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RELATIONSHIP BETWEEN LINEAR MEASUREMENT OF SELLA-TURCICA AND PALATALLY IMPACTED CANINES: CONE BEAM COMPUTED TOMOGRAPHIC STUDY

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KEYWORDS

CBCT, Impacted Canines, Sella-Turcica

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ABSTRACT

Introduction: Variation in the morphology, shape, and size of the Sella-Turcica has been associated with malocclusions, including palatally impacted canines. **Aim**: The goal of this study was to find out if there was a link between the linear measurement of Sella-Turcica and canines that were pushed into the palate. **Material and methods**: After getting approval from the ethical committee, 28 cone-beam computed tomography (CBCT) scans were taken and split into two groups: a study group with palatally affected dogs that met the inclusion criteria and a control group with no affected dogs. Software was used to measure the angle made by the long axis of the impacted canine and the occlusal plane. It was then used again to measure the Sella-Turcica dimension. **Results**: It was found that there was a statistically significant difference in the Sella-Turcica dimensions between the control and study groups, where the readings were generally higher in the study group. **Conclusion:** When people with impacted canines are compared to people who don't have impacted canines, the Sella-Turcica Dimensions are outside of the normal mean value. When the Sella-Turcica is quickly and accurately cut out of a CBCT image, it will be possible to analyze large sets of clinical data to find and treat problems early.

INTRODUCTION

It is a common clinical situation for the maxillary canines to get impacted. The origin of canine impaction may be regional, systemic, or hereditary. There are numerous potential outcomes to dog bites. Based on clinical and radiographic tests, the most important part of taking care of affected dogs is finding and identifying them. Frequently, the treatment of impacted maxillary canines demands a multidisciplinary approach. There are numerous approaches to treating an impacted canine, including doing nothing, adopting an interceptive approach, removing the tooth, auto-transplantation, surgical exposure, and orthodontic alignment. Early diagnosis and prevention are the most recommended treatments for possible impaction. In the absence of prevention, surgical exposure and orthodontic alignment should be considered. Surgical treatment and orthodontic considerations for impacted canines depend on where the tooth is in the dental arch [(1)].

The Sella-Turcica is a saddle-shaped depression in the middle of the sphenoid bone. The many development and appearance patterns of the Sella have been meticulously studied and defined [2]. Some disorders and terrible bites, such as canine impactions, have been associated with alterations in the form, size, and shape of the Sella turcica.

Since the early 1980s, numerous research investigated the relationship between linear Sella-Turcica measures and anomalies of the skull and face. Sundareswaran et al.[3] examined the relationship between the Sella-Turcica in unilateral cleft lip and palate patients. Moreover, the relationship of Sella-Turcica with different mandibular growth patterns was studied by Konwar et al.[4]. The aim of this study was to investigate the relationship between linear measurement of Sella-Turcica and palatally impacted canines. Previously, all the studies investigating the Sella-Turcica were done using cephalometric x-rays, which had the problem of viewing a 3-dimensional anatomical part via a 2-dimensional view, but after the introduction of CBCT radiographs, more data can be acquired.

MATERIALS AND METHODS

In this retrospective study, a total of 36 CBCT were gathered after the approval of the Ethical Committee from the archives of Suez Canal University's Department of Radiology, Faculty of Dentistry. Using the same standard protocol, Suez Canal University's Department of Radiology utilized Soredex SCANORA 3D for all CBCT examinations.

OnDemand Imaging Software received the CBCT scans in DICOM (Digital Imaging and Communications in Medicine) format and processed them.

Inclusion criteria:

1. The radiology department was responsible for selecting unidentified CBCT images with good views of the Sella-Turcica and maxillary region and a definitive diagnosis of unilateral or bilateral palatal canine impaction.
2. Palatal canine impaction was distinguished when the crown was positioned palatal to adjacent teeth, there was more than 3/4 or complete root development, and the angle of the canine's long axis to the occlusal plane (-angle) was less than 45 degrees, as determined by simulated panoramic images recreated from CBCT data.

Exclusion criteria:

1. Presence of any craniofacial anomalies.
2. Presence pf any maxillary or mandibular fractures of any kind.
3. Supernumerary or missing teeth except for the 3rd molars.

Sample size calculation:

The sample size for this study was calculated according to Arkin [5]. The sample size calculations revealed that a sample size should be at least 14 subjects per group.

Groups:

Group 1: Study group composed of 14 CBCT scans, including impacted canines.

Group 2: control group composed of 14 CBCT scans with no impacted canines.

Identification of the impacted canine Figure (1):

After gathering the radiographs, examination of the impacted canines was done to make sure they followed the inclusion criteria.

First, the 3D picture was evaluated to locate the position of the set canine.

Then, the axial view was used to outline the arch form of the patient to generate an accurate panoramic section.

Finally, after having a clear panoramic view of the impacted canine, a line was drawn representing its long access.

The intersection between the long axis of the canine and the occlusal plane formed an angle which was measured via the angle measuring tool on OnDemand 3D software.

Landmark Identification and Examination of Sella-Turcica Figure (1):

In order to standardize the volume orientations, the axial plane (x) was set to the middle of the anterior nasal spine. The coronal plane (y-axis) was set so that both infraorbital canals were clearly visible, after setting the mentioned planes, the depth of caliber was zoomed in and was added. The depth of the sagittal view allowed the researchers to have a clear view of the standardized cut of the Sella-Turcica. The depth, length, and diameter of the Sella-Turcica were measured individually, and repeated on the same cut with a digital caliper in millimeters. The study included an additional reading to provide a new perspective view of the Sella-Turcica from the dimension, measuring the distance between the right and left clinoid process from the axial view which was not possible when doing similar studies using lateral cephalometric radiographs, being only 2 dimensional. The tool used in measuring all the distances in this study was the ruler offered by OnDeman. By clicking on the first desired point of measure, a green straight line was drawn to the next selected point. After finishing the desired measure, a number appeared in a box next to the measured distance, representing the distance in mm. After measuring all the scans of the study and the control group, the data was sent to a statistical analyst.

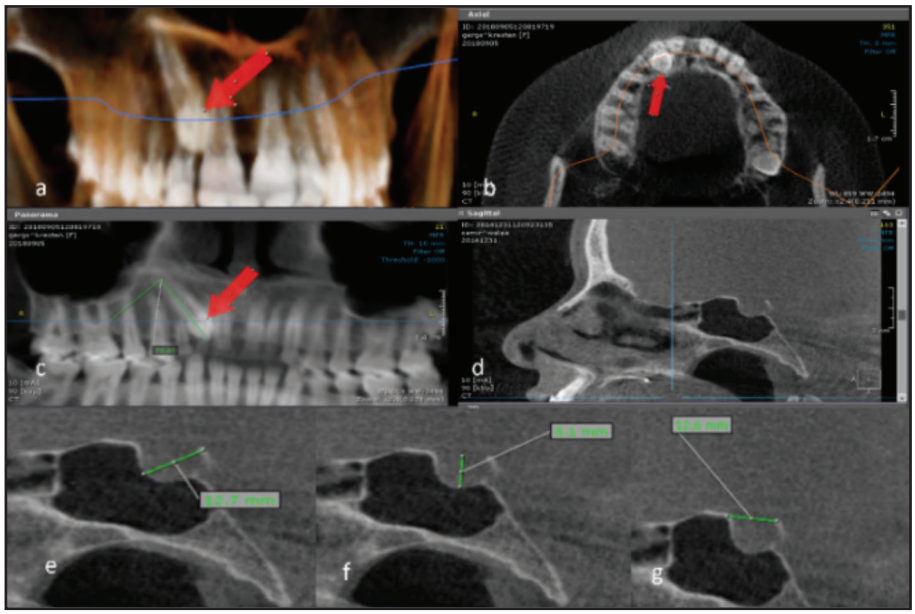

Fig. (2) A, 3D views of the canine; b, Axial view of the impacted canine; c, Angle of the canine's long axis with the occlusal plane; d, Standardized Sella-Turcica cut; Parameters of Sella-turcica (e = diameter, f = depth, g = length)

Statistical analysis of the data

Data was entered into the computer and analyzed using version 20.0 of the IBM SPSS software suite. Package, version 20.0. (Armonk, New York: IBM Corporation) The Kolmogorov-Smirnov test was performed to determine the distribution's normality. The range (minimum and maximum), mean, standard deviation, and median were used to characterize quantitative data. The obtained results were considered significant at the 5 % level. A Student t-test and Logistic Regression analysis were employed as tests.

RESULTS

There was a statistically significant difference in mean Sella length (p = 0.030*) in the two groups. The study group showed a higher Sella length than the control group. There was a statistically significant difference in mean Sella diameter (p = 0.010*) in the two groups. The study group showed a higher diameter than the control group. There was a statistically significant difference in mean Sella depth (p = 0.035*) in the two groups. The study group showed a higher depth than the control group. There was a statistically significant difference in mean interclinoid distance (p = 0.003*) between the two groups. The study group showed a lower interclinoid distance than the control group (Table 1).

Logistic regression analysis, both univariate and multivariate

In univariate, Sella length, Sella diameter, and interclinoid distance were associated with impacted canines. As the Sella length and diameter and interclinoid distance increase, this indicates impacted canines. In multivariate, interclinoid distance was associated with impacted canines. As the interclinoid distance increases, it indicates impacted canines in Table (2).

Table (1) *Comparison between the two studied groups according to Sella length*

Measurement or Parameter	Study Group (n = 14)	Control Group (n = 16)	t	p
Sella length	11.71 ± 1.67	10.40 ± 1.50	2.286*	0.030*
Sella diameter	11.15 ± 1.15	9.83 ± 1.43	2.758*	0.010*
Sella depth	8.14 ± 1.28	9.71 ± 2.43	2.243*	0.035*
Interclenoid distance	20.10 ± 0.86	21.73 ± 1.69	3.377*	0.003*

t: Student t-test, *p: p-value for comparing between the studied groups*: Statistically significant at p ≤ 0.05*

Table (2) *Univariate and multivariate logistic regression analysis for the parameters affecting the study group (Impacted Canines) (n = 14 vs. 16)*

Measurement or Parameter	Univariate		#Multivariate	
	P	OR (95%C. I)	p	OR (95%C. I)
Sella length	0.045*	1.785 (1.014 – 3.142)	0.063	2.039 (0.962 – 4.319)
Sella diameter	0.026*	2.326 (1.108 – 4.882)	0.147	2.353 (0.740–7.485)
Sella depth	0.057	0.641 (0.406 – 1.012)		
Interclenoid distance	0.017*	0.353 (0.151 – 0.828)	0.025*	0.295 (0.101 – 0.855)

*OR: Odd's ratio, C.I: Confidence interval LL: Lower limit UL: Upper Limit #: All variables with p<0.05 were included in the multivariate analysis. *: Statistically significant at p ≤ 0.05*

DISCUSSION

In orthodontics, the introduction of CBCT scans contributed significantly to research by providing advanced tools for viewing a previously unknown dimension in cephalograms [6]. CBCT scans consist of many layers of scans delivered in the form of various DICOM files, which are then used to regenerate a 3D image using a variety of software that provides a variety of research tools [7]. Since the early 1990s, software companies have developed a variety of software that has undergone significant modifications to reach the incredible versions that are currently on the market and accessible to academics and doctors [8].

Dolphin 3D and OnDemand3D are two of the most widely used software programs in business and academic research Elshebiny et al.[9] compared the voxel-based superimposition of CBCTs between the aforementioned software applications. The demonstrations of Dolphin 3D and OnDemand3D were extremely useful in demonstrating the capabilities of each software's features. OnDemand3D was utilized to examine the aim of the current study, utilizing the knowledge gathered from the previous study.

In the present study, no age preferences were taken because numerous authors, as Muhammed et al. [10], and Shrestha et al.[11] have demonstrated through their investigations that age has no bearing on Sella-Turcica research in adult patients. This is further explained by the fact that the maturation of the cranium is complete by 5–6 years of age, whereas the ability to be categorized as impacted develops later in a dog's life. Since the debut of CBCTs in orthodontics, the association among both impacted canines and Sella-Turcica has been investigated utilizing various studies, procedures, and software. Using Dolphin ImagingTM software, Ortiz et al.[12] measured the bridging of Sella-Turcica in relationship to impacted canines.

Using OnDemand Imaging Software, the current study identified five anatomical landmarks for measuring the interclinoid distance, depth, length, and diameter of the Sella turcica. By measuring the angle created by the intersection of the long axis of the canine and the occlusal plane, the software was also utilized to determine if the impacted canines satisfied the inclusion criterion. Since the advent of digital dentistry, software has significantly contributed to the simplification and standardization of research labor. The Dolphin Imaging software, Vivodental software, and OnDemand software are referenced in the literature as linear measurements of the Sella-Turcica program. Using Dolphin Imaging TM software, Ortiz et al. [12] measured the bridging of Sella-Turcica in relation to impacted canines. Typically, Dolphin imaging software was utilized in prior researches studying comparable themes.

OnDemand 3D software was selected for the current study due to its ease of use and ability to provide fresh references for future research [13]. In the current investigation, OnDemand 3D software was utilized to assess the linear dimensions of the Sella-Turcica and the angle between the long axis of the impacted canines and the occlusal plane. Examining and quantifying the angle generated by the long axis of the impacted canines intersecting the occlusal plane was the first step of the investigation. According to the recommendations of Kumar et al.[14] this angle had to be 45 degrees or less for the radiographs to be included in the study.

Comparing the length, diameter, depth, and interclinoid distance of the Sella-Turcica to that of the control group, which also represented the general population as in subjects with no impacted canines, was similar to a study by Yasa et al.[15] in which the 3D morphology of the Sella-Turcica was documented using CBCTs. In addition, when comparing the Sella-Turcica depth, length,

diameter, and interclinoid distance of our control group to the control group of Afzal and Fida's[16] study examining the correlation between variation in Sella-Turcica dimensions and morphology and skeletal malocclusions, no significant differences was found. In contrast, when comparing the data of the study group in which the subjects had impacted canines meeting the inclusion criteria, it was statistically significant, which is also consistent with the findings of Afzal and Fida[16] who concluded statistically significant changes in the dimensions of the Sella-Turcica in skeletal class lll subjects.

These results support the notion that there may be a correlation between the dimensions of the Sella-Turcica and skeletal class lll, as well as impacted canines in which the maxilla is constricted and prevents the canines from following their usual eruption course. Upon comparing the current study to others, it was evident that different terms were employed to describe the dimension. For instance, Axelsson et al.[2] used Camp 1924 for measuring comparable results using multiple reference points in the front, posterior, and sagittal directions. In light of this, the current study revealed a statistically significant difference in the measured Sella-Turcica depth, length, and diameter when compared to the data presented in Axelsson et al.[2] cephalograms in which the Sella-Turcica was measured to determine whether there was a correlation between Sella-Turcica morphology and skeletal malocclusion. Could it be that because their research involved cephalograms, they were unable to provide any information regarding the interclinoid distance because it is only two-dimensional? Regarding the linear dimensions of the Sella turcica, it is reasonable to believe that CBCTs provide a more precise reading; thus, the statistical significance observed in the present investigation[17].

When comparing the interclinoid distance to a study by Yasa et al. [15] in which they used CBCTs to document the 3D morphology of the Sella turcica, it was discovered that the Sella-Turcica length, depth, diameter, and distance were comparable to theirs; however, the study group with the impacted canine had statistically significant higher readings.

Chen et al.[18] presented a unique machine learning method to measure maxillary structural diversity in unilateral canine impaction in order to advance therapeutically important information, which was recognized as one of the most intriguing subjects uncovered during this investigation. As underdevelopment of the maxilla is frequently associated with unilateral canine impaction in early adolescence, the findings of this study suggest that palatal extension may be beneficial for those with unilateral canine impaction, as well as large clinical data sets can be analyzed efficiently if the CBCT segmentation process is both rapid and efficient [5].

CONCLUSION

The null hypothesis that the Sella-Turcica Dimensions are outside the normal mean value in patients with impacted canines compared to those with no impacted canines was accepted. Fast and efficient CBCT image segmentation of the Sella-Turcica will allow large clinical data sets to be analyzed effectively for early detection and intervention.

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