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Prevalence of congenitally missing upper lateral incisors in an orthodontic adolescent population

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Abstract:

OBJECTIVE: To determine the frequency of congenitally missing maxillary lateral incisors (LIs) and to find out its variability in relation to gender.

MATERIALS AND METHODS: A retrospective study was carried out between January 2017 and December 2017. Orthopantomographs (OPGs) and lateral cephalographs record search of all orthodontic adolescent patients aged 12 to 18 years were taken from the archival records of the department. Orthopantomographs helped to diagnose the presence of unilateral/bilateral maxillary lateral incisors while the ANB angle was calculated from the lateral cephalographs to divide the subjects into various skeletal malocclusions.

STATISTICAL ANALYSIS USED: The statistical analysis was done using the Statistical Package for Social Sciences (SPSS version 17.0). The frequencies were compared with the help of the Chi-square test. $P < 0.05$ was considered statistically significant.

RESULTS: The frequency of missing upper laterals among the male patients was 0.9%, however, 2.8% of the female patients were having missing maxillary lateral incisors. Based on gender, 62.16% had a bilateral expression of missing upper laterals, 16.21% had left unilateral expression, and 21.62% had right unilateral expression. Furthermore, skeletal class I malocclusion had a prevalence of 54.16% of bilateral missing lateral incisors in upper arch as compared to 40% of left unilateral expression and 37.5% of right unilateral expression whereas in skeletal class II malocclusion, the prevalence of right unilateral expression was 37.5% as compared to bilateral expression which was 33.33%. The left unilateral expression in skeletal class II malocclusion was found to be only 20%. The highest prevalence of missing laterals in skeletal class III malocclusion was left unilateral expression which was around 40%. The prevalence of right unilateral expression was 25% whereas the bilateral absence of upper laterals in skeletal class III malocclusion was 12.5%.

CONCLUSION: The prevalence rate for congenitally missing upper lateral incisors in the orthodontic adolescent population aged 12 to 18 years was found to be 3.77% in the present study while females were found to have a greater percentage of agenesis of the upper lateral incisors (2.8%) as compared to the males (0.9%).

Keywords:

Adolescent population, congenitally missing, lateral incisor, prevalence, space management, tooth agenesis

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Introduction

Anodontia is the complete absence of teeth. Hypodontia means the absence of fewer than six teeth. Agenesis is defined as failure of development of teeth at birth. Absence of teeth, congenital, or otherwise, causes alignment problems, arch length discrepancies, and dental asymmetry.[1,2] The fact that the formation and maturation of teeth are strictly governed by factors like genetics is a well-established theory. Few missing teeth in an individual are identified to be associated with several genetic and syndromic conditions.[3-6] Mutations in MSX1, PAX9, and AXIN2 in families with multiple missing teeth have been proven by several studies in molecular genetics.[7-9] Moyers stated that there are 5 major recognized reasons for agenesis of the teeth. He stated that heredity, syphilis, and rickets might predispose to agenesis. Some mutational and evolutionary changes in the dentition, also, lead to disturbances in formation of tooth.[10] The present study was planned to determine the frequency of congenitally missing maxillary lateral incisors (LIs) and to find-out its variability in relation to gender.

Materials and Methods

A retrospective study was carried out between January 2017 and December 2017. Orthopantomographs (OPGs) and lateral cephalographs record search of all orthodontic adolescent population aged 12 to 18 years were taken from the archival records of the department. This retrospective study excluded ambiguous OPGs of subjects with no proper birth records or with distorted images. Ethical clearance was obtained from the Institutional Ethics Committee before the start of the study with IEC approval no. IMS/IEC/137/2017 dated 23/01/2017. Patients who were from the same ancestry, who were with no past record of maxillary lateral incisor extraction, those who had not underwent enameloplasty or, had prosthesis of the maxillary lateral incisors, and those who were having no history of previous orthodontic treatment were included in the study while cleft lip and/or, palate patients and those having any other craniofacial anomalies were excluded. Based on the inclusion and exclusion criteria, 1000 OPGs and lateral cephalographs were selected. The demographic variables such as gender and age were determined. Out of the selected archival records, 290 radiographs belonged to male patients while 710 were of female patients. Orthopantomographs helped to diagnose the presence of unilateral/bilateral maxillary lateral incisors while the ANB angle was calculated from the lateral cephalographs to divide the subjects into various skeletal malocclusions. The OPGs which revealed evidence of impacted maxillary lateral incisors were also excluded from the study.

Statistical analysis used

The statistical analysis was done using the Statistical Package for Social Sciences (SPSS version 17.0). The frequencies were compared with the help of the Chi-square test. $P < 0.05$ was considered statistically significant.

Results

In a sample of 1000 patients' radiographs were collected from the archival records for a retrospective survey, of which 290 (29%) radiographs belonged to male patients while 710 (71%) were of female patients. [Table 1] Out of the 37 (3.77%) patients with missing maxillary lateral incisors, 28 were females and 9 were males. [Table 2] To summarize, 4.04% of the female patients were having missing maxillary lateral incisors whereas 3.10% of the male patients were having agenesis of the said tooth. The frequency of missing upper laterals amongst the male patients was 0.9% while 2.8% of the female patients were having missing maxillary lateral incisors. Based on gender, 62.16% had a bilateral expression of missing upper laterals, 16.21% had left unilateral expression and 21.62% had right unilateral expression. [Table 3] Table 4 reveals the statistical significance of prevalence of missing lateral incisor in both the genders side-wise. Furthermore, skeletal class I malocclusion had a prevalence of 54.16% of bilateral missing lateral incisors in upper arch as compared to 40% of left unilateral expression and 37.5% of right unilateral expression whereas in skeletal class II malocclusion, the prevalence of right unilateral expression was 37.5% as compared to bilateral expression which was 33.33%. The left unilateral expression in skeletal class II malocclusion was found to be only 20%. The highest prevalence of missing laterals in skeletal class III malocclusion was left unilateral expression which was around 40%. The prevalence of right unilateral expression was 25% whereas bilateral absence of upper laterals in skeletal class III malocclusion was 12.5%. [Table 5] Table 6 reveals the statistical significance of prevalence of missing lateral incisors in different skeletal patterns.

Discussion

The retrospective analysis of published literature revealed no study being carried out in adolescent population. In the present study, the sample size in a sequence was large to acquire epidemiological and clinical information that correlates to the nonexistence of lateral incisors in the upper arch. It is essential to have significant epidemiological data on various classes of malocclusion, sequentially, to calculate, approximately, the overall time required for correction and management of each individual case. Increased number of samples were considered in the present study to achieve a

Table 1: Gender distribution of patients in the study

Gender	Male	Female
No. of patients	290/1000	710/1000
% of frequency	29%	71%

Table 2: Prevalence of missing lateral incisors amongst the patients

Gender	Male	Female
No. of patients with missing lateral incisor	9/1000	28/1000
% of frequency	0.9%	2.8%

Table 3: Prevalence of missing lateral incisors in both the genders side-wise

Gender	Both		Left		Right		Total	
	n	%	*n*	%	*n*	%	*n*	%
Female	18	78.26	5	83.33	5	62.5	28	100
Male	5	21.73	1	16.66	3	37.5	9	100
Total	23	62.16	6	16.21	8	21.62	37	100

Table 4: Statistical significance of prevalence of missing lateral incisor in both the genders side-wise

Gender	Both	Left	Right	Total
Female	18	5	5	28
χ^2	17.41	4.54	6.05	28.00
P	0.02	0.05	0.18	0.00
Male	5	1	3	9
χ^2	5.59	1.46	1.95	9.00
P	0.06	0.14	0.57	0.00
Total	23	6	8	37

*$P<0.05$ Statistically Significant

Table 5: Prevalence of missing lateral incisors in different skeletal patterns

Skeletal Class	Both		Left		Right		Total	
	n	%	*n*	%	*n*	%	*n*	%
I	13	54.16		40	3	37.5	18	100
II	8	33.33	1	20	3	37.5	12	100
III	3	12.5	2	40	2	25	7	100
Total	24	64.86	5	13.51	8	21.62	37	100

Table 6: Statistical significance of prevalence of missing lateral incisors in different skeletal patterns

Skeletal Class	Both	Left	Right	Total
I	13	2	3	18
χ^2	11.68	2.43	3.89	18.00
P	0.15	0.08	0.20	0.00
II	8	1	3	12
χ^2	7.78	1.62	2.59	12.00
P	0.01	0.24	0.06	0.00
III	3	2	2	7
χ^2	4.54	0.95	1.51	7.00
P	0.52	1.17	0.16	0.00
Total	24	5	8	37

*$P<0.05$ Statistically Significant

comprehensible and suitable representation of the prevalence pattern regarding the agenesis of permanent maxillary lateral incisors in the orthodontic adolescent population. The utilization of OPGs permitted entry to a supply of dependable, widespread, and effortlessly available data.

The prevalence of congenitally missing permanent maxillary lateral incisors varied significantly amongst the numerous studies conducted so far.[10-15] This variation in the prevalence and patterns of agenesis of the maxillary lateral incisors might be attributed to the racial and ethnic origin of the people representing different populations. Sofaer *et al*.[16] conducted a study on a sample of 17,000 high school students from Hawaii wherein the representative population ranged from subjects with a full complement of teeth to congenitally missing maxillary lateral incisors. The clinical examination of the subjects was done and was cross-checked with radiographs. In the present study, it was observed that in cases where there was a missing lateral incisor, the size of the normal central incisor was found to be comparatively larger. Similarly, a radiographic study conducted by Le Bot and Salmon[17] on 200 male subjects from French population with maxillary lateral incisor agenesis concluded that 39.6% of the study samples who reported missing maxillary lateral incisors had an agenesis of the third molars too, in comparison to the control group which revealed the prevalence of missing third molars to be 12.4%. Moreover, the review of the existing literature in relation to the agenesis of the teeth reveals that tooth agenesis is related to some commoner conditions such as supernumerary teeth, retained deciduous teeth, ectopic eruptions, microdontia, or peg-shaped incisors along with taurodontism and teeth transpositions.

Contrary to this, the linkage between dental anomalies and missing maxillary lateral incisors has been sparsely documented in the database. A study conducted by Ephraim R and Shubha M[18] stressed the significance of early diagnosis of missing lateral incisors in the mixed dentition period, to intercept the developing malocclusions highlighting the potential consequences, such situations might have on the developing dentitions. In the present study, the prevalence of the agenesis of missing maxillary lateral incisors as high as 3.77% was documented. Furthermore, in the present study, a striking increase in the percentage of missing maxillary lateral incisors was found in the females with approximately 2.8% of the females having missing maxillary laterals as compared to the males who showed around 0.9% prevalence. A similar study conducted by Horowitz[11] on a sample of 1000 subjects found a prevalence of 1.11% of missing lateral incisors in the population studied. Another study conducted by Aasheim and Ogaard[19] in a Nordic sample of 1953 subjects being screened for orthodontic examination reported a still higher prevalence of around 2% of missing lateral incisors in

the population studied close to the observations made in the present study. Kabbani *et al*.,[20] also, evaluated the prevalence of congenital absence of maxillary lateral incisors in 8000 school children with an equal number of males and females (age range 12–15 years) in a Syrian population and concluded that the prevalence of isolated maxillary lateral incisor agenesis was 1.15%. Srivathsa[21] recorded an overall prevalence of congenitally missing teeth in a range from 2% to 16.3% in the population studied. The variability in the results amongst different populations could be explained on the basis of the role of genetics and/or, different environmental conditions during the genesis of the teeth during their developmental stages.

The teeth that most commonly fail to erupt are those that erupt in the vital terminal areas of the dental lamina. The most commonly impacted teeth are the maxillary lateral incisors, second premolars, and third molars. Agenesis can be explained as the absence of innervations in the final stages of development of the teeth furthest from the innervations of the field. There is a close connection between agenesis of lateral incisors in the maxillary arch and the second premolars. At the molecular level, some factors affecting neural structure formation might have an influence on the tooth formation during the developmental stages leading to some defect in the molecular factors that influence neural growth which, in turn, might lead to the failure of development and thereby hinder tooth formation. In addition, the agenesis of laterals in the maxillary arch has frequently been reported in females than in males as was observed in the findings from the various studies conducted so far.[11,13,14,22,23] The findings of the present study, also, supported the above-mentioned fact. The explanation for the above finding could be attributed to the variation seen in the genders due to differences in both tooth-eruption and skeletal growth patterns observed in males and females.[24] During the primary stages of development, space which is available for the lateral incisor depends largely upon the space which is left-out after the development of the central and canines. On a factual basis, there is potential competition for space between the lateral incisors and their neighbors as the canines and central incisors develop prior to the lateral incisors as hypothesized in various studies conducted so far in this regard. A similar study conducted by Sofaer *et al*.[16] assumed that the tooth size asymmetry observed in their study was due to the environmental disturbances during the developmental stages of the said teeth and/or, due to deprived primordium or, both. Out of the radiographs with missing maxillary lateral incisors in the present study, 62.16% of the patients revealed bilateral expression of missing maxillary laterals, 16.21% had left unilateral expression while 21.62% had right unilateral expression.

In the present study, the ANB angle was, also, calculated and based on that, the sample was divided into skeletal class I, II, and III patterns. Again, in skeletal class I pattern, a prevalence of 54.16% of bilaterally missing maxillary lateral incisors was found as compared to 40% of the left and 37.5% of the right unilateral expression. In skeletal class II malocclusion, the prevalence of right unilateral expression was found to be 37.5% as compared to 33.33% of bilateral and 20% of left unilateral expression. The highest prevalence of missing maxillary laterals in skeletal class III malocclusion expressed as left unilateral expression found to be around 40% as against a right unilateral expression of around 25% and bilateral absence of 12.5%. Though the results of the present study did not possess a clear statistical significance as indicated by the results, it clearly had immense clinical importance. It is very important on the part of clinicians to diagnose the type of teeth missing, the variations seen in relation to the gender affected, the etiology behind, either due to congenital absence of the related tooth buds or due to impactions and the type of skeletal base present and accordingly plan the treatment.[25-28] Arandi and Mustafa,[29] likewise, conducted a study on 2662 dental patients in Palestine who were evaluated for the prevalence of congenitally missing lateral incisors and found 1.91% of the subjects with unilateral agenesis accounting for up to 66.6% of the total cases. In addition, around 79% of the unilateral cases were on the left side while 21% were on the right side. Bilateral agenesis was reported in 33.3% of the total cases.[29] Similar bilateral absence of maxillary lateral incisors was observed and accounted for due to decreased mesiodistal widths in both the maxillary and mandibular anterior segments in the studies conducted by Yakoob *et al*.[30] and Caterini *et al*.[31]

The management of missing maxillary lateral incisors can be done either by orthodontic space closure, mesial positioning of the canines and/or, reshaping of the adjacent teeth or, by a prosthodontic intervention.[32,33] Osseo-integrated implants can, also, be used to replace congenitally missing maxillary lateral incisors.[34-37] Customized lingual orthodontic appliances and adjunctive use of direct skeletal anchorage derived from two palatal mini-implants have, also, been successfully used in patients to close the space of congenitally missing lateral incisors.[38] The review of the literature suggests that orthodontic space closure in missing laterals produced stable results and were accepted better by patients compared to prosthetic rehabilitation.[39] Knowledge of the pattern and prevalence of tooth agenesis is, thus, an important aspect for the planning of treatment in such situations. If such cases getting a timely intervention, an interdisciplinary treatment approach might prevent the patient from esthetic and functional discrepancies that might interfere with the desired, adequate growth

and development leading to functional, occlusal, and esthetic disharmony. The present study, thus, provides useful information and statistics regarding lateral incisor agenesis and helps learn more about the prevalence of maxillary lateral incisor agenesis. The authors emphasize the significance of an early diagnosis and adequate and timely intervention in such cases to prevent or, reduce the number of complications that might affect function and aesthetics.

The strength of the present study was that there was surprisingly little information regarding literature on the prevalence of congenitally missing maxillary lateral incisors and the associated skeletal patterns in any similar study conducted among the Indian population. Orthodontic patients do not necessarily replicate the number of individuals in the population with tooth agenesis, this being dependent on the availability of orthodontic treatment and its uptake in a particular population which could be considered as the major limitation, on the other hand. However, retrospective studies rely on good record-keeping and orthodontic patients often have more complete records.

Conclusion

The prevalence rate for congenitally missing upper lateral incisors in the Orthodontic adolescent population aged 12 to 18 years was found to be 3.77% in the present study while females were found to have a greater percentage of agenesis of the upper lateral incisors (2.8%) as compared to the males (0.9%). Furthermore, 62.16% had bilateral while 16.21% had left unilateral and 21.62% had the right unilateral expression of missing upper lateral incisors based on gender. Moreover, in skeletal class I pattern, a prevalence of 54.16% of bilaterally missing maxillary lateral incisors was found as compared to 40% of the left and 37.5% of the right unilateral expression. In skeletal class II malocclusion, the prevalence of right unilateral expression was found to be 37.5% as compared to 33.33% of bilateral and 20% of left unilateral expression. The highest prevalence of missing maxillary laterals in skeletal class III malocclusion expressed as left unilateral expression was found to be around 40% as against a right unilateral expression of around 25% and bilateral absence of 12.5%.

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Conflicts of interest
There are no conflicts of interest.

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