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The Skeletal Characteristics of Patients with Buccal and Palatal Impacted Permanent Maxillary Canines in Ahvaz, Iran

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The maxillary permanent canines are the second most common impacted teeth after the third molars. Nevertheless, the degree to which clinicians are aware of the risk of canine impaction in each skeletal pattern may help them prevent these impactions or manage them. The present study determined the skeletal characteristics of the patients with the buccal and palatal impacted permanent canines among Ahvaz populations. In a descriptive epidemiologic study, lateral cephalometric and panoramic radiographs of 110 patients with the permanent impacted canines (bilateral or unilateral) were collected from the Orthodontic Department and orthodontic offices in the city of Ahvaz. Using cephalometric and panoramic images, and by clinical evaluations, buccal and palatal impacted canines were diagnosed. Cephalometric analysis was done to determine the anterior-posterior parameters including the angle of maxilla to the skull base (SNA), the angle of the mandible to the skull base (SNB), SNA angle and SNB angle difference (ANB) and the indices to determine the vertical characteristics including the angle between the Frankfurt plane and mandibular plane (FMA); Anterior lower facial height index and Jaraback index was calculated. According to the data obtained, anterior- posterior and the vertical skeletal patterns were determined for the patients by gender. The frequency of different patterns was calculated and then reported. Among those patients who have buccal canine impactions, females with Cl II skeletal pattern and long-face had the most frequencies, whereas the males with the Cl II skeletal pattern and normal face and also the males with the Cl III skeletal pattern and three vertical patterns had the least prevalence. In patients with the maxillary palatal canine impactions, female population with the Cl I skeletal and short-face pattern had the most frequency and the subjects with Cl III skeletal pattern showed the least prevalence. What could be concluded is that various facial morphologies were observed in both male and female populations of Ahvaz having permanent buccal and palatal impacted maxillary canines.

Keywords: Tooth impaction, Cephalometric analysis, Maxillary canines, Skeletal characteristics.

There are several factors which affect the process of tooth eruption such as climate, geographical location, race and blood, genetics as well as nutrition. Localized factors sometimes cause disorders in the natural process of tooth eruption leading to tooth impaction. Complications and problems such as mal-occlusion, losing of arch length, displacement and resorption of the adjacent teeth, periodontal diseases, cyst and tumor are quite common when teeth stop eruption[1-3]. The maxillary permanent canines are the second most common impacted teeth after the third molars[4].

The disorder in the eruption of maxillary permanent canines is quite common as they take

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longer to evolve in addition to the complicated process they undergo compared to other teeth[5,6]. It is reported that approximately 0.8 to 3 % of the populations suffer from impaction[7,8].

There are several complications which impacted maxillary canines can cause such as displacement and resorption of adjacent teeth, cystic degeneration, ankylosis of canine, shortening of tooth arch or a combination of all these[9].

There are several theories on why maxillary canines are impacted on the whole. However, only two are highly reported: the theory of guidance (lack of guidance in lateral teeth) as well as genetic theory[10-12]. There is also an argument that gender is effective in a way that palatal impaction in women are twice more than men[13]. Another related cause to eruption disorder in canines is spatial conditions in the upper jaw[14].

Mal-occlusion in orthodontics is a typical abnormal status and is highly related to disconformity in face[15]. The first determining index of mal-occlusion is genetic predisposition and there are other secondary environmental factors which fundamentally affect the positioning of dental arches. Face can be classified in three forms of class '!, class a! and class b! in an anterior-posterior pattern based on the size and position of jaws. It is also classified into three forms of short, long and normal based on the vertical skeletal pattern[16].

As genetics plays an important role in canine impaction and it can cause skeletal and dentofacial patterns[10-12,16], the degree to which one is aware of the risk of canine impaction in each skeletal pattern may help them prevent these impactions or cure them.

The present study was carried out to determine the skeletal characteristics in an anterior-posterior pattern using lateral cephalometric radiography in patients with buccal and palatal impacted permanent canines.

METHODS AND MATERIALS

The research was conducted through a descriptive epidemiology using a result-based non-accidental sampling. Lateral cephalometric and panoramic radiographs of 110 patients with the permanent impacted canines (bilateral or unilateral) were collected from the Orthodontic Department and orthodontic offices in the city of Ahvaz. The samples involved non-syndromic subjects who did not have any orthodontic treatment history. Locating the impacted canines were determined through clinical examinations and direct observation after exposure surgery based on radiographic assessments. In cases where the tip of the impacted tooth cusp was more palatal than the ridge center it was considered palatal impaction and when the cusp was more buccal than the ridge center it was considered as buccal impaction. The samples were divided into two categories of buccal impacted canines and palatal impacted canines.

The cephalometric lateral radiographs of the patients were put into AutoCAD. The required points to trace include the most anterior point on the chin (POG), the anterior pinnacle of the sharp bone spur of the maxilla on the lower border of the anterior nostril (ANS), the most anterior point of the frontonasal suture in the mid-sagittal plan (N), the geometric center of the pituitary fossa (S), the most superior point of the external ear openings (PO), the most inferior point on symphysis of the mandible (ME), the most posterior point of the midline of the concavity between ANS and prosthion (A), the most posterior point of the midline of the mandibular concavity between POG and infradental (B), and a point on the curve of the mandible whose place is determined through bisecting the tangents on the posterior Ramos and the lower border of mandible (GO). The radiographs were then verified by a couple of professors of the Orthodontic department of Ahvaz University. The required lines and angles of the cephalometric analysis were traced as following:

The Frankfurt plane, mandible plane, SNA angle, SNB angle, ANB angle and FMA angle

In the next step, millimeter intervals of ANS-MEN and N-MEN as well as S-GO were measured and Ant Lower Facial Height Index and Jaraback Index was calculated. This was also verified by two professors of the Orthodontic department. The obtained data was classified through the analysis of Down, Steiner and McNamara in anterior-posterior and vertical patterns. What could be concluded from the data is that the anterior-posterior skeletal pattern and vertical pattern of the facial skeleton were put into distinct categories by gender. The frequency for each category was calculated and then reported.

RESULTS

The prevalence of palatal and buccal impaction by gender

More females are exposed to impaction than males. Among 110 subjects, 83% were female compared to 17% which were male. Considering the type of impaction, the patients had two types of palatal impaction (66.4%) and buccal impaction (33.6%). Taking gender and impaction type into account, the female population with palatal impacted canines were the highest with 55.45% whereas the male population with buccal impacted canines were at the bottom with 6.36%. (Table 1)

The prevalence of skeletal patterns of class '!, a! and b! in patients having buccal impacted canines by gender

What was found in the anterior-posterior patterns taken from patients who have buccal impacted canines was that class '! (57.1%) and class a! (46.6%) had the highest impaction for men and women respectively whereas class b! mal-occlusion (men 0% and women 16.7%) was the least common prevalence. (Table 2)

The prevalence of skeletal patterns of class '!, a! and b! in patients having palatal impacted canines by gender

In patients who had palatal impacted canines categorized by gender, class '! mal-occlusion had the highest impaction in women (65.6%). In male populations, skeletal patterns of class '! and a! had a same frequency (41.6%) and they had the highest prevalence. Class b! mal-occlusion, on the other hand, was the least common (16.7% for men and 4.9% for women). (Table 3)

The prevalence of long-face, normal-face and short-face patterns of the patients having buccal impacted canines by gender

Having analyzed the vertical patterns of the patients who had buccal impacted canines which were categorized by gender it was realized that for women, long-face pattern had the highest prevalence of 50% whereas for men normal-face was as high as 42.9%. The lowest prevalence in female populations was for short-face with 13.3% and in men the least frequency of 28.6 % belonged to short-face and long-face. (Table 4)

The prevalence of long-face, normal-face and short-face patterns of the patients having palatal impacted canines by gender

By analyzing the vertical patterns of the patients having palatal impacted canines by gender it was found out that men who have long face were the most frequent with 58.3% whereas those with normal face had the least prevalence of 8.3%. In female populations, no considerable difference was met with the least of 24.5% and the peak of 37.8% among common vertical mal-occlusions. (Table 5)

The prevalence of buccal impacted canines in male populations based on anterior-posterior and vertical skeletal patterns

In a more in-depth analysis carried out on the anterior-posterior and vertical skeletal patterns of mal-occlusions of male populations with buccal impacted canines, the most common prevalence belonged to male populations with the skeletal pattern of class '! having normal face **(43.0%).** The least common, on the other hand, was the same for skeletal pattern of class b! in all the three vertical patterns and skeletal pattern of class a! with normal face. (Table 6)

The prevalence of palatal impacted canines in male populations based on anterior-posterior and vertical skeletal patterns

In a combination of analyses of vertical and anterior-posterior mal-occlusions carried out on male patients who had palatal impacted canines, the most frequent prevalence was to men in class a! who had long face **(34.0%)**. Nevertheless, the lowest frequency was jointly for the normal-face skeletal pattern class '! with and the skeletal pattern class b! of both vertical patterns of short and normal face which was 0. (Table 7)

The prevalence of buccal impacted canines in female populations based on anterior-posterior and vertical skeletal patterns

In a mixed analysis of the vertical and anterior-posterior mal-occlusions of the female populations suffering from buccal impacted canines, the highest frequency was for women in class a! with long face **(27.0%)**. The lowest one, however, was for skeletal pattern of class b! both short and long face as well as skeletal pattern of class a! with short face which was 3.0%. (Table 8)

The prevalence of palatal impacted canines in female populations based on anterior-posterior and vertical skeletal patterns

In a mixed analysis of the vertical and anterior-posterior mal-occlusions of the female populations suffering from palatal impacted

canines, the highest prevalence was for women in class '! with short face **(29.0%)**. The lowest frequency, however, was for skeletal pattern of class b! with normal face which was reported as 0.0%. (Table 9)

DISCUSSION

The main cause for impaction of canines is genetic-based and it can include: lack of space, mal-formation of lateral teeth or transposition of tooth germs (17). The current theories of guidance (lack of guidance in lateral teeth) and the genetic theory also prove this. On the other hand, the skeletal patterns are classified based on the position and the size of the jaws to the skull base and both are enormously determined by genetic parameters. The foremost index of a mal-occlusion is genetic predisposition although environmental factors are also effective in reducing or increasing the effects from genetic indices (16). Canine impaction can cause several problems such as damaging the adjacent teeth, neurologic, pathologic, periodontal or aesthetic problems. Also, the cure for canine impaction in permanent dentition is a combination of complicated orthodontic and surgical treatment for positioning the tooth in the correct position in jaw. Therefore, the simplest cure for tooth impaction is to prevent it. Obviously, periodical clinical and radiographic examination for those aging between 8 to 10 and by removing the obstacles of tooth eruption and extracting deciduous canines at the best age can prevent tooth impaction.

To simplify the eruption and to predict impaction of a canine and by knowing the degree to which genetics is effective in germination

Table 1. The prevalence of palatal and buccal impaction by gender

Sex/ impaction type	Buccal	Palatal	Total
Male	7 (6.4%)	12 (10.9%)	19 (17.4%)
Female	30 (27.2%)	61 (55.4%)	91 (82.6%)
Total	37 (33.6%)	73 (66.4%)	110 (100.0%)

Table 2. The prevalence of skeletal patterns of class I, II and II in patients having buccal impacted canines by gender

Skeletal pattern /Gender	Class I	Class II	Class III	Total
Male	4 (57.1%)	3 (42.9%)	0	7 (100.0%)
Female	11 (36.6%)	14 (46.6%)	5(16.7%)	30 (100.0%)

Table 3. The prevalence of skeletal patterns of class I, II and III in patients having palatal impacted canines by gender

Skeletal pattern /Gender	Class I	Class II	Class III	Total
Male	5 (41.6%)	5 (41.6%)	2 (16.7%)	12 (100.0%)
Female	40 (65.6%)	18 (29.5%)	3 (4.9%)	61 (100.0%)

Table 4. The prevalence of long-face, normal-face and short-face patterns of the patients having buccal impacted canines by gender

Face pattern /Gender	Normal face	Short face	Long face	Total
Male	3 (42.9%)	2 (28.6%)	2 (28.6%)	7 (100.0%)
Female	11 (36.7%)	4 (13.3%)	15 (50.0%)	30 (100.0%)

disorders such as impaction or dentofacial skeletal patterns, awareness of more probable impaction of canine in each of the skeletal patterns plays an important role in curing or preventing it. Hence, the present study was carried out to evaluate the skeletal characteristics of patients suffering from buccal and palatal impacted canines such as the frequency of skeletal patterns of Cl a! and Cl b!, long face and short face, by using cephalometric lateral radiography.

As results are indicative, in female populations with buccal impacted canines the skeletal pattern of Cl a! and long face had the highest prevalence, whereas in male populations, all the three vertical patterns of class Cl b! and men with skeletal pattern of Cl a! and normal face had the lowest frequency. For those with palatal impacted canines, the most frequency belonged to female population of Cl '! with short face and the least frequencies were for: males with pattern Cl '! with normal face, males of pattern Cl b! with short face, both genders in pattern Cl b! with normal face.

Mercuri et al (2013) reflected that the people who have palatal impacted canines usually have normal skeletal patterns and frequent lack of mal-occlusion in patients who have palatal displacement of impacted canines delays their impaction diagnosis (18). In patients who have mal-

Table 5. The prevalence of long-face, normal-face and short-face patterns of the patients having palatal impacted canines by gender

Face pattern /Gender	Normal face	Short face	Long face	Total
Male	1 (8.3%)	4 (33.3%)	7 (58.3%)	`12 (100.0%)
Female	15 (24.5%)	23 (37.7%)	23 (37.8%)	61 (100.0%)

Table 6. The prevalence of buccal impacted canines in male populations based on anterior-posterior and vertical skeletal patterns

Face pattern/ Skeletal pattern	Normal face	Short face	Long face
Class I	3 (43.0%)	1 (15.0%)	1 (14.0%)
Class II	0	1 (14.0%)	1 (14.0%)
Class III	0	0	0

Table 7. The prevalence of palatal impacted canines in male populations based on anterior-posterior and vertical skeletal patterns

Face pattern/ Skeletal pattern	Normal face	Short face	Long face
Class I	0	3 (25.0%)	1 (8.0%)
Class II	1 (8.0%)	1 (8.0%)	4 (34.0%)
Class III	0	0	2 (17.0%)

Table 8. The prevalence of buccal impacted canines in female populations based on anterior-posterior and vertical skeletal patterns

Face pattern/ Skeletal pattern	Normal face	Short face	Long face
Class I	5 (17.0%)	2 (7.0%)	6 (20.0%)
Class II	3 (10.0%)	1 (3.0%)	8 (27.0%)
Class III	3 (10.0%)	1 (3.0%)	1 (3.0%)

Table 9. The prevalence of palatal impacted canines in female populations based on anterior-posterior and vertical skeletal patterns

Face pattern/ Skeletal pattern	Normal face	Short face	Long face
Class I	9 (15.0%)	18 (29.0%)	13 (21.0%)
Class II	6 (10.0%)	4 (7.0%)	8 (13.0%)
Class III	0	1 (2.0%)	2 (3.0%)

occlusion and displacement of buccal impacted canines, the desire for orthodontic treatment will be more as their face pattern indicates. Nevertheless, in the present study, the relationship between skeletal pattern Cl '! and short face was the most frequent in patients with palatal impacted canines. Moreover, although buccal impacted canines were most frequent in patients, skeletal pattern Cl a! and long face was the most prevalent and skeletal pattern Cl b! was the lowest. So, we can see that the results of this study does not correspond the results of Mercuri et al (18).

In a research carried out by Cernochova (2012), patients who had palatal impaction indicated more frequency of the increased prognathism of the maxilla and also the links between skeletal pattern Cl '! and retrusion of the central teeth of the maxilla (19). Also, more anterior rotation was found in their mandibles. In patients with buccal impaction, the retrognathism of the maxilla and Cl b! skeletal links was the most obvious. In the recent study, different facial morphologies indicated the etiopathogenesis of canine eruption disorders in patients having displacement of buccal and palatal canines. In the present study, among the patients with palatal impacted canines, the skeletal pattern Cl '! and short face was the most frequent and the skeletal pattern Cl b! was the least. Besides, in patients with buccal impacted canines, Cl a! and long face was the most frequent and Cl b! was the rarest. The final results from the present study is indicative of the dispersed skeletal patterns in anterior-posterior and vertical dimensions of the patients having buccal and palatal impacted canines and they correspond the results of Cernochova (2012). (19).

Based on the results obtained from this study, palatal impaction prevalence included 70% of the population whereas buccal impaction was 30%. On the other hand, canine impaction in females was reported as 80% and 20% was reported for males. Therefore, when it came to predict impaction, palatal canine impaction was considerably the most in female populations. Furthermore, based on the calculations made, there is no link between dispersion of the skeletal characteristics and buccal-palatal impaction of canine.

CONCLUSION

All in all, various facial morphologies were observed in both male and female populations of Ahvaz having permanent buccal and palatal impacted maxillary canines.

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