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Research Article

PREDICTION OF MANDIBULAR CANINE/S IMPACTION: A POSSIBILITY

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ABSTRACT

Introduction: This study investigates buccolingual crown size of the maxillary and mandibular incisors in patients with permanent mandibular canine/s impaction.
Material and methods: Dental models of 43 subjects diagnosed with mandibular canine/s impaction (Impaction Group) were compared with those of 86 subjects of a control reference sample (Control Group). Independent *t*-test was used to determine the association between mandibular canine/s impaction and the maximum buccolingual crown diameter of the incisors. **Results:** Only mandibular central incisor and lateral incisor had statistically significant differences ($P<0.05$) between the groups.
Conclusion: Subjects with mandibular canine/s impaction appear to be characterized with buccolingually wider incisors. It raises the possibility that mandibular incisors teeth size helps in prediction of mandibular canine impaction, early during the mixed dentition.
Keywords: Impaction, Eruption, Genetics, Tooth Size, Prediction.

INTRODUCTION

Impaction is defined as failure of tooth eruption caused by a physical obstacle in the eruption path or the abnormal position of the tooth[1]. Failure of eruption of the mandibular canine is an unusual event[2]. Bluestone, as early as 1951, was the first to describe impaction of permanent mandibular canine/s (PMC/s)[3]. Shah et al found eight unerupted mandibular canines in 7886 individuals[4]. Grover and Lorton found 11 impacted mandibular canines in 5000 individuals[5].

The potential undesirable sequalae of this wayward process of impaction may range from loss of space in the arch to resorption of the roots of the neighbouring teeth[6]. To worsen the matter, orthodontic treatment of the impacted canines, particularly when started after the conclusion of the pubertal growth spurt, is likely to be protracted. This may have profound unfavourable psychological impact on the patient. This makes incumbent on a dental practitioner, in general and the orthodontist in particular, to monitor for early indications of mandibular canine/s impaction. This shall not only raise the possibility of predicting impending eruption disturbances but also minimise the risk of associated complications by helping an astute clinician prevent some, intercept and/or treat yet other cases of mandibular canine impaction, more efficiently.

Peck[7] cited the role of genetics in the etiology of ectopic mandibular canines. Ectopic position of the tooth germ is likely to result in its impaction. Heredity is also known to influence the tooth-size[8]. Possible linkage between size alterations of incisors and the mandibular canine impaction is therefore likely. On account of important diagnostic and therapeutic implications, this subject needs further investigations.

Hence, we intend to investigate the bucco-lingual crown size of the maxillary and mandibular incisors of PMC impaction patients to better understand the relationship between this eruption anomaly and the tooth sizes. Null hypothesis is stated as follows: the maximum bucco-lingual crown diameter (MBD) of maxillary and mandibular central and lateral incisors does not differ between the subjects with and without permanent mandibular canine/s impaction.

MATERIALS AND METHODS

Following the approval of the institutional review board, a cross-sectional clinical study was designed and undertaken at the Department of Orthodontics, Purvanchal Institute of Dental Sciences (PIDS) in Gorakhpur, India. The research was conducted in full and strict accordance with ethical principles and including those from the 'Declaration of Helsinki (2008)'.

A multistage sampling technique was adopted to select subjects exhibiting PMC/s impaction from various schools in the district Gorakhpur, Uttar Pradesh, India. The geographic map of the district was obtained and divided into six zones from each of which, two schools were randomly selected. All students of at least 14 years of age, from the 12 selected schools, were evaluated and a total of 10,422 (females: males, 0.9:1) subjects were screened. Subjects who lacked any clinical sign of PMC/s eruption were referred to the dental college for subsequent radiographic evaluation. Fifty-nine subjects fulfilled the Becker's[9] criteria for the diagnosis of mandibular canine/s impaction, according to the subject's history, clinical and radiographic examination (orthopantomograph, occlusal, intra-oral periapical views assessed using Clark's rule and Lateral cephalogram). A mandibular canine was accepted as impacted only if it showed radiographic evidence of complete root formation. Factors like clinical or radiographic evidence of supernumerary teeth, odontoma or cyst directly related to the unerupted mandibular canine/s; congenitally missing teeth including mandibular canine(s) (but excluding third molars); history of trauma or extraction of any primary or permanent tooth, presence of gross caries interproximally, orofacial clefts or any other hereditary, syndromic or systemic manifestations and previous endodontic treatment of primary mandibular canines and history of prior orthodontic intervention that possibly influenced eruption of PMC led to the exclusion of 16 subjects.

The 'Impaction Group' (IG) of 43 subjects diagnosed with PMC/s impaction and who were Indian by origin and ranged between 14-21 years of age with a mean of 15.8 years. A Control Group (CG), as a reference sample, consisted of study models from 86 age- and gender-matched Indian subjects, randomly selected from the initial subjects, but who had complete eruption of both PMCs.

Maxillary and mandibular alginate impressions for each subject were taken and the dental models were poured in dental stone. Using the study models and a specially tipped electronic digital caliper (Digimatic caliper; Mitutoyo, Kawasaki, Japan), MBD was recorded in millimeters (to the nearest of 0.01 mm) for the permanent maxillary and mandibular central incisors (CI) and lateral incisors (LI) on both sides of each dental arch for all the subjects by a single investigator (co-author), who was blinded to the null hypothesis. Data consisting of age, gender and bucco-lingual diameters were collected and entered into a spreadsheet (Excel 2000, Microsoft Corporation, Redmond, WA, USA). Statistical analyses were performed using SPSS (version 17, Chicago, IL, USA).

Statistical analyses

Paired *t*-tests were used to compare the differences in MBD for each incisor type between affected and unaffected sides in subjects with unilateral PMC impaction and right versus left sides in those with bilateral impactions. A comparison for MBD between the IG and CG was conducted using the independent two sample *t*-tests. Two weeks later the same examiner (co-author) undertook duplicate measurements of MBD on all incisors using 20 study models randomly selected from each group. Intra-examiner reliability was assessed using double determination method.

RESULTS

Of 43 subjects, in IG, only 6 (14%) were affected bilaterally. In the remainder unilateral cases, impaction occurred with almost similar frequency on the right (46%) and left sides (40%). Female: male ratio in IG was 2.07:1.

Error in tooth size measurements was found to be statistically insignificant.

As seen in Table I, Paired *t* tests showed insignificant differences in MBD between corresponding teeth of each side. This confirmed strong metrical concordance between homologous maxillary and mandibular CI and LI[10] and allowed us to use mean MBD of the right and left sides of each incisor type for further consideration. Table II reports descriptive statistics of MBD of the maxillary and mandibular CI and LI for the two groups viz. IG and CG. Independent 2-sample *t* test showed that only mandibular CI and LI had statistically significant differences ($P<0.05$) between the groups. In general, when compared to the controls, the MBD of mandibular incisors tended to increase in the subjects with mandibular canine/s impaction, thereby rejecting the null hypothesis.

DISCUSSION

We found PMC/s impaction in 0.41 per cent of an Indian subpopulation sample. Female predominance and observations on location of impaction observed in the present study were in accordance with previous reports[11].

One strategy to comprehend and clarify how the genetic code may affect biologic processes is through comparison and testing of carefully selected samples for significant occurrence differences in variables that have known genetic control mechanisms[12]. Two such variables are assessed in the present study: PMC/s impaction and incisor tooth sizes. Tooth size is a relevant topic to explore because it has a direct impact on orthodontic diagnosis, prognosis, treatment methods and retention[13]. Becker et al[14] indicated that most maxillary teeth are significantly narrower bucco-lingually in cases with palatal displacement of maxillary canine than with normally erupted ones. On the contrary we found that mandibular CI and LI showed statistically significant increase of MBD in IG in comparison to controls. Buccolinually wider incisors are possibly indicative of generalized and/or mesio-distal increase in tooth sizes throughout the dentition[15]. As canines normally erupt ahead of premolars in the mandible[17], it is unlikely that wider-than-average incisors mechanically encroach upon the space available for the eruption of remaining teeth and thereby, lead to the impaction of canines rather than premolars. Therefore, it seems reasonable to assume that the association between the incisor size alterations and mandibular canine/s impaction may not be purely mechanical or causal but rather non-causal, biologically or genetically related too[7,8,17]. This is validated by the frequent occurrence of genetically controlled dental disturbances that often occur in combination[18-21,22]. We emphasize that clinicians should understand bucco-lingually wider incisors as a non-causal trait

associated with the PMC/s impaction. Wider-than-average bucco-lingual size of the incisors, as may be assessed in the early mixed dentition, may be understood as a possible risk factor for mandibular canine/s impaction; especially in combination with some other associated dental anomalies. A collateral study indicated PMC/s impaction to be closely associated with mesio-distal tooth-size alterations and Class II division 2 Angle's malocclusion[22]. Integrating this information with the results of the present study; early identification of candidates with PMC/s impaction for interceptive treatments, such as the extraction of corresponding deciduous canines; is likely[22].

It shall be of great interest in view of the present clinical results (association of mandibular canine impaction with tooth sizes) to examine tooth sizes in males vs females and unilateral vs bilateral impaction cases and whether genes associated with mandibular canine eruption/impaction are also involved in controlling teeth sizes. Observed biological associations may help us modernize the century old mechanical view of malocclusion[23].

CONCLUSION

The bucco-lingual widths of the maxillary incisors were not significantly different in the impaction and control groups. Mandibular incisors were found to be wider bucco-lingually in the subjects with PMC/s impaction when compared to the controls. Results should be considered preliminary as it is one of first studies on bucco-lingual tooth sizes in association with PMC/s impaction. Further verification in a more extensive study with more elaborate resources is recommended.

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Table I: MBD of maxillary and mandibular CI and LI; Comparison between affected and unaffected sides in Unilateral Impaction subjects and between Right and left sides in bilateral subjects

Location/ MBD		Max. CI	Max. LI	Mnd.CI	Mnd.LI
Unilateral	Affected side	6.4±0.43	5.28±0.45	5.78±0.35	6.03±0.46
	Unaffected side	6.36±0.51	5.31±0.35	5.68± 0.39	6.05±0.48
	P	0.45#	0.43#	0.45#	0.71#
Bilateral	Right	6.36±0.42	6.45±0.38	5.67±0.45	5.98±0.56
	Left	6.33±0.45	6.34±0.44	5.62±0.46	5.91±0.52
	P	0.59#	0.45#	0.64#	0.56#

Max. = maxillary, Mand. = mandibular, CI = Central Incisor, LI = Lateral Incisor, MBD = Maximum bucco-lingual crown diameter; # Non significant Paired '*t*' test.

Table II: Comparison of MBD of maxillary and mandibular CI and LI between IG and CG

Groups / MBD	Max. CI	Max. LI	Mnd.CI	Mnd.LI
IG	6.35±0.46	5.34±0.56	5.72±0.41	6.02±0.46
CG	6.23±0.34	5.2±0.45	6.12±0.21	6.40±0.13
P	0.71#	0.41#	0.00*	0.00*

Max. = maxillary, Mand. = mandibular, CI = Central Incisor, LI = Lateral Incisor, MBD=Maximum bucco-lingual crown diameter; #Non significant, * P<0.05, Statistically significant independent 't' test

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