

Dental Crowding & Its Correlation to Tooth Size & Arch Dimension : A Review

Dr. Mridul Khanduri
Professor
Dept. of Orthodontics

Dr. Sarika Garg
Reader
Dept. of Pedodontics & Preventive Dentistry

Dr. Shveta Jain
Reader
Dept. of Prosthodontics

Dr. Ashutosh Dixit
Professor
Dept. of Periodontics
Shree Bankey Bihari
Dental College, Gaziabad

Uttaranchal Dental and Medical Research Institute, Dehradun, Uttarakhand

Abstract:

Dental crowding for long has been the main concern of orthodontic fraternity. The part played in its etiology by the different arch dimensions and tooth size has been investigated by many authors from time to time. This article tries to look again into those studies and concludes that tooth size may be the causative factor in dental crowding but not in isolation. Considered along with arch dimensions such as arch width and intercanine width mesiodistal crown dimension contributes in the etiology of crowding.

Key Words : Dental crowding, tooth size, arch size, arch width.

Introduction

Dental crowding has been present since prehistoric times as observed by Mockers and co workers; it is still the most common complaint of patients seeking orthodontic treatment. The alignment of teeth within a dental arch is mainly dependent upon the relationship of tooth size and jaw size. Any imbalance between tooth size and jaw dimension could result in crowding or spacing. Lack of space in dental arch can be a manifestation due to disproportionately large sized teeth or due to a decrease in arch length or arch width or due to a combination of these factors. A perfect alignment of the teeth is possible only when an optimum relationship between these two factors exist.

The part played by these factors on the manifestation of dental crowding is not clearly understood. Many investigators have examined the relationship of arch size and tooth size with crowding. The observations made in these studies are quite conflicting. Lundstorm² and Fastlicht³ found on one hand, a significant relationship of dental crowding with tooth size whereas, Mills⁴ & Howe et al⁵ found a more significant relationship of dental crowding with arch dimensions. Thus, if the role of these factors in dental crowding is understood more clearly it may immensely help in the treatment of such conditions.



Fig. 1 Different Cases of Crowding
Review of Literature

Definition: Dental crowding as described by Nance⁶, is the difference between the space needed in the arch and the space available in that arch that is the space discrepancy. Thus, whenever there is a disparity in the relationship between tooth size and jaw size it manifests itself as crowding or spacing in the dental arches. Several investigators have tried to establish the cause of this crowding and its relationship if any with the jaw size and tooth dimensions. The review of some of the literature pertaining to this is as follows:

The cause of Dental Crowding: Though the cause is still not fully understood. There

are different theories which try to explain the cause of crowding but vary widely among themselves. The factors affecting crowding could be evolutionary, hereditary and environmental factors.

Hooton⁷ while trying to explain the cause of crowding suggested that it may be probably resulting from a evolutionary trend towards a reduced facial skeleton size without any corresponding reduction in tooth dimensions.

Brash⁸ however, considered heredity as one factor of dental crowding. He speculated that crowding may be a result of continued interbreeding between physically dissimilar ethnic groups. He also suggested that environmental factors are an influencing factor in the facial bone growth as is the case with the modern refined diet, which requires less of muscular activity for mastication leading to lesser muscular stimulation hence, the lesser expression of facial bone growth.

Mockers, Aubry and Mafart⁹ in their investigation of 43 prehistoric adult mandibles of archaeological site of Roaix observed that in the prehistoric times crowding was present in hundred percent cases in mandibular anterior region, they concluded the cause to be genetic in nature as tooth size were not seen to be larger in these cases.

Barber⁹ put forward those other environmental factors such as abnormal muscle forces, aberrant paths of tooth eruption, occlusal forces resulting in mesial migration of teeth and loss of arch length through dental caries were the factors responsible for the crowding in dental arches.

Interrelationship of crowding with arch size and tooth size

Lundstrom² investigated the inter-relationship of tooth size, arch size and dental crowding. He did a survey using maxillary study models of 139, 13 year old boys of Sweden who demonstrated varying degrees of crowding in their dental arches and concluded that as the tooth size increases crowding also increased. He also stated that



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arch perimeter decreases as the crowding increases.

Morrees and Reed¹⁰ conducted a study on the mandibular dental study casts of 72, 18-20 year old American females of European stock to examine the source of variation in the alignment of the teeth. They concluded that a lack of association between tooth size and arch size leads to crowding and spacing in the mandibular dentition. They showed that crowding may occur in individuals with less than average tooth size and also in individuals with more than average arch size. Crowding and spacing are the joint product of size of teeth and the size of dental arch thus it is difficult to independently correlate tooth size and arch size to dental crowding.

Mills⁴ studied the inter relationship of arch size, tooth size and dental crowding by conducting a study on 230 male subjects, age ranging from 17-21 years and indicated a significant association between malalignment of teeth and arch width. No relation was demonstrated between the severity of malalignment, and maxillary and mandibular arch length mesial to second permanent molar. The incisor crown diameter also did not vary in persons with and without malalignment.

Bolton^{11&12} reached to the conclusion that a relative difference between the width of maxillary and mandibular teeth may be an etiologic factor in malocclusion. He worked out a tooth size analysis which gives the relationship between the mesiodistal tooth diameters necessary in each jaw for an ideal occlusion.

Fastlicht³ conducted his study on fifty six subjects and measured their mesiodistal diameters of the incisors, the inter-canine width, overbite and overjet and made several correlations. Some of them were

- As the mesiodistal width of the incisors increases the crowding also increases
- There is very little relation between overbite and maxillary crowding.
- As overbite increases mandibular crowding increases.
- As the maxillary inter-canine width increases space increases and thus maxillary and mandibular crowding decreases.

Lavelle¹³ in an examination of dental crowding, age and race found that with age the dental crowding increased for Caucasoid and Mongoloid races. Tooth size was found to be significantly larger in Negroid than in mongoloid races, he also stated that although crowding and spacing are dependent upon the size of the teeth and dental arch, arch size in turn, is affected by jaw size and muscular pressures arising from the tongue, lips and cheeks.

Lavelle¹⁴ studied a total number of hundred and twenty dental study casts having excellent occlusion of subjects in the age range of 18 to 28 years and belonging to different racial groups. The mesiodistal crown diameters and degree of overbite were measured in these casts and the results

suggested that even in patients with good occlusions, tooth size is more highly correlated between maxillary and mandibular dental arches in Negroids as compared with Caucasoid. The measurements of tooth size in different 'Angle' categories of occlusion showed that tooth size may be a factor in the etiology of malocclusion.

Peck and Peck¹⁵ in their study for assessing tooth shape deviations as applied to mandibular incisors stated that, a substantial relationship exists between mandibular incisor shape and the presence and absence of mandibular incisors crowding, and well aligned mandibular incisors have mesiodistal/ faciolingual indices that are significantly lower than those of crowded incisors.

Hunter and Smith¹⁶ studied the relationship of degree of dental crowding to the age. They examined patients at age 9 and again at age 16 and found that the greater the dental crowding at age 9, the less was the arch perimeter decreased by age 16. Furthermore, crowding at age 9 showed a high correlation with crowding at age 16.

Norderval, Wisth and Boe¹⁷ studied the problem of mandibular anterior crowding by comparing a group of 27 adults, having approximately ideal occlusion with a sample of 39 adults with slight crowding in the mandibular segment. Both the sexes were represented in this study. A statistical evaluation revealed that in the latter group the mesiodistal diameter of the four mandibular incisor teeth was significantly greater, whereas the intercanine width and the frequency of third molars were the same in both the groups. A comparison of the craniofacial morphology of the two groups displayed limited differences and only the basal sagittal jaw relationship and the mandibular inclination differed significantly.

Dorris and cowerkers¹⁸ conducted a study for the purpose of comparing mesiodistal tooth width between a group of patients with good tooth alignment and a group of patients with crowded dental arches. The sample size in this study was of 80 subjects and the crowded arches were those which had more than 4mm of space deficiency. By this study the conclusion reached was that the total mesiodistal tooth size was uniformly larger in the crowded arches, certain teeth were in particular found to be larger in the crowded arch group (maxillary lateral incisors, maxillary second premolars, mandibular canines and first and second premolars). There was a low correlation between sex and arch status, but males do have larger teeth, particularly the maxillary central incisors and canines and the mandibular canines and both premolars. This study also found that cases in which, extraction orthodontic therapy was employed showed consistently larger teeth and a greater sum of mesiodistal widths than he group treated on non extraction basis.

Smith Davidson and Gipe¹⁹ in their study of incisor shape and incisor crowding to reevaluate the Peck and Peck ratio reached to

the conclusion that the incisor crowding is correlated with the tooth shape ratios confirming the general observation of Peck and Peck. However, the mesiodistal incisor lengths have slightly higher correlation with the crowding than the shape ratio. Tooth shape ratios are related to crowding because they include the significant measurement of the mesiodistal length.

Adams²⁰ conducted a study in 138 fifteen year old children of which 47 had excellent occlusion and 91 had crowding of teeth and Angle class I malocclusion, in order to make a comparison in respect of face size and shape and tooth size. Girls' faces were found to be on average significantly smaller than boys, whether the teeth were well arranged or were crowded. Girls' total tooth substance was on an average significantly smaller than boys and it was also found that boys and girls with crowded teeth had a larger mean total tooth size than boys and girls with well arranged teeth.

Howe, McNamara and O'Connor⁵ conducted a study in order to investigate the extent to which jaw size and tooth size each contribute to dental crowding. Two groups of dental study casts were used in this study, one group consisted of 18 males and 32 females exhibiting gross dental crowding and the second group consisted of 24 males and 30 females exhibiting little or no crowding. Between these two groups the mesiodistal tooth diameters, dental arch perimeters and buccal and lingual dental arch widths were measured and compared, the two groups could not be distinguished on the basis of tooth dimensions, but the arch dimensions of crowded group were smaller than the non crowded group. Thus they concluded that dental crowding was associated with smaller dental arches rather than large teeth.

Stanley, Stunts and Paterson²¹ conducted a study on 75 subjects and reached to the conclusion that the subjects with normal occlusion had larger maxillary molar widths, maxillary canine widths and maxillary alveolar widths than subjects with mal occlusion.

Radnzcic²² investigated on 120 pairs of dental casts from two different ethnic groups, to determine the correlation among cumulative mesiodistal tooth dimension and different arch dimensions and concluded that in both ethnic groups there were very significant correlation between certain arch dimensions and the degree of crowding. There was no significant correlation between cumulative mesiodistal crown widths and dental crowding when considered in isolation. In combination with other parameters however, cumulative mesiodistal crown widths contributed significantly to the dental crowding.

Eduado, Cert, Karla and Carlos²³ in their study used 13 dental casts of crowded and 33 spaced o male individuals and 43 crowded and 27 spaced of female individuals. They measured tooth width and Bolton analysis was applied to calculate the tooth width ratio

and compared the measurements. They observed no significant clinical difference (less than one mm) in other the groups.

Eduardo and Carlos²⁴ conducted a study on dental casts of 200, 12-16 year old school children and measured mesiodistal and buccolingual dimension of all permanent teeth except second and third molars and compared the measurements with moderate mild and non crowded arches. They concluded that buccolingual dimensions do not vary in deferent group of arches whereas mesiodistal dimensions were deferent in crowded and non crowded arches.

Agenter, Harris and Blair²⁵ studied the tooth size arch size discrepancy and its relation to mesiodistal tooth size .they measured 42 normal occlusion and 92 with malocclusion. They observed that only the m-d dimension of maxillary lateral incisor was different in the two groups thus they concluded tooth size is not necessarily the foremost cause of malocclusion in a patient.

Puri N, Pradhan KL, and co workers²⁶ in their study used 240 orthodontic study casts of crowded, spaced and normal dentition groups and they concluded that MD crown dimension of individual teeth was larger in crowded arch compared with normal dental arches.

PR Begg²⁷ in his historic observation stated that the non crowded arches of Australian Aborigines were due to severe proximal wear present in these populations. Thus concluding smaller tooth size is related to non crowded dentition.

Summary

As observed through the review, dental crowding has since prehistoric times been present¹, and, genetic and environmental factors^{1,7,8,9} have contributed it to become one of the most prevalent malocclusions today. Crowding or arch length discrepancies are the main complaints for which orthodontic treatment is required.

Mesiodistal crown length have been considered to be the main cause of crowding^{2,3,13,14,15,17,20}, on the other hand it has also been observed arch size to be a major contributing factor for dental crowding^{4,5,22}, as smaller arch size provides lesser amount of space for the available tooth material leading to crowding in dental arches. But seeing the literature it can also be clearly observed that tooth size and arch length when not in harmonious relationship leads invariably to

crowding or spacing in the dental arches¹⁰.

Many more investigators have observed that space problems are frequent in the dental arches^{29, 30, 31, 32}. The space discrepancy in the permanent dentition may be caused by many etiologic factors or by their combination such as mesial migration of the permanent teeth after early extraction or extensive caries in the deciduous dentition, third molar eruption and discrepancies between tooth size and jaw size.

Tooth size² has long been considered as the etiologic factor for the space discrepancies and it has also been observed that tooth size discrepancies between maxillary and mandibular teeth may cause malocclusion^{10,11,33,34}.

Thus after seeing the literature it is clear that conflicting evidence exists in general, regarding the cause and the part played by the tooth size and arch dimension in the development of dental crowding. Thus further investigations are required to clear this situation.

Conclusion

It can be thus concluded from the review

- Mesiodistal width of the teeth is directly related to the crowding in the arch.
- Arch length and arch width is inversely related to crowding.
- In isolation these parameters may sometimes not show a significant correlation.
- Together arch length and tooth size are the major cause of crowding in dental arches.

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