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Evaluation of the correlation between impacted canine and malocclusions.

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Abstract

Introduction: Tooth impaction is defined as the absence of a tooth on the arch, after its normal eruption age. The main reason canines are impacted is the lack of space required for the tooth to erupt.

Aim of study: The main objective of this study is to determine the types of malocclusions associated with canine impaction (Lindauer classification). A secondary objective is to establish the correlation between these parameters and identification of subjects with high risk of canine impaction based on pre-existing malocclusion.

Material and methods: This study was performed on a sample of 20 patients, 9 men and 11 women. The dental casts were subject to Angle classification and various measurements such as arch perimeter, Pont's index, sum of the mesiodistal width of the incisor and arch length were performed. The Lindauer sectorial classification was determined based on the patients' panoramic radiography.

Results: According to the data collected, the Class II /2 malocclusion is more frequent, and it is associated with the impacted canine (approximately 50%). According to the Lindauer classification higher frequency of the impacted canines was found in Sector IV.

Conclusion: The diagnosis for impacted canines is often associated with Class II /2 malocclusion, and according to the Sector classification, it is often localised in Sector IV.

Keywords: malocclusion, tooth eruption, tooth impaction, impacted canine

Introduction

Tooth impaction is the lack of eruption of a tooth in its adequate position on the dental arch within a specific time frame and physiological limits of the dental eruption process [1]. In the present perspective, a tooth is considered impacted if it presents a considerably delayed eruption and also there are clinical or radiographic evidence that prove a future eruption will not take place [2]. A canine is impacted when the tooth has not erupted after the full development of its root, or if the contralateral tooth has erupted for at least 6 months and has a fully developed root [2].

This anomaly is frequently caused by insufficient space required for eruption on the dental arch, causing aesthetic and functional complications, as well as the shortening of the dental arch, causing follicular cysts, canine ankyloses, recurrent infections, pain, external root resorption of the canines and adjacent teeth [3].

The upper impacted maxillary canine comes second after the 3rd molar impaction [4,5]. According to various studies, canine impaction is most often found in palatal position, with a frequency of 80%, and in buccal position with a 20% frequency. Regarding the sex ratio, impacted canines are present twice as often in females. The impacted maxillary canine is twice as often than the impacted mandibular canine and 8% of the patients with impacted canine also display bilateral impaction [4,5].

According to a study conducted by Ericson, the majority of the impacted canines are palatally positioned (85%) and only 15% are buccally impacted canines. Also the unilateral impaction is more frequent than the bilateral one, only 8% of the impacted canines are bilateral. The majority of the impacted canines observed in Caucasians are in palatal position,

while in Asian population the predominant occurrence is in the vestibular position. Related to sex, the impacted maxillary canine is twice more frequent in women than in men, with a ratio of 2.3:1 [1].

The maxillary canine presents a broad spectrum for eruption anomalies, mostly due to the length of the eruption process, hard tissue obstructions, lesions of the soft tissue or some anomalies of neighboring teeth, respectively to the fact that the maxillary canine is the last of the anterior teeth to appear on the dental arch [6]. In order to understand why the maxillary canine is so often impacted, it is important to identify the trajectory that the canine will follow at bone level during the eruption process.

Several radiographs have been used to diagnose impacted canines, such as retro-alveolar radiography, panoramic radiography, occlusal radiography and cephalometric radiography. The mesio-distal location of the crown and tooth angulation, measured on a panoramic radiography, are the two prognostic factors in treating impacted canines [7-9].

The main objective of this study is to determine the types of malocclusions associated (molar class, incisor class) with canine impaction (Lindauer classification). A secondary objective is determining the correlation between these parameters and the identification of subjects with high risk of canine impaction based on pre-existing malocclusion.

Material and methods

This study was performed on a sample of 20 patients with ages between 10 and 46 years old, 9 men and 11 women, patients at the „Natural Smile Dental Clinic by dr. Pop" diagnosed with canine impaction. Based on the dental casts, the Angle classification and incisor classification for each patient was determined. Using the digital calliper and millimetre measurement paper graph, the following parameters were determined: arch perimeter, Pont's index, Inter-premolar and inter-molar widths, sum of the mesiodistal width of the upper incisor and arch length. The following parameters were observed:

- Dental Class Angle;
- Incisor Class;
- Arch perimeter (the mesiodistal width of the teeth measured from the mesial surface of the primary molar all the way to the mesial surface of its contralateral homologue);
- Pont's Index (the transverse arch dimensions – the interpremolar and intermolar distance);
- Sum of the mesiodistal width of the upper incisors;
- Arch length;
- Sectorial Classification of the impacted canines on panoramic radiography.

In order to determine the discrepancy between the existent space on the arch and the space required for teeth alignment, difference between IP (ideal parameter –calculated) and EP (existent perimeter- measured) for each dental arch was evaluated. IP – is the mesiodistal diameter of the teeth. The transversal dental arch discrepancy was also determined by calculating IPD (interpremolar distance), IMD (intermolar distance) respectively, according to the following mathematical formula: SI × 100/80 (IPD) and SI × 100/64 (IMD).

The upper interpremolar width was measured from the centre of the intercuspal groove of the first upper premolars. The lower interpremolar width was measured in the most vestibular point of the contact line between the first premolar and the second premolar. The upper intermolar distance was measured in the central fosse (central to the first permanent molars) and the lower intermolar distance from the central-vestibular cusps of the lower molars.

For the evaluation of the sagittal dimension of the dental arches, arch length was measured, from the anterior midpoint of the arch to the posterior midpoint.

The Lindauer sectorial classification of the impacted canines was determined based on the selected patients' panoramic radiography (figure 1). Sector I is the distal area from the tangent line on the distal surface of the crown and the root of the lateral incisor. Sector II is in a mesial position of Sector I and in a distal position of the bisecting line of the mesiodistal width of the lateral incisor, along its axis. Sector

III is at a mesial distance from Sector II, but at a distal tangent line from the mesial surface of the crown and the root of the lateral incisor. Sector IV includes all mesial areas of Sector III.

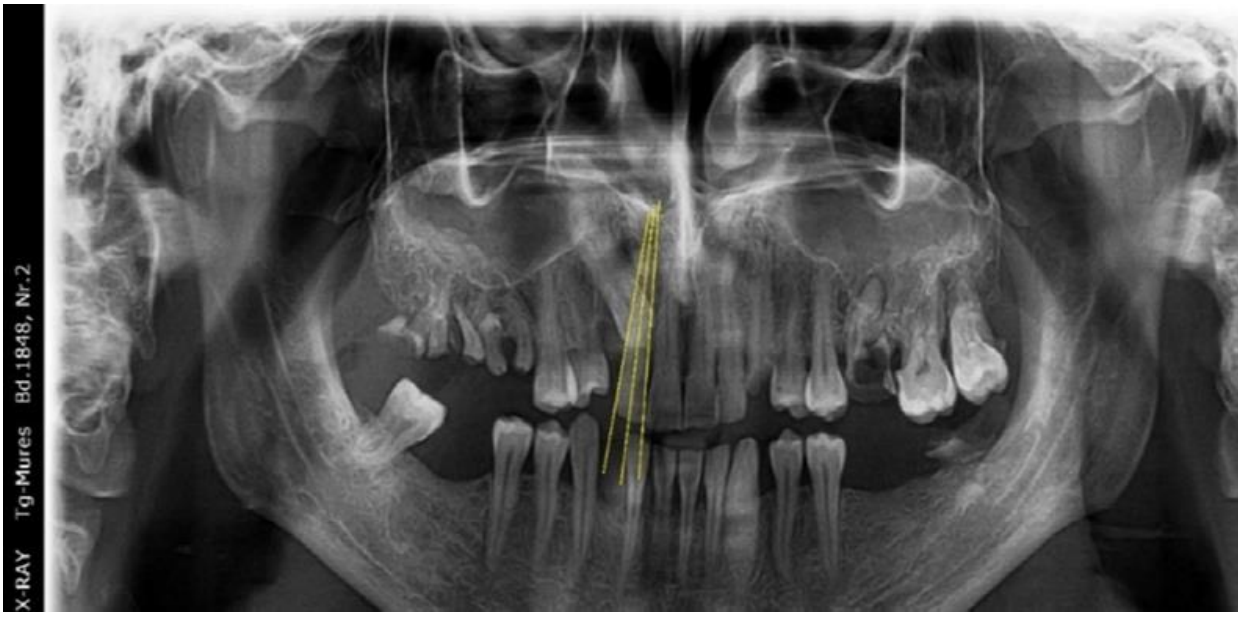

Figure 1. Panoramic radiography with sector tracing

Tangent lines to the mesial and distal surfaces along the axis of the lateral incisor adjacent to the impacted canine were traced. This enabled us to split the respective area in 4 sectors (figure 2) and to determine the sector where the cusp of the impacted canine is situated, for each patient.

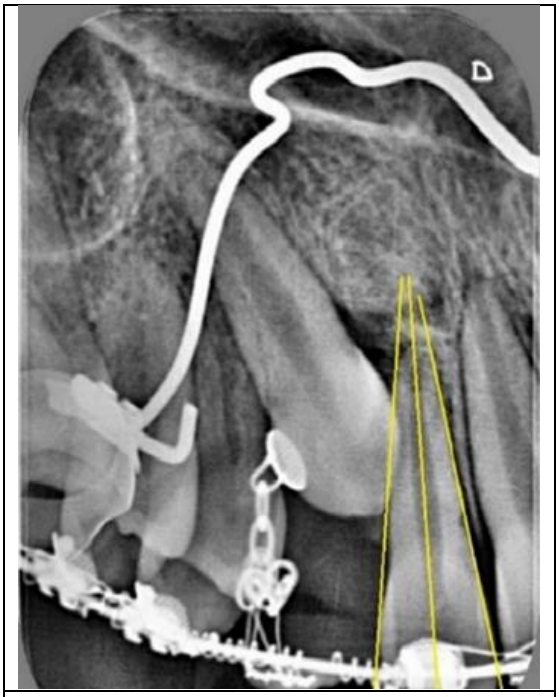

Figure 2. Lindauer sectorial classification

The data was statistically analysed using the descriptive frequency analysis, Student T-test, Chi Square Test and Pearson correlation test. The analysis was performed using IBM SPSS Statistics Version 20 software (IBM Corp. Armonk, New York, United States).

Results

The results of this study were organized in tables and diagrams. First diagram (figure 3) shows the results obtained for Dental Class Angle.

Table 1 integrates the result for the arch perimeter measurements on the dental casts for both arches, respectively the malocclusion type.

Pont's index at a maxillary level and the frequency of transversal crowding in the dental arches are presented in table 2.

The percentage of the mesiodistal width of the incisors is presented in table 3.

The diagram illustrated in Figure 4 presents the frequency of impacted canines.

Figure 5 are illustrates the results for the Lindauer Sectorial Classification of the impacted canine.

Figure 3. Frequency results Angle Class

Table 1. The result for the arch perimeter measurements on the dental casts for both arches, respectively the malocclusion type

Malocclusion type	Maxillary	Mandible
Spacing	7 (36.8%)	5 (26.3%)
Correct alignment	4 (21.1%)	4 (21.1%)
Light crowding (<4mm)	4 (21.1%)	5 (26.3%)
Mild crowding (4-8mm)	3 (15.8%)	4 (21.1%)
Sever crowding (>8mm)	1 (5.3%)	1 (5.3%)

Table 2. Pont's index at a maxillary level and the frequency of transversal crowding

Pont Index – Maxillary	Premolar	Molar
Surplus	5 (26.3%)	7 (36.8%)
Correct Interpremolar width	6 (31.6%)	7 (36.8%0
Light crowding (2-4mm)	1 (5.3%)	0 (0.0%)
Mild crowding (4-6mm)	5 (26.3%)	2 (10.5%)
Severe crowding (6-10mm)	2 (10.5%)	3 (15.8%)

Table 3. The percentage of the mesiodistal width of the incisors

Mesiodistal width of the incisor	Maxillary
Normodontia (28-34mm)	15 (78.9%)
Microdontia (<28mm)	4 (21.1%)
Macrodontia (>34mm)	0 (0.0%)

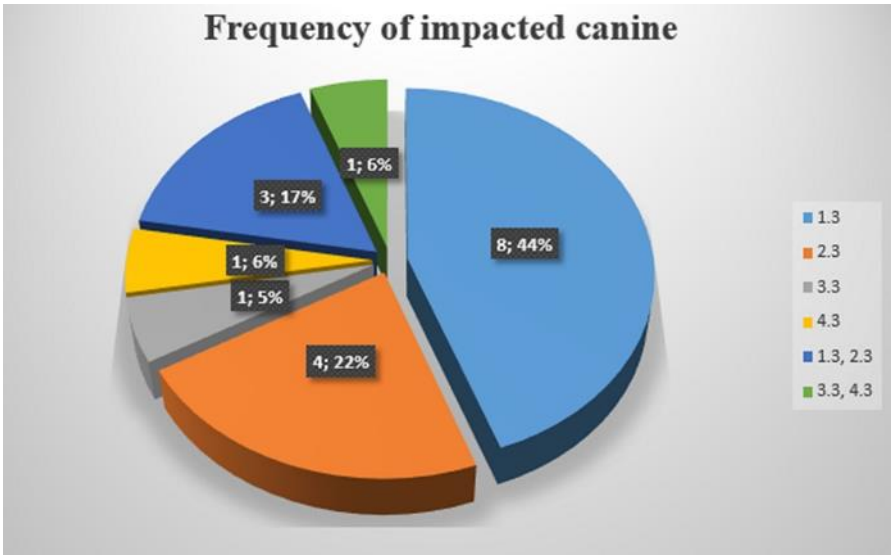

Figure 4. Impacted canine frequency results

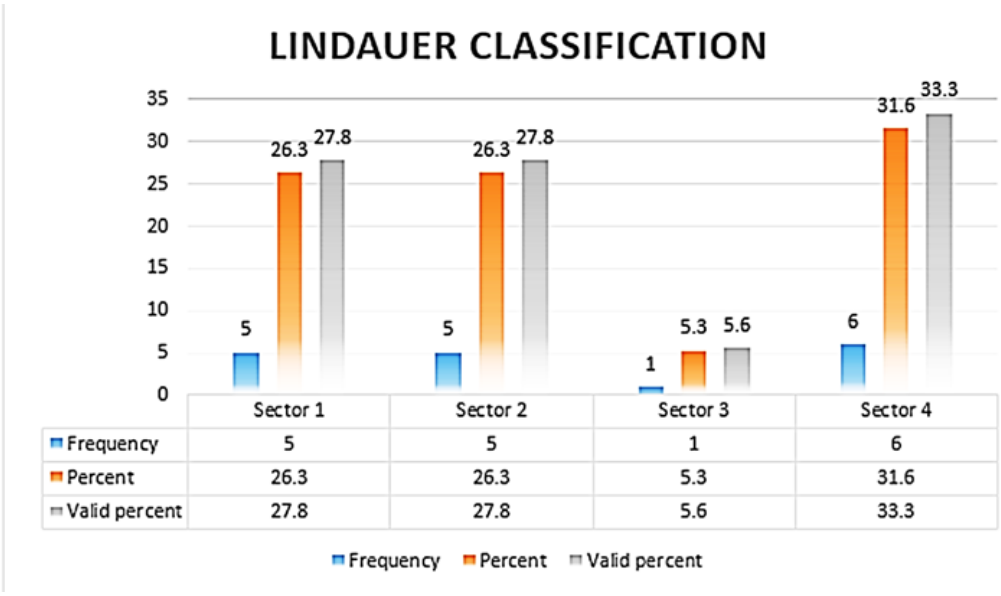

Figure 5. Results of Lindauer sectorial classification

Chi square test determined that the only statistically significant correlation is between the impacted canine and Class Angle, respectively p=0.016 (table 4).

Table 4. Chi square test determined in impacted canine and Class Angle

	Impacted tooth
Class Angle	p= 0.016
Incisor Class	p=0.623
Pont Max PM	p=0.721
Pont max Mol	p=0.088

With respect to the Dental Class Angle, we have observed that for Class I Angle there is a 33.3% frequency; Class II/1 has e 11.1% frequency; Class II/2 has the greatest

frequency, 50.0%; and Class III with a 5.6% frequency.

Regarding the Incisor Class, we have identified Class I-10.5%, Class II/1 – 21,1%; Class II/2 – 36,8% and Class III – 31,6%.

For the measurements performed on the dental casts we have the following results:

- Malocclusion with spacing at maxillary level 7 (36.8%), and spacing at mandible level 5 (26.3%);
- Light crowding at maxillary level 4 (21.1%), and at mandible level 5 (26.3%);
- Mild Crowding (4-8mm) at maxillary level 3 (15.8%), and at mandible level 4 (21.1%);
- Severe crowding (>8mm) at maxillary and mandible level 1 (5.3%).

Discussions

The permanent canines are highly important due to their role in determining the form of the dental arch, participating in the functional occlusion as well as in the aesthetic aspect. Determining the precise position of the impacted canine is crucial in choosing the right surgical approach and best access area, as well as in determining the correct orthodontic forces.

The best option in determining the position of the impacted canine is the Cone-Beam CT, although it can be costly [10]. This study has used panoramic radiographies to evaluate the position of the impacted canine, because these types of radiographies are usually performed on patients following an orthodontic treatment, minimising the exposure to radiations. The aforesaid mentioned radiographies present sufficient data for the subject of this study.

It has been reported that 8% of the impacted canines are bilateral [8]. This study shows that 22.3% are bilateral, and 77,8% are unilateral. The percentage resulted in this study regarding the bilateral impaction is significantly greater than the previous studies.

Regarding the age of diagnosis of the impacted canine, the study included patients with age between 10 and 46 years old, unlike other studies which are predominantly conducted on an age interval between 13 to 15.

McConnell et al remarked that patients with lack of transversal space in the anterior area of the dental arch had impacted canines [8]. The present study asserts that patients with impacted canines presented the following:

- Interpremolar distance 31.6%, and correct intermolar distance 36.8%;
- Interpremolar surplus 26.3%, intermolar surplus 36.8%;
- Light interpremolar crowding 5.3%, and intermolar respectively 0.0%.

The cases of severe interpremolar crowding are 10.5% and respectively intermolar 15.8%. Similarly to our results, a study conducted by Tadinada A et al. determined that the transversal maxillary deficiency is not a main factor in the canine impaction [11].

Unlike the study of Chaushu and Becker (1999) on panoramic radiography, which chose not to mention the sectorial classification, this study has used the positioning of the impacted canine cusp on the 4 levels Lindauer described, in order to determine its various types of positions [12]. We have determined positions in Sector I and II with a 27,8% frequency, Sector III 5,6% frequency, whereas the frequency in sector IV – 33.3% is similar to the results in our study. A different study conducted in India in 2009 asserts that for Sector I the frequency is 75,67%, and Sector IV has a 38,46% [13]. Lindauer et al discovered that 78% of the impacted canines have the tips of the cusp in sectors II, III and IV [14].

After correlating the information obtained in the study we observed that the frequency of dental class II/2 Angle has a higher frequency of 50%, associated with canine impaction, closely followed by Class I Angle with a 33.3%, where the impacted canines are predominantly unilateral at maxillary point, and more frequent in the first quadrant. Therefore, the malocclusion in Class Angle in fact depends on the positioning of the impacted canine (1.3, 2.3, 3.3 or 4.3).

Conclusions

- Between the maxillary canine and the mandibular canine, the most affected by impaction is the maxillary canine.
- Most frequent canine impaction is unilateral (50%).

- The impacted canine is most frequently associated with malocclusion Class II/2 Angle.
- Regarding the transversal size of the dental arch, the impacted canine is predominantly associated with normal arches, or those that present a space surplus, rather than the ones with crowding.
- According to Lindauer's Sectorial classification, the impacted canine is most often situated in Sector IV.

Conflict of interest: None declared.

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