sella turcica. The excessive release of ligaments extending between the anterior and posterior clinoid processes of the sphenoid through abnormal fetal development leads to the development of this abnormal bridge. Anatomical anomalies of the sella turcica can be used in the interpretation of lateral cephalometric radiographs. The interclinoid ligament ossification of sella turcica is associated with the transformation of the sella turcica which may be seen in some osseous anomalies, as well as some systemic conditions.[4] Studies have reported the presence of sella turcica bridging in skeletal Class II and Class III malocclusions, dental anomalies, unilateral cleft lip and palate, severe craniofacial deviations and syndromes. The incidence of sella turcica bridging in the general population varies between 3.6 and 13%.[5]

The formation process of the sella turcica and the teeth involves neural crest cells. The anterior portion of the sella turcica is known to develop entirely from neural crest cells, and it is known that the progenitor cells of the dental epithelium differ by sequential and mutual interaction with the mesenchyme derived from the nerve crest. There may be a relationship between anatomical deviation and dental anomalies in the sella turcica. Therefore, the relationship between sella turcica bridging (STB) and dental anomalies has been investigated by many authors. As a result of these studies, it was proven that there is a relationship between STB and affected palatal canine teeth and tooth transposition.[6]

The maxillary canines are some of the most frequently impacted teeth after the third molars, with a prevalence of 0.8-2.8%.[7] Additionally, these cases are two times more common in women than men. The incidence of impacted canine teeth in the maxilla is twice as high as that in the mandible. Eight percent of maxillary impacted canine cases are bilateral. Impacted canine formation can be caused by various factors.[8] Many different etiological factors such as the incomepatibility of arch size with teeth structure, the congenital deficiency of lateral teeth, early loss or prolonged retention of deciduous canine teeth, root dilaceration, malposed tooth germ, endocrine diseases, cystic and/or neoplastic formations and hereditary factors can cause canine teeth to remain impacted.[9]

This study aims to evaluate the relationship between the cases of normal sella turcica, partial and total sella turcica bridging and unilaterally and bilaterally impacted canines and maxillary parameters.

MATERIAL AND METHODS

This retrospective study was performed between 2015 and 2020 by selecting preprocessing records of digital lateral cephalometric radiographs for the analysis of STB from the archive of the Department of Orthodontics at Istanbul Aydın University. The study was approved by the Local Ethics Committee of Istanbul Aydın University (No: 2021/393). The criterion for including records with panoramic and lateral cephalometric radiographs was the quality of these radiographs. Only radiographs where the sella turcica region was clearly seen were selected. The exclusion criteria were history of orthodontic treatment or orthognathic surgery, craniofacial anomaly, congenital syndromes, history of facial trauma, skull surgery or low-quality lateral cephalometric and panoramic radiographs.

The sella turcica bridge grading method reported by Leonardi et al.[10] was used to evaluate STB. According to the anatomical shape of the sella turcica, the sample of the study was divided into three groups based on their sella turcica bridging status (Fig. 1):

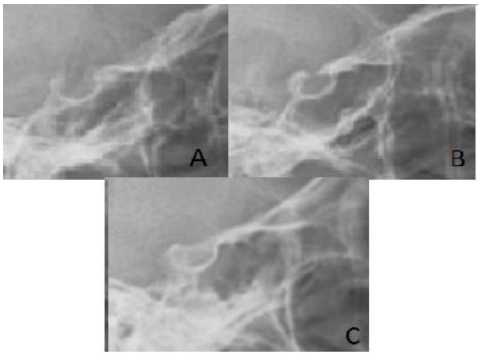

Figure 1. A: Normal sella turcica shape (no calcification). B: Partial sella turcica bridge (partial calcification). C: Total sella turcica bridge (complete calcification)

Normal sella turcica (no calcification): the length of the sella turcica is greater than three-quarters of its diameter.

Partial bridging (partial calcification); the length of the sella turcica is shorter than or equal to three-quarters of its diameter.

Total bridge (full calcification): there is visible contact between the tuberculum sellae and the dorsum sellae.

The G*Power 3.1.9.4 program was used for power analysis. Sella turcica measurements were taken as the main data for the study. The power of the study was calculated as 0.92 with an effect size of f = 0.25 (medium effect size), alpha = 0.05, total simple size = 260 and number of groups = 3.

The sample was divided into three groups according to the calcification status of the anterior and posterior processes of the sella turcica. Eighty normal sella turcica (30 females and 50 males), 102 partial bridging (52 females and 50 males) and 78 total bridging (41 females and 37 males) cases were included in the study.

The panoramic and cephalometric radiographs of all patients were evaluated by the same researcher (S.S.). The lateral cephalometric radiographs were taken with a Planmeca 2011-05 Proline Pan / Ceph X-Ray X-ray machine (Planmeca, Helsinki, Finland). The cephalometric parameters were evaluated with the Facad trial version 3.8 software (Ilexis AB, Linkoping, Sweden) as shown in Figure 2. Forty panoramic and cephalometric radiographs were randomly selected from the sample and re-evaluated after four weeks. According to the Kappa statistic, the rate of reliability between the two evaluations was 0.95.

Statistical Analysis

The IBM SPSS 21 program was used in the data analysis of this study. The categorical data are presented as frequency and percentage distributions, and the measured data are presented with mean, median, standard deviation, minimum and maximum values. The normality of the distribution of the data was tested using Kolmogorov–Smirnov test. Mann Whitney u test was used to compare two independent groups, and Kruskal Wallis test was used to compare more than two independent groups. Dunn's multiple comparisons test was used to compare subgroups. The relationships between the categorical variables were analyzed by chi-squared analysis, and the relationship between the measured variables was tested with Spearman's correlation analysis. $p<0.05$ was accepted as the level of statistical significance.

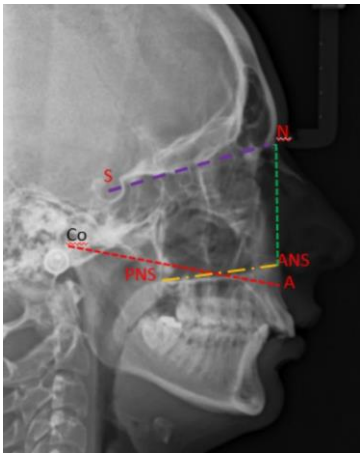

Figure 2: Co-A (effective midface length), ANS-PNS (maxillary base length), PP/SN (angle of the maxillary plane) and N-ANS (middle third facial height)

RESULTS

This study included the data of a total of 260 patients, 123 female patients and 137 male patients with a mean age of 16.28±0.98. There was no statistically significant relationship between sex and the impacted canine teeth variables ($p>0.05$).The relationship between sex and the sella turcica bridging groups was not statistically significant ($p>0.05$) (Table 1). The relationship between the STB groups and the impacted canine variables was also not statistically significant ($p>0.05$) (Table 2).

Table 1. Relationship between Gender and Impacted Canines and Sella Turcica Groups

		Gender						p
		Female			Male			
		N	% within Gender	% within Impacted Canine	N	% within Gender	% within Impacted Canine	
Impacted Canine	Unilateral	66	53.7%	47.8%	72	52.6%	52.2%	0.859
	Bilateral	57	46.3%	46.7%	65	47.4%	53.3%	
Sella Turcica Groups	Normalsella turcica shape	30	24.4%	37.5%	50	36.5%	62.5%	0.105
	Partial sella turcica bridge	52	42.3%	51.0%	50	36.5%	49.0%	
	Total sella turcica bridge	41	33.3%	52.6%	37	27,00%	47.4%	

p – p-value from Chi-Squared Test

There was no statistically significant relationship between sex and age and the variables of Co-A (effective midface length), ANS-PNS (maxillary base length), PP/SN and N-ANS (middle third facial height).Additionally, the cephalometric measurements

for the maxilla were higher in the male patients than the female patients (Table 3).

Table 2. Relationship between Sella Turcica Groups and Impacted Canines

			Sella Turcica Groups			p
			Normal sella turcica shape	Partial sella turcica bridge	Total sella turcica bridge	
Impacted Canine	Unilateral	Frequency	44	59	35	0.206
		% within Impacted Canine	31.9%	42.8%	25.4%	
		% within Sella Turcica Groups	55.0%	57.8%	44.9%	
	Bilateral	Frequency	36	43	43	
		% within Impacted Canine	29.5%	35.2%	35.2%	
		% within Sella Turcica Groups	45.0%	42.2%	55.1%	

p-value from Chi-Squared Test

Table 3. Relationship between Sex and Cephalometric Maxillary Measurements

Sex		Age	Co-A	ANS-PNS	PP/SN	N-ANS
Female	N	123	123	123	123	123
	Median	16.4	81.4	47.6	12	48
	Mean	16.33	81.03	47.81	12.10	48.30
	Std. Deviation	0.91	4.03	3.34	0.94	3.49
	Minimum	14.5	75	41	10.4	42
	Maximum	18.5	90	56	15	56
Male	N	137	137	137	137	137
	Median	16	83.2	47.6	12	48
	Mean	16.24	82.04	48.20	12.17	48.63
	Std. Deviation	1.04	4.19	3.38	0.84	3.44
	Minimum	14.6	76	42	10.7	43
	Maximum	18.7	91	56	14.5	56
p		.288	.159	.437	.474	.457

p-value from Mann Whitney U test

The differences in the ANS-PNS, PP / SN and N-ANS measurements were found to be statistically significant ($p<0.05$) based on the impacted canine teeth variable, but there was no significant difference in terms of age and Co-A based on the same variable ($p>0.05$). The mean ANS-PNS, PP/SN and N-ANS values of the unilaterally impacted canine teeth were higher than those of the bilaterally impacted canine teeth (Table 4).

Table 4. Relationship between Impacted Canines and Cephalometric Maxillary Measurements

Impacted Canines		Age	Co-A	ANS-PNS	PP/SN	N-ANS
Unilateral	N	138	138	138	138	138
	Median	16.4	82.25	48.4	12.45	49.2
	Mean	16.38	81.78	49.64	12.59	50.28
	Std. Deviation	1.10	4.16	3.31	0.89	3.37
	Minimum	14.6	76	44	10.4	43
	Maximum	18.7	91	56	15	56
Bilateral	N	122	122	122	122	122
	Median	15.95	82.1	46.4	11.6	46.4
	Mean	16.17	81.31	46.18	11.61	46.43
	Std. Deviation	0.82	4.21	2.32	0.52	2.22
	Minimum	14.5	75	42	10.6	42
	Maximum	17.8	90	51.2	12.9	52
p		.229	.634	.000*	.000*	.000*

p value from Mann Whitney U test

The analysis revealed a statistically significant difference among the STB groups in terms of their Co-A, ANS-PNS, PP/SN and N-ANS measurements. In the partial STB group, the Co-A, ANS-PNS, PP/SN and N-ANS values were found to be higher in comparison to the values of the other groups (Table 5).

The Co-A variable had a positive significant relationship with age, ANS-PNS and PP/SN. The ANS-PNS variable had a positive significant relationship with age, Co-A and PP/SN. PP/SN had a positive significant relationship with age, Co-A and ANS-PNS. N-ANS had a positive significant relationship with age, Co-A, PP / SN and ANS-PNS (Table 6).

Table 5. Relationship between Sella Turcica Groups and Cephalometric Maxillary Measurements

Sella Turcica Groups		Age	Co-A	ANS-PNS	PP/SN	N-ANS
Normal sella turcica shape	N	80	80	80	80	80
	Median	16.4	82.1	46.2	11.6	46.6
	Mean	16.37	81.75	47.40	11.94	48.01
	Std. Deviation	0.98	3.42	3.96	1.06	4.13
	Minimum	14.6	76	42	10.4	42.4
	Maximum	18.6	91	56	14.6	56
Partial sella turcica bridge	N	102	102	102	102	102
	Median	16.2	83.8	48	12.1	48.4
	Mean	16.23	83.37	49.02	12.37	49.30
	Std. Deviation	0.99	4.71	2.82	0.73	2.79
	Minimum	14.6	77	44.4	11.2	44.8
	Maximum	18.7	90	56	14.2	56
Total sella turcica bridge	N	78	78	78	78	78
	Median	16.2	81.74	47	11.8	46.8
	Mean	16.27	81.56	47.34	12.02	47.87
	Std. Deviation	0.98	4.50	3.07	0.83	3.34
	Minimum	14.5	75	41.2	10.6	42
	Maximum	18.7	91	56	15	56
p		.603	.000*	.000*	.000*	.000*

p value from Mann Whitney U test

Table 6. Spearman Correlation Test between Cephalometric Maxillary Measurements

		Age	Co-A	ANS-PNS	PP/SN
Co-A	r	.370**	1.000	.764**	.694**
	p	.000		.000	.000
	N	260	260	260	260
ANS-PNS	r	.343**	.764**	1.000	.958**
	p	.000	.000		.000
	N	260	260	260	260
PP/SN	r	.351**	.694**	.958**	1.000
	p	.000	.000	.000	
	N	260	260	260	260
N-ANS	r	.359**	.689**	.946**	.968**
	p	.000	.000	.000	.000
	N	260	260	260	260

Correlation coefficient (r), Statistically significant (p< .05),

DISCUSSION

The sagittal maxillo-mandibular relationship can be evaluated cephalometrically with angular variables.[11] A lateral cephalogram is a radiograph routinely used for the diagnosis, treatment planning and evaluation of the skeletal structure in orthodontics.[12] Furthermore, cephalometry is a useful method for asses-

sing the coordination of the skull, face and teeth, as well as the relationships of these parts, in addition to clinical examinations. Cephalometric analyses are also very important in evaluating treatment outcomes and can be used to understand the craniofacial characteristics of different ethnic populations.[13]

The development of the craniofacial region may be associated with the development of the sella turcica. Malformations in the development of the sella turcica may affect maxillary, mandibular and nasal anatomical regions, as well as other related craniofacial structures.[14] The sella turcica is an important and widely used symbol in cephalometric drawings. Anatomical anomalies of the sella turcica can be used to interpret lateral cephalometric radiographs.[15] Buyuk et al. found a significant difference between normal sella turcica and partial STB patients for the Nperp-A distance, palatal plane-to-SN angle and anterior facial height.[16] Additionally, the Nperp-A distance and palatal plane-to-SN angle showed a significant difference between individuals with normal sella turcica structures and those with total STB. No significant difference was found between the partial and total STB groups in the measured cephalometric parameters. As a result of this study, a statistically significant difference was found among the STB groups in terms of their Co-A, ANS-PNS, PP/SN and N-ANS cephalometric measurements. Additionally, the cephalometric measurements of Co-A, ANS-PNS, PP/SN and N-ANS were found to be higher in the partial STB group. Buyuk et al.[16] stated that STB may affect the development of the maxilla, the mandible and other craniofacial structures because the sella turcica and the craniofacial region originate from neural crest cells.

Sobuti et al.,[4] Alkofide,[17] Dixit et al.,[18] Leonardi et al.[10] and Buyuk et al.[16] have determined no significant relationship between STB status and the variables of age and sex. Ali et al.[19] stated that there was no significant relationship between STB and sex. As a result of this study, the relationship between STB and the variables of sex and age was not found to be statistically significant.

Changes in the sella turcica may also be seen in primary hypopituitarism, Williams syndrome, growth hormone deficiency, Cushing syndrome, lumbosacral myelomeningocele, intracellular adenomas, empty sella syndrome (ESS), some syndromes affecting the craniofacial region such as the presence of Rathke's cleft cysts, aneurysms and craniofacial abnormalities.[20] Sobuti et al.[4] and Valizadeh et al.[21] reported that the prevalence of sella turcica bridging is more common in patients with craniofacial skeletal class III malocclusion than class II and class I patients. The frequency of STB is reported to be higher in dental anomalies such as dental transposition and palatally displaced canines, mandibular second premolar aplasia and Class III skeletal malocclusion patterns.[22,23]

After evaluating lateral cephalograms of Caucasian patients, Leonardi et al.[10] determined that the incidence of STB increased in individuals with palatal impacted canines. Ali et al.[19] reported that increased calcification at the interclinoid ligament or sella bridging was four times more prevalent among patients with impacted canine teeth than those without dental anomalies. Najim and Nakib[24] identified an increased prevalence of STB in cases of impacted canine. Scribante et al.[6] and Haji Ghadimi et al.[25] stated that there was a relationship between the ossification of the interclinoid ligament (STB) and impacted canine teeth. As a result of their study on 3D Cone Beam Computed Tomography, Ortiz et al.[26] could not find a statistically significant relationship between STB and unilaterally and bilaterally impacted canine teeth. Therefore, it is suggested that there is no statistically significant relationship between maxillary palatal impacted canine teeth and sella turcica bridging. In the present study, the relationship between STB and the unilaterally and bilaterally impacted canine variables was not statistically significant. The ratio of partial STB was higher in the unilaterally and bilaterally impacted canines. There are methodological differences in 2D radiographs used to evaluate the presence of a partial or complete sella bridge in comparison to 3D images, suggesting that further research is needed to improve the diagnostic process of this sella anomaly. 2D radiographs still represent the standard for orthodontic diagnosis.[27]

In their study on palatally impacted canine teeth, Ali et al. identified the incidence of partial STB as 54.8% and total STB as 25.8%, whereas Scribante et al. found the incidence of partial STB as 56% and total STB as 13%. Leonardi et al. reported the incidence of total STB as 17.6%.[16] In this study, while we found the prevalence of partial STB as 39.2%, the prevalence of total STB was 30%. The incidence of sella turcica bridging in the general population varies between 3.6 and 13%.[5] After collecting radiographs that met the inclusion criteria of our study, we identified 102 partial STB and 78 total STB cases.

CONCLUSION

As a result of the present study, the Co-A, ANS-PNS, PP/SN and N-ANS values, which are maxilla-related cephalometric measurements, were found to be higher in the partial STB group. Furthermore, the mean ANS-PNS, PP/SN and N-ANS values of the unilaterally impacted canine teeth were higher than those of the bilaterally impacted canine teeth. There was no correlation between the STB groups and the unilaterally and bilaterally impacted canine variables.

DECLARATIONS
Ethical Approval and Consent to participate
The study was approved by the Local Ethics Committee of Istanbul Aydın University (No: 2021/393).
Informed Consent: A consent form was completed by all participants.
Peer-review: Externally peer reviewed.
Authorship Contributions
Concept: A.K. Design: A.K., S.S. Data Collection or Processing: A.K., S.S. Analysis or Interpretation: A.K., S.S. Literature Search: A.K., S.S. Writing: A.K.
Conflict of Interest: No conflict of interest was declared by the authors.
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