Comparison of Skeletal Dimensions in Patients with Unilateral Palatally Impacted Canine Between Impacted Side and Contralateral Non Impacted Side – A CBCT Study

Mudasir Yaqoob[1], Mohamad Aslam Baidar Gull[2], Abhishek Khajuria[3]

ABSTRACT

Introduction: Permanent maxillary canines are the second most frequent impacted teeth after third molars with 2% prevalence rate in the general population since they have an extended development period deep in maxilla, have large root surface area to develop and a long tortuous path of eruption compared to other teeth. The aim of this study was to delineate the effect of palatally impacted canine on the skeletal dimensions like alveolar bone height, alveolar bone width and arch perimeter.

Material and methods: There were a total of 42 CBCT samples (15 males, 27 females) in the study. Alveolar bone height, buccopalatal width of alveolar ridge, arch perimeter and palatal width at premolar region were measured both on the impacted side and non-impacted side and results were compared.

Results: The alveolar height was greater on non-impacted side (mean = 16.1 mm, S.D ± 2.32) than on impacted side (mean = 14.9 mm, S.D ± 2.07). The bucco-palatal width was greater on non-impacted side as compared to impacted side. Arch perimeter was greater on non-impacted side (mean = 35.4 mm, S.D = 2.83) as compared to impacted side (mean = 33.5 mm, S.D = 2.80). Palatal width was greater on non-impacted side (mean = 18.0 mm, S.D = 2.23) as compared to impacted side (mean = 16.7 mm, S.D = 2.35).

Conclusion: Values of skeletal dimensions is different on impacted side when compared to non-impacted side.

Keywords: Alveolar Height, Buccopalatal Width, Impaction, Skeletal

INTRODUCTION

In pathological terms, impacted teeth can be defined as a state where a tooth remains embedded in the oral mucosa or bone past its normal eruption period. However, the clinical definition of impacted teeth can be broadened to include teeth that are predicted to undergo abnormal eruption, even before its normal eruption period, due to position of tooth germ, tooth shape, direction of eruption, and available space.[1] Permanent maxillary canines are the second most frequent impacted teeth after third molars with 2% prevalence rate in the general population since they have an extended developmental period deep in maxilla, have large root surface area to develop and a long tortuous path of eruption compared to other teeth.[2] Also, existence of additional teeth in the eruption path is an important factor for delaying maxillary canines from eruption.[3]

Research studies lack the characterization of alveolar bone dimensions and mechanical environment at the impacted site; while it may be hypothesized that impaction may lead to reduced masticatory stimulation of the bone. With the advent of cone-beam computed tomography (CBCT), more specifically, by rendering three-dimensional (3D) views of teeth and bone at high resolution, detailed characteristic of alveolar bone dimensions can be obtained at the impacted side.[4,5]

Taking assistance from CBCT generated images it was decided to find out how the morphology and maxillary dimensions can affect the eruption and subsequent impaction of maxillary canines and in turn how an impacted canine would affect the skeletal dimensions in a sample with unilateral palatally impacted canines when compared with the unaffected side.

The study was designed with an aim to analyse the characteristics of these dimensions and determine how they influence the impacted canines on vertical and transverse measurements using coronal, sagittal and axial views on CBCT.

MATERIAL AND METHODS

The study was carried out on the patients registered for undergoing fixed orthodontic treatment at Department of Orthodontics & Dentofacial Orthopaedics, Government Dental College & Hospital, Shireen Bagh, Srinagar. Inclusion criteria included patients with a unilateral maxillary palatal canine impaction, patients more than 12 years of age, complete eruption of the contralateral canine, and no prior orthodontic treatment. Exclusion criteria included patients with craniofacial anomalies and syndromes, cleft lip and cleft palate patients, cases with congenitally missing teeth, CBCT scans showing supernumerary teeth, enlarged/cystic

[1]Resident, Department of Orthodontics, Government Dental College, Srinagar, J&K, [2]Registrar, Department of Orthodontics, Government Dental College, Srinagar, J&K, [3]Senior Resident, Department of Dentistry, GMC Kathua, J&K

Corresponding author: Mudasir Yaqoob, Room No. T2, Government Dental College Boys Hostel, Bemina, Srinagar, 190010

How to cite this article: Yaqoob M, Gull MAB, Khajuria A. Comparison of skeletal dimensions in patients with unilateral palatally impacted canine between impacted side and contralateral non impacted side – a CBCT study. International Journal of Contemporary Medical Research 2021;8(2):B6-B9.

DOI: http://dx.doi.org/10.21276/ijcmr.2021.8.2.23

follicle, or any other pathology, history of facial trauma and previous history of orthodontic treatment.

The data was obtained using the NewTom GiANO NNT Scanner. All the scans were taken using the same machine by the same operator. The NewTom GiANO Scanner is based on a cone-beam technique that uses X-ray emissions efficiently, thus reducing the dose absorbed by the patient.

The following analysis and measurements were performed for every included subject:

1. Measurement of alveolar bone height: The alveolar bone height was measured from a line tangent to alveolar crest on panoramic reconstruction of CBCT images to nasal floor on both impacted and non impacted side (Fig.1).

Two lines were used to orient and standardize the measurements. The first line was tangent to the alveolar crest in the panoramic reconstruction from the CBCT volume. The second line was the line perpendicular to first line for localization of the long axis of the canine as well as representing the longitudinal axis of an ideal location of an imaginary endosseous dental implant in the site of the impacted canine. The alveolar height was measured from the level of the crest to the floor of the nasal fossa. The height on the impacted side was measured along the longitudinal axis of an imaginary endosseous implant and height on the non-impacted side was measured along the longitudinal axis of the canine.

2. Bucco-palatal width of alveolar ridge: The Bucco-palatal width of the alveolar ridge was measured in the sagittal sections. It was measured at three different heights (2 mm, 6mm and 10 mm) from alveolar crest towards apex. On the impacted side, the buccopalatal width was measured at the centre of the edentulous space and on the non-impacted side, the buccopalatal width was measured at the centre of the canine [Fig. 2 (a) and 2 (b)].

3. Arch Perimeter: Arch perimeter was measured from mesial of the first molar to the inter-maxillary suture on the impacted and non-impacted sides (Fig.3). Measurements were made using the arch measurement tool along the centre of the ridge.

4. Palatal width at Premolar region: Distance in millimetres from the mid palatine raphe to proximal alveolar bone crest between the canine (deciduous or permanent) and first premolar on each side, in the axial view (Fig.4).

STATISTICAL ANALYSIS

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were summarized in the form of means and standard deviations and categorical variables were summarized as percentages. Chi-square test or Fisher's exact test, whichever appropriate, was used for comparison of categorical variables. A P-value of less than 0.05 was considered statistically significant.

RESULTS

The alveolar height was greater on non-impacted side (mean = 16.1 mm, S.D ± 2.32) than on impacted side (mean = 14.9 mm, S.D ± 2.07) (Table 1). Maximum and minimum alveolar heights on non-impacted side were 21.5 mm and 11.7 mm respectively and 19.4 mm and 9.0 mm respectively on impacted side. The difference was statistically significant. The bucco-palatal width of the alveolar ridge in the region of canine was measured in the sagittal sections. It was

Alveolar Bone Height	Mean	SD	Min	Max	P-value
Impacted Side	14.9	2.07	9.0	19.4	0.023*
Non-Impacted Side	16.1	2.32	11.7	21.5	

Table-1: Comparison of alveolar bone height between impacted and non-impacted side (mm)

	Impacted Side			Non-Impacted Side			P-value
	Mean	SD	Range	Mean	SD	Range	
2mm	6.97	1.62	2.8-9.6	8.19	1.00	6.2-10	<0.001*
6mm	7.78	1.82	2.5-11.5	8.92	1.44	5.6-12.8	0.002*
10mm	8.83	2.23	2.1-13.2	9.47	1.84	4.7-14.1	0.155

Table-2: Comparison of Bucco-palatal width between impacted and non-impacted side at various heights from alveolar crest (mm)

Arch perimeter	Mean	SD	Min	Max	P-value
Impacted Side	33.5	2.80	28.5	39.1	0.003*
Non-Impacted Side	35.4	2.83	30.2	41.2	

Table-3: Comparison of arch perimeter between impacted and non-impacted side (mm)

Palatal width	Mean	SD	Min	Max	P-value
Impacted Side	16.7	2.35	12.4	21.2	0.010*
Non-Impacted Side	18.0	2.23	13.3	22.5	

Table-4: Comparison of palatal width between impacted and non-impacted side (mm)

measured at three different heights from alveolar crest. The buccopalatal width of the alveolar ridge was measured at 2, 6, and 10 mm apically to the alveolar crest (Table 2). The bucco-palatal width was greater on non-impacted side as compared to impacted side. Mean width on impacted side at 2 mm from alveolar crest was 6.97 mm (S.D = 1.62), at 6 mm from alveolar crest was 7.78 (S.D = 1.82) and at 10 mm from alveolar crest was 8.83 (S.D = 2.23). Mean width on non-impacted side at 2 mm from alveolar crest was 8.19 mm (S.D = 1.00), at 6 mm from alveolar crest was 8.92 (S.D = 1.44) and at 10 mm from alveolar crest was 9.47 (S.D = 1.84). The difference was statistically significant at heights of 2 mm and 6 mm but insignificant at 10 mm.

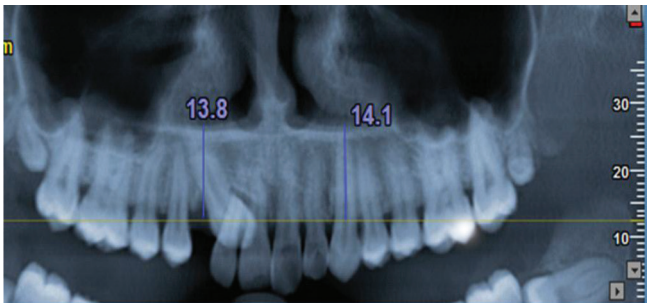

Figure-1: Panoramic reconstruction showing the reference lines used for standard measurements of the alveolar height

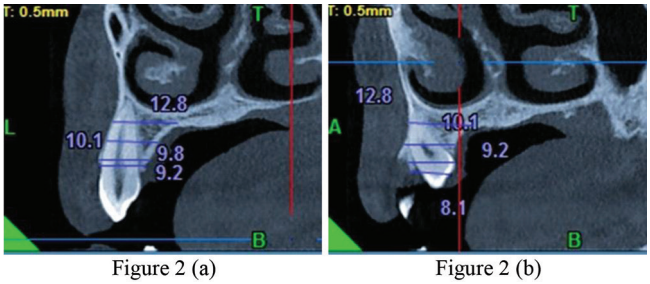

Figure 2 (a) Figure 2 (b)

Figure-2: Buccopalatal width of the alveolar ridge on (a) non-impacted side and (b) impacted side

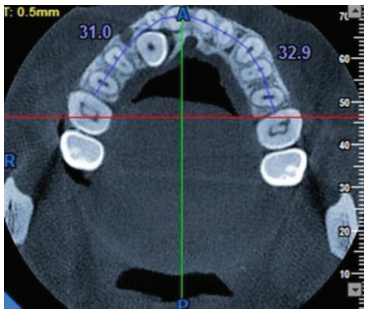

Figure-3: Arch perimeter measured from the mesial of the first molar to the inter-maxillary suture on the impacted and non-impacted sides.

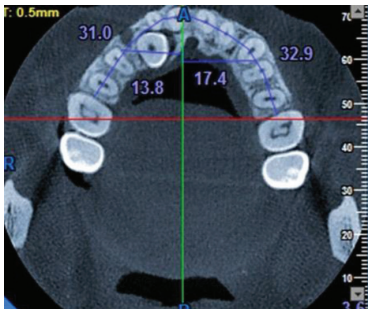

Figure-4: Premolar width from the mid palatine raphe till proximal alveolar bone crest between the canine and first premolar on each side

Arch perimeter was measured from mesial of the first molar to the inter-maxillary suture on the impacted and non-impacted sides. Arch perimeter was greater on non-impacted side (mean = 35.4 mm, S.D = 2.83) as compared to impacted side (mean = 33.5 mm, S.D = 2.80) (Table 3). Maximum and minimum arch perimeter on non-impacted side was 41.2 and 30.2 respectively and 39.1 and 28.5 respectively on impacted side. The difference was statistically significant.

Distance from the middle palatine raphe to proximal alveolar bone crest between the canine (deciduous or permanent) and first premolar on each side, in the axial cut at bone crest level was measured (Table 4). Palatal width was greater on non-impacted side (mean = 18.0 mm, S.D = 2.23) as compared to impacted side (mean = 16.7 mm, S.D = 2.35). Maximum and minimum dimensions of palatal width at premolar region on non-impacted side were 22.5 mm and 13.3 mm respectively and 21.2 mm and 12.4 mm respectively on impacted side. The difference was statistically significant.

DISCUSSION

Unilateral palatally impacted maxillary canines represent an asymmetric basal bone structure of the right or left anterior segment of the maxillae.[6] The main objective of this study was to compare the skeletal and dentoalveolar dimensions of the maxillae in a sample with unilateral palatally impacted canine between impacted side and contralateral unaffected side. Literature search has shown a few studies with similar methodology but did not use CBCT or did not include all variables like this study. [7,8] Overall there has been a lacunae of information in this field.

Alveolar bone height was significantly less on the impacted side when compared to erupted canine side, i.e., there was reduced bone formation on the impacted side or a combination of reduced osteogenesis and osteoclastogenesis, which led to decreased 'nasal floor to alveolar bone' (NFAB) distance. Moreover, in our study, we had similar findings both for males and females (statistically insignificant). Cahill temporarily impacted premolars in dogs and found that eruption was characterized by an increase in the trabecular bone at the base of each tooth. [9,10]

The results of our study showed that bucco-palatal (BP) width 2 mm and 6 mm above the alveolar crest was significantly less on the side where the canine was impacted. We had similar findings both for males and females. It has been well documented that site specific resorption of alveolar ridge takes place in the absence (extraction and impaction) of a particular tooth. The amount of bone loss is more in the horizontal direction when compared to vertical bone loss (reduced alveolar ridge height).[11,12] However, there was no significant difference in the BP width at 10 mm above the alveolar crest between impacted and non-impacted side. This was primarily due to presence of impacted canine at 10 mm

above the alveolar crest.

Jacoby reported that 85% of the palatal canine impactions are in patients with adequate arch perimeter.[6] Similarly, Stellzig et al. reported sufficient arch perimeter in 82% of the palatally impacted canines[13]. However, in our study, the arch perimeter on the impacted side was significantly lesser than the non-impacted side. This significant change in arch perimeter between impacted and non-impacted side was seen in both males and females. One of the probable reasons could be early loss of primary canine on the impacted side and mesial migration of the posterior teeth, thus decreasing the arch perimeter. Since all the patients included in this study had permanent maxillary lateral incisors present both on impacted and non-impacted side, the arch length decrease on the impacted side could also be due to smaller mesio-distal dimensions of maxillary lateral incisor on the impacted side.

Significant differences were observed on the measurements from the mid-palatine raphe to the interproximal area between canine and first premolar (palatal width at premolar region), since the measurements in affected side were significantly lower than the non-impacted side. This was because the side of the impacted canine may have not been sufficiently developed, compared with the unaffected side where canines have normally erupted.

CONCLUSION

Reduction in bone formation at the base of the socket can lead to impaction of teeth. Orthodontic treatment of unilateral palatally impacted maxillary canine should correct the transverse asymmetry mainly at the level of the premolar width on the affected side.

REFERENCES

1. Kim Y, Hyun HK, Jan KT. The position of maxillary canine impactions and the influenced factors to adjacent root resorption in the Korean population. Euro J Orthod 2012; 34: 302–306.
2. Bedoya MM, Park JH. A Review of the Diagnosis and Management of Impacted Maxillary Canines. J Am Dent Assoc 2009;140: 1485-93.
3. Richardson G, Russel KA. A review of impacted permanent maxillary cuspids—diagnosis and prevention. J Can Dent Assoc 2000; 66:497-501.
4. Mischkowski RA. et al. Geometric accuracy of a newly developed cone-beam device for maxillofacial imaging. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics 2007;104, 551–559.
5. Timock AM. et al. Accuracy and reliability of buccal bone height and thickness measurements from cone-beam computed tomography imaging. American Journal of Orthodontics and Dentofacial Orthopedics, 2011;140:734–744.
6. Ericson S, Kurol J. Early treatment of palatally erupting maxillary canines by extraction of the primary canines. Eur J Orthod. 1988;10:283–95.
7. Kanavakis G, Curran KM, Wiseman KC, Barone NP, Finkelman MD, Srinivasan S, Lee MB, Trotman CA. Evaluation of crown-root angulation of lateral incisors adjacent to palatally impacted canines. Prog Orthod. 2015;16:4.
8. Tadinada A, Mahdian M, Vishwanath M, Allareddy V, Upadhyay M, Yadav S. Evaluation of alveolar bone dimensions in unilateral palatally impacted canine: a cone beam computed tomographic analyses. Eur J Orthod. 2015;37:596–602.
9. Cahill DR. The histology and rate of tooth eruption with and without temporary impaction in the dog. The Anatomical Record. 1970; 166: 225–237.
10. Cahill DR. Eruption pathway formation in the presence of experimental tooth impaction in puppies. The Anatomical Record. 1969; 164: 67–77.
11. Lekovic V. et al. Preservation of alveolar bone in extraction sockets using bioabsorbable membranes. Journal of Periodontology. 1998; 69: 1044–1049.
12. Lekovic V. et al. A bone regenerative approach to alveolar ridge maintenance following tooth extraction. Report of 10 cases. Journal of Periodontology. 1997; 68: 563–570.
13. Stellzig A, Basdra EK and Komposch G. The etiology of canine tooth impaction–a space analysis. Fortschritte der Kieferorthopädie. 1994; 55: 97–103.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 15-01-2020; **Accepted:** 20-01-2021; **Published:** 20-02-2021