

ASSESSMENT OF INCISOR CROWDING IN MIXED DENTITION AMONG SAUDI SCHOOLCHILDREN ATTENDING COLLEGE OF DENTISTRY CLINICS AT KING SAUD UNIVERSITY

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ABSTRACT

The purpose of this study was to assess the prevalence of permanent incisor crowding in the maxillary and mandibular arches among Saudi schoolchildren. Three hundred and fifty four dental casts of Saudi schoolchildren attending pediatric dentistry and orthodontic clinics in College of Dentistry at King Saud University in Riyadh, Saudi Arabia were studied by one examiner. The children's age ranged from 7 to 11 years. The children were divided into two age groups: the first group (Group I) comprised of children aged 7 - 9 years (mean age 8 years \pm 4 months) and the second group (Group II) comprised of children aged >9 - 11 years (mean age 10 years \pm 2 months). All measurements were carried out using digital caliper. Descriptive statistics were generated and independent samples t-test was used to compare the data. In Group I, 40.2% of the children had crowding in the maxillary arch, 62.3 % in the mandibular arch; and 30.9% of the children had crowding in both maxillary and mandibular arches. In Group II, 31.4% of the children had crowding in the maxillary arch, 49.5% in the mandibular arch; and 26.4% had crowding in both the arches. The mandibular arch showed significantly ($p < 0.05$) higher degree of incisor crowding compared to the maxillary arch in both groups and in both genders. The prevalence of permanent incisor crowding in both arches was higher in Group I than in Group II. It can be concluded that the prevalence of incisor crowding varies between the dental arches in both genders and age groups.

Key words: Incisor crowding, mixed dentition, Saudi schoolchildren

INTRODUCTION

Recognizing permanent incisor crowding at an early stage is very important for interceptive treatment planning.¹ An increasing number of parents are concerned about the possibility of future dental crowding in their children; most probably due to esthetic reasons.² Dental crowding is defined as a disparity in the relationship between tooth size and jaw size that results in imbrications and rotation of teeth.³ Anterior dental crowding is one of the most frequent types of malocclusion in children; and the chief complaint of many parents.^{4,5}

Several longitudinal studies evaluating dental crowding have been performed in primary, mixed and permanent dentitions.^{3,4,6-9} Melo *et al*² evaluated indicators of crowding in the primary dentition that may lead to future anterior crowding in the mixed dentition stage. They found that the mesiodistal size of the

primary canines, maxillary and mandibular dental arch length as factors in the early mixed dentition that could possibly be indicators for crowding. Dental arch size is an important aspect in the dentition; a smaller dental arch is associated with crowding as are larger teeth.^{3,5-10} When the permanent lateral incisors erupt, an average 1.6 mm of additional space is required for the perfect alignment of the four permanent incisors.^{11,12} This slight crowding has been reported to be solved by a slight increase in intercanine width and labial positioning of the permanent incisors relative to the primary incisors.^{13,14}

Reliable measurements of the human dentition are needed in various disciplines of dentistry. Such measurements are generally carried out on dental casts or directly on the teeth in the oral cavity. Dental casts are still considered a vital diagnostic tool in dentistry.¹⁵ The dental casts facilitates the analysis of tooth size

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and shape, alignment, crowding, spacing and presence or absence of teeth.¹⁶

Available space in the anterior region is at minimum when the permanent lateral incisors have erupted¹¹, but in the subsequent phase, differences in size of deciduous and permanent teeth, and leeway space alleviate anterior crowding temporarily. The counteracting forces such as mesial drift of the permanent molars and/or eruption of the third molars will however prevail and eventually shorten the arches and cause anterior dental crowding. Children with crowding of the deciduous incisors are very likely to be followed by crowding of the permanent incisors.¹⁷ In pediatric dentistry and orthodontics, there is a need to distinguish between young children who will develop future problems of deficiency of space for the maxillary or mandibular incisors and children who only have temporary problems.¹⁸⁻²⁰ Several factors can affect the development and severity of crowding, such as direction of mandibular growth, early loss of deciduous molars, mesiodistal tooth & arch dimensions, oral & perioral musculature in addition to incisor and molar inclination.²¹⁻²³ The determination of the factors contributing to anterior dental crowding, especially in the early mixed dentition stage is of great importance for treatment planning.¹ On the other hand, some authors have correlated tooth size with crowding.^{5,24} Fastlicht²⁵ reported significant correlation between dental crowding and mesiodistal dimensions of mandibular permanent incisors. Norderval et al²⁶ reported that the mesiodistal diameter of four mandibular incisor teeth was significantly larger in adults with slight crowding in the mandibular anterior segment than those with no crowding.

Based on the recent literature search, there is no information available about crowding of permanent incisors in the mixed dentition of Saudi children. Therefore, the aim of the present study was to determine the prevalence of permanent incisor crowding in the maxillary and mandibular arches of 7 to 11 years old Saudi schoolchildren attending pediatric dentistry and orthodontic clinics in College of Dentistry at King Saud University, Riyadh, Saudi Arabia.

METHODOLOGY

Maxillary and mandibular dental casts of 354 Saudi schoolchildren of Arab extraction (176 boys & 178 girls)

attending pediatric dentistry and orthodontic clinics in College of Dentistry at King Saud University were studied by one examiner. The children were randomly selected according to the following criteria:

- Age range from 7 to 11 years.
- Fully erupted permanent incisors and deciduous canines.
- No congenitally missing permanent incisors or premature loss of deciduous canines.
- No loss of tooth dimension by caries or attrition.
- No interproximal tooth abrasion.

The children were divided into two age groups. The first group (Group I) was comprised of children aged 7-9 years and the second group (Group II) of children aged >9-11 years. The measurements were carried out directly on plaster dental casts under neon light. Incisors crowding was measured on the dental casts with a digital caliper (Rocky Mountains Inc., Denver, CO, USA) to the nearest 0.01 mm. The digital caliper has two fine tips to improve the access interproximally (mesio-distally) as shown in figure #1. The degree of crowding was recorded as described by Turkkahraman and Sayin.²⁷ Available incisor space was measured between mesial surfaces of the deciduous canines by dividing the dental arch into two straight line segments on the dental casts. Total incisor widths were subtracted from available incisor space to calculate the degree of the crowding. Incisors widths were measured as described by Hunter and Priest.²⁸ The tips of the digital caliper were inserted from the labial side of each tooth and held incisally parallel to the long axis of the tooth. Then the tips of the gauge were closed until they touched the contact points of the tooth. The dental casts were numbered for the ease of identification. The measurements were done as carefully as possible to avoid any damage on beaks contact.

The data were entered into the computer using Statistical Package for Social Science (Version 16; SPSS Inc., Chicago, IL, USA) and statistical analysis were carried out using the same package. Pearson Correlation Coefficient was used to determine the intra-examiner reliability. The measurements of 25 randomly selected set of dental casts were redone with two weeks interval to determine measurement error.

Descriptive statistics including the mean and standard deviation were calculated. Statistical comparison of incisor crowding between the maxillary and mandibular arches was performed with independent samples *t*-test. The significant level was set at 0.05.

RESULTS

The Pearson Correlation Coefficient showed high measurement reliability ($0.992 < r < 0.996$). Of the 354 selected children whose dental casts were studied; 172 were in Group I (89 boys and 83 girls) with mean age of 8 years \pm 4 months and 182 were in Group II (87 boys and 95 girls) with mean age of 10 years \pm 2 months. The distribution of the subjects examined in the two groups is shown in Table 1. In Group I, 40.2% of the children had crowding in the maxillary arch, 62.3 % in the mandibular arch; and 30.9% of the children had crowding in both maxillary and mandibular arches.

TABLE 1: DISTRIBUTION OF SAMPLE BY AGE GROUP AND GENDER

Age group	Boys	Girls	Total
Group I	89	83	172
Group II	87	95	182
Total	176	178	354

Among Group II; 31.4% of the children had crowding in the maxillary arch, 49.5% in the mandibular arch and 26.4% had crowding in both arches (Table 2).

The prevalence of incisor crowding was higher in the mandibular arch compared to the maxillary arch in both age groups and genders. The occurrence of crowding in both arches at the same time was higher in girls than boys in both the age groups (Table 3).

Among the Group I, the mandibular arch showed significantly ($p < 0.05$) higher degree of incisor crowding (2.78 ± 0.25) as compared to the maxillary arch (1.36 ± 0.15) [Table 4]. In Group II also, the mandibular arch showed significantly ($p < 0.05$) higher degree of incisor crowding (2.31 ± 0.23) as compared to the maxillary arch (1.94 ± 0.19) [Table 4].

Boys in Group I showed significantly ($p < 0.05$) higher degree of incisors crowding in the mandibular arch (2.37 ± 0.23) compared to the maxillary arch (1.48 ± 0.20). Girls in the Group I also showed the same trend (Table 5). Boys in Group II showed significantly ($p < 0.05$) higher degree of incisor crowding in the mandibular arch (1.76 ± 0.21) compared to the maxillary arch (1.58 ± 0.15) and the girls in this group has the same trend (Table 5).

TABLE 2: THE PREVALENCE OF INCISOR CROWDING IN THE TWO AGE GROUPS

Age Group	Incisor crowding maxilla		Incisor crowding mandible		Incisor crowding maxilla/mandible	
	n	%	n	%	n	%
Group I (n=172)	69	40.2	107	62.3	53	30.9
Group II (n=182)	57	31.4	90	49.5	48	26.4

TABLE 3: THE PREVALENCE OF INCISOR CROWDING BY GENDER IN THE TWO AGE GROUPS

Age Group	Incisor crowding maxilla		Incisor crowding mandible		Incisor crowding maxilla / mandible	
	n	%	n	%	n	%
Group I (n=172) Boys (n=89)	29	32.5	49	55	24	26.9
Girls (n=83)	40	48.2	58	69.8	29	34.9
Group II (n=182) Boys (n=87)	24	27.5	39	44.8	20	22.9
Girls (n=95)	33	34.7	51	53.6	28	29.4

TABLE 4: MEANS OF THE MAXILLARY AND MANDIBULAR INCISOR CROWDING IN THE TWO AGE GROUPS

Age Group	Incisor Crowding maxilla				Incisor Crowding mandible				P value*
	Mean (mm)	SD (mm)	Min. (mm)	Max. (mm)	Mean (mm)	SD (mm)	Min. (mm)	Max. (mm)	
Group I	1.36	0.15	0.61	2.20	2.78	0.25	1.64	4.02	< 0.001
Group II	1.94	0.19	0.81	2.76	2.31	0.23	0.98	3.82	0.004

*Independent samples *t*-test

TABLE 5: MEANS OF INCISOR CROWDING BY GENDER IN THE TWO AGE GROUPS

Age Group		Incisor crowding maxilla				Incisor crowding mandible				P value*
		Mean (mm)	SD (mm)	Min. (mm)	Max. (mm)	Mean (mm)	SD (mm)	Min. (mm)	Max. (mm)	
Group I (n=172)	Boys (n=89)	1.48	0.20	0.76	2.20	2.37	0.23	1.64	3.10	< 0.001
	Girls (n=83)	1.24	0.18	0.61	1.87	3.19	0.28	2.36	4.02	< 0.001
Group II (n=182)	Boys (n=87)	1.58	0.15	0.81	2.35	1.76	0.21	0.98	2.54	0.006
	Girls (n=95)	1.16	0.14	1.85	2.76	2.86	0.25	1.90	3.82	< 0.001

*Independent samples *t*-test

Fig 1: The digital caliper with fine tips

DISCUSSION

In recent years, several methods have been proposed for the assessment of crowding. These methods include; the use of a brass wire,²⁴ calipers,²⁹ digitizers and stylus,³⁰ catenometer,³¹ and three dimensional

recording devices.³² The present study utilized a digital caliper. Some authors have noted that the caliper is a reliable method for the assessment of dental crowding.^{28,29} Most previous investigators used plaster casts for the assessment of dental crowding, while few of

them did measurements directly on the teeth.^{29,33} It is worth mentioning that use of plaster casts could give rise to errors due to distortion of the impression material, dimensional changes in the impression material and changes during setting of the plaster. Hunter and Priest²⁸ found that measurements on dental casts were on average of 0.1 mm greater than those of actual teeth. However, Lundstrom³⁴ recorded measurements of six anterior teeth by direct and indirect methods and reported no significant differences between the direct and indirect methods.

The present study showed higher prevalence of maxillary and mandibular incisor crowding than that reported by Keski-Nisula *et al*³⁵ who showed incisor crowding as 11.6 % in the maxillary arch, 38.9 % in the mandibular arch and 8% in both arches in children with early mixed dentition. A study by Da Silva & Gleiser¹⁸ showed mixed dentition mandibular incisor crowding prevalence of 29% in Brazilian children, which is lower than the prevalence shown by the present study in both age groups. Some factors might have contributed to the higher prevalence shown by the present study, such as the sample selection from children referred to pediatric dentistry and orthodontic clinics; that are expected to have comparatively higher prevalence of incisors crowding. Some other factors such as the difference in race and ethnicity as well as the prevalence of caries in the primary dentition among different populations might be considered to contribute in the difference of incisors crowding prevalence. Carious lesions if not detected early and restored, might lead to early loss of deciduous molars which is considered as a factor to affect the development and the severity of anterior dental crowding. As the first permanent molars drift mesially after premature loss of primary molars, they exert a greater force on the anterior segment (incisors and primary canines) subsequently causing a horizontal overlap leading to dental crowding.²⁷ The higher incisor crowding in the study population than in other population might be due to the high prevalence of dental caries among Saudi children.³⁶ As the arch length decreases due to anterior and/or posterior caries lesions, the prevalence of anterior crowding becomes higher.

The present study showed higher incisor crowding in girls than boys, which can be appropriated to early growth spurt in girls that cause significant orofacial

growth leading to early mandibular rotation, which is considered an element in incisors crowding.²³

In the current study there was significant difference in the degree of mandibular incisor crowding when compared to the maxillary arch. The mandibular arch showed a higher frequency of crowding in the both age groups. This is in agreement with the study of Melo *et al*² which revealed that crowding of the permanent teeth especially in the anterior part of the mandible is believed to be the most frequent form of malocclusion in children. The findings of the current study showed that the incisor crowding in both gender was less in the older age group than the younger group. This can be due to a variety of factors including an increase in intercanine width, which is considered a factor in alleviating incisors crowding. Also, distal movement of the primary canines to primate spaces is considered as a factor in alleviating anterior crowding. The present study showed less incisor crowding in the maxillary arch than the mandibular arch in both genders, which is in agreement with findings of Moorrees and Chada¹¹ which revealed that the increase in arch length is confined to maxillary arch, and that also explains why emerging maxillary incisors have sufficient space for their alignment as opposed to mandibular incisors.

While evaluating incisor crowding, it is necessary to consider the influence of intrinsic and extrinsic factors such as race, nutritional characteristics (eating habits) and oral habits (thumb-sucking, tongue thrust, pacifier use and mouth breathing) on the maxillary and mandibular incisor crowding at the mixed dentition stage.

CONCLUSIONS

- Four out of 10 Saudi children in age group 7-9 years had crowding of the maxillary incisors; and six out of 10 had crowding in the mandibular incisors.
- Three out of 10 children in age group >9-11 years had crowding of the maxillary incisors and nearly five out of 10 children had mandibular incisor crowding.
- The prevalence of incisor crowding was higher in the mandibular arch than maxillary in both genders.

- The degree of incisor crowding was significantly ($p<0.05$) high in mandibular arch than maxillary arch in both genders and age groups.

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