ORIGINAL ARTICLE

Relationship of Dental crowding with Mesiodistal Crown Diameters and Arch Dimension

S. Sadeghian
Dept. of Orthodontics, Islamic Azad University, Isfahan (khorasgan branch)
N. Esnaashari
Dept. of Orthodontics, Islamic Azad University, Isfahan (khorasgan branch)
N. ghoreishi
DDS. Dentist

Background and aim: The objective of this study is determining the correlation among the dental crowding and mesiodistal tooth width and dental arch dimensions.

Materials and methods: In this case-control study dental casts of two groups of 40 subjects was investigated. Each group included 20 male and 20 female subjects with the age range of 17 to 25 years old.
The first group had class I malocclusion with nominal or no crowding. (space deficiency ≤ 4).
The second group had class I malocclusion with significant crowding. (space deficiency ≥ 4).
The following parameters were measured and compared in both groups:
The sum of mesiodistal tooth width, arch length in canine and molar spaces and arch perimeter. In order to compare the two group independent t-test with 95% confidence was applied.

Results: In lower arch a significant difference was detected in both tooth size (P=0/02) and arch dimensions. The group with the significant crowding has smaller arch dimension and larger tooth size in comparison to the group with no crowding.
In the upper arch a significant difference in intercanine width (P=0/01), arch perimeter (P=0/023), arch length (P=0/012), and intermolar width (P=0/03) was detected.

Conclusion: The results of this study indicated that in upper arch the arch dimensions plays a significant role in crowding, and in the lower one both tooth size and arch dimensions have important role in crowding.

Keywords: Dental arch, Malocclusion, Tooth crown.

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Corresponder:N.Esnaashari
Dept. of Orthodontics, Islamic Azad University, Isfahan (khorasgan branch)

Introduction

Dental crowding is certainly the most common dental malocclusion of the present time [1]. Dental crowding is due to lack of coordination between the tooth size and arch dimensions which results in positioning the teeth on each other or rotate of the teeth in dental arch [2]. In other words when there is space deficiency for alignment of the teeth in dental arch, the teeth suffer from rotate , dislocated eruption, or delayed eruption and crowding occurs [3].

Variety of theories described the effect of the environmental and genetic factors on dental arch dimensions (width, length, and jaw arch perimeter). [4]

mesiodistal tooth width is also affected by genetics, race, and sex. [5] As indicated, teeth in males are larger than females. [6]

Usually the most prevalent malocclusion in mixed dentition is described with crowding. Most of the patients are referred to the dentistry specialists due to dental protrusion or shortage of enough space for eruption of permanent teeth.[8]

Through investigating the spaces of the patients in all ages, in the case with space deficiency, there will be two possibilities: maxillary and mandibular teeth are positioned directly on the bone but are rotated lingual or labial. In this case, crowding occurs truly and is not deniable. Another possibility is relative or complete alignment of the teeth with space deficiency with the cost of displacing the lips forward and dislocation in the rest position. This case is diagnosable in side-view examination. [1]

In 1983, McNamara et al studied the correlation between dental crowding and size of the teeth and dental arch dimensions. The case group includes 50 pair of casts with severe crowding and the control group includes 54 pair of casts without crowding or with minimum crowding. No meaningful difference between the two groups was detected in terms of size of the teeth. The main difference between the two groups was in their dental arch dimensions; this amount is smaller for the case group in comparison to the control group. [2]

Radnzic et al conducted a study in 1988 to compare the relationship between the dental arch crowding and mesiodistal crown widths in two Pakistani and Britain races. The result of this study indicated that in both ethnic group there is a significant correlation between arch dimensions and the degree of crowding. However, there is no significant correlation between cumulative mesiodistal crown widths and dental crowding. [9]

A study conducted by Sayin showed that mandibular deciduous intercanine widths, mandibular deciduous intermolar width, mandibular permanent intermolar width, , mandibular interalveolar width, space available for the mandibular permanent incisors, and total arch length are significantly larger in non-crowding group compared with crowed group, but no significant correlation detected between total arch length and crowding. [10]

Another study was conducted by Soosan Alkhateeb et al investigated the tooth size discrepancies and arch paramenters among different malocclusion in a Jordanian sample and concluded that there is no significant difference between Bolton ratios for 6 anterior teeth and 12 teeth in different malocclusions. But arch dimensions have significant differences in different malocclusions. [11]

In 2005, Bernabe et al investigated intra-arch factors, effective in permanent crowding in 150 cast pairs (three cast groups with sever crowding, medium crowding, and spacing) of students with the age range of 12-16 years old and came to the conclusion that mesiodistal tooth sizes, intermolar jaw arch width, and jaw arch length are effective in crowding, but jaw arch length is one of the most important factors in crowding. [3]

In 2007, M. Poosti et al studied the Tooth size and arch dimension in uncrowded versus crowded Class I malocclusions.They concluded that there is a meaningful difference between the two groups in both tooth diameters and transverse arch dimensions. They reported that in crowded group maxillary arch width is smaller and sum of mesiodistal tooth sizes is larger than non-crowded group. [4]

In 2007, Navgeet Puri et al studied the dental mesiodistal width in normal condition (without crowding or spacing), crowded condition, and spacing condition. In each group they investigated the difference between mesiodistal tooth size and arch length and

concluded that mesiodistal tooth width is larger in crowded group in comparison to two other groups. [5]

In 2012, Othman et ai conducted astudy toexplore how many millimeters of tooth size discrepancy (TSD) are clinically significant, to determine what percentage of a representative orthodontic population has such a tooth size discrepancy, and to determine the ability of simple visual inspection to detect such a discrepancy. They concluded that2 mm of required tooth size correction is an appropriate threshold for clinical significance. A significant percentage of patients have a TSD of this size. Visual estimation of TSD has low sensitivity and specificity. Careful measurement is more frequently required in clinical practice than visual estimation would suggest.[12]

Therefore, in order to come to a rational and logical conclusion for choosing an appropriate treatment method as well as maintaining the treatment, recognition of the etiologic factors and the main factor which causes essential crowding. [7]

So,the perpose of this study was to determine the correlation among the dental crowding and mesiodistal tooth width and dental arch.

Material &Methods

In this analytical study the control group included 40 dental cast pairs (20 male and 20 female) with nominal or no crowding which were from students of dentistry department of Khorasgan University.

The casts of the case group included 40 dental casts (20 male and 20 female) with significant crowding (space deficiency more than 4 mm) which were taken from private orthodontists' offices in Isfahan. All subjects were in the age range of 17 to 25.

In all subjects existence of all permanent teeth except for 2nd and 3rd molar in dental arch was necessary as well as having no record of orthodontic treatment and for the case of molar relation it should have been class I.

In this study sum of mesiodistal tooth width, intercanine and intermolar arch width, arch length, and arch perimeter in each jaw were calculated.Sum of mesiodistal tooth width is measured through adding mesiodistal width of all individual teeth in arch including the 1st permanent molar. measurement was done by use of a collice (1108-150 ,Insize.co,chine) with precision of 0.5 mm. in order to perform this measurement the collice was located on dental proximal in the position with highest mesiodistal width in a way that if a surface traverses over the collice it will be parallel to occlusal plan. All measurements were done twice and the average was calculated.(13)

Intercanine arch width was determined through measuring the maximum distance between distal surfaces of lateral teeth in surrounding position of the gingival in each arch. (13)

Intermolar arch width was measured through calculating the distance between two palatal grooves of the 1st permanent molars in surrounding position of the gum of each jaw. In lower jaw this measurement was done from lingual groove of the 1st permanent molar. (13)

The arch length is equal to the length of the line which stats from the junction between two permanent central teeth and is vertical to the line joining the distal surface of the 1st permanent molars.(13)

In order to measure the arch perimeter, dental arch was divided into a number of sections which were almost straight and in one line from permanent 1st molar distal. arch perimeter was sum of the sizes of the mentioned sections in each arch.(14)

In order to compare each of the variables like sum of dental mesiodistal widths and arch dimensions (width, length, jaw arch perimeter) between the two groups i.e. crowded and non-crowded independent t-test was applied and the data were analyzed by use of SPSS.

Results

Table 1 and 2 show the mean + SD of the measured parameters in upper and lower archs for two group under study.Statical comparision indicated that there is no significant difference between the sum of mesiodistal widths in the two groups under study for the upper arch(Pv=0.13).

The independent t-test demonstrated that there is significant difference between arch perimeter (Pv=0.023), inter-molar width (Pv=0.03), and

intercanine width (Pv=0.01) in the two groups under study for the upper arch.

In addition, the independent t-test indicated that there is significant difference between the arch lengths in the two groups under study for the upper arch(Pv=0.012).

Comparison of the average of the measured parameters of the lower arch by use of independent t-test for the two groups under study indicated that there is significant difference between arch perimeter (Pv=0.018), inter-molar width (Pv=0.005), and intercanine width (Pv=0.01) in the two groups under study for the lower jaw.

In addition, the independent t-test indicated that there is significant difference between the arch lengths in the two groups under study for the lower arch(Pv=0.001).

Discussion

In order to achieve a rational and plausible result in regard to selection of an appropriate treatment method for tooth size-arch size discrepancy which is manifested in the form of crowding in clinics, detecting the etiology and the main cause of the crowding is necessary.

In this regard, and regarding the variety of results have been taken in different studies about etiological cause of crowding, the researcher decided to compare the size of the upper and lower teeth and arch in patients with crowding and without crowding.

The findings of the present study indicated that in the two groups under study, the average mesiodistal tooth width in upper arch shows no significant statistical difference (pv=0.13). This is in line with the findings of Radzic et al (1988), McNamara (1983), and Soosan Alkhateeb et al (2005). [9][2][11]. However, Nawling Poori et al (2007) and Bernabe et al (2005) came to the conclusion that in addition to the size of arch, mesiodistal width showed meaningful statistical difference in two groups which is a sign of larger tooth width in crowded group. [5][3] .

Regarding the role of heritage and race in determining the size of the teeth, the differences in the results of different studies can be attributed to ethnic and racial differences.

The findings of the present study indicated that there is a significant statistical correlation between upper arch intercanine widths of the two groups under study. In other words, upper arch intercanine width of the crowded group is smaller than the intercanine width of the non-crowded subjects (Pv=0.01). this is in line with findings of McQueen, McNamara, Radnizc, and Soosan Alkhateeb [2][9][11]. These findings are however contradictory to the results of the studies done by Nawgin Poori et al and Bernabeh et al (they considered the intermolar width as the mere effective factor) [5][3]

Upper arch intermolar widths in the two groups under study showed a significant statistical difference (Pv=0.03). this is in line with the studies done by Poosti et al and bernabe et al. [5][3]

The present study demonstrates that arch length has a meaningful statistical difference in the two groups under study (Pv=0.01). This is in line with the findings of Bernabeh et al who considered the arch length as one of the most effective factors in crowding. [3] In addition, Home, Howe& McNamara, and poosti et al came to similar results. [15] [2][4]However, findings of the studies done by Nawgit Poori, Bernard, and Vish demonstrate a more important role for mesiodistal width

Regarding the arch perimeter, findings of this study indicates that this factor plays a role in upper jaw crowding (Pv=0.02). This is in line with the studies of Soosan Alkhateeb, McNamara, Radnzic. [11][2][9]

Majority of the studies done in this regard mentioned the effect of arch dimensions in upper arch crowding and almost all of them are in agreement with each other. However, there is not such an agreement about the mesiodistal tooth width.

Contrary to the upper arch, in the case of lower arch mesiodistal tooth width, findings of the present study indicated significant statistical difference in this regard (P=0.02). This is in line with the findings of Nawgit Poori et al, Poosti et al, and Bernabe et al. [5][3]

In regard to the lower arch dimensions (perimeter, intermolar and intercanine widths, and lower arch length) the findings of the present study demonstrated that there is significant statistical differences between the two groups under study which is in agreement with the findings of McNamara and Radnzic. [2][9]

It is recommended that in a study, the parameters measured for subjects with spacing is investigated in normal subjects and subjects with significant crowding in class I malocclusion. Also Bolton ratios can be studied in groups mentioned above.

Table 1: Meant± SD of the Meascred puramecers in upperarch

P – value	Minimum	Maxinum	Mean ± SD	group	Paramecers
0.23	86	102.5	3.63±93.55	Space deficiency≤ 4	Arch perimeter
	80	101	5.94±90.73	Space deficiency>4	
0.03	28.5	40	2.30±34.97	Space deficiency≤ 4	Intermolar width
	28	38.5	2.65±33.78	Space deficiency>4	
0.01	21	27.5	1.35±24.21	Space deficiency≤ 4	Intercanin width
	20	26	1.68±23.32	Space deficiency>4	
0.012	30	38	1.75±33.94	Space deficiency≤ 4	Arch length
	28	36	2.13±32.82	Space deficiency>4	
0.13	87.5	105	3.80 ±95.38	Space deficiency≤ 4	Mestodistal tooth width
	85	106	5.57±96.86	Space deficiency>4	

Table 2: Meant ±SD Measured parameters in lower arch

P – value	Minimum	Maxinum	Mean ± SD	group	Paramecers
0.018	79.5	96	3.86± 86.00	Space deficiency≤ 4	Arch perimeter
	75.05	93	4.36±83.85	Space deficiency>4	
0.005	26.5	38	2.43± 33.33	Space deficiency≤ 4	Intermolar width
	28	37	2.24±31.82	Space deficiency>4	
0.01	16.5	21.5	1.24±18.68	Space deficiency≤ 4	Intercanin width
	14	26	2.02±17.72	Space deficiency>4	
0.00<	26.5	34.5	1.78±30.39	Space deficiency≤ 4	Arch length
	19	33	2.74±27.88	Space deficiency>4	
0.02	79.5	97	3.93±87.94	Space deficiency≤ 4	Mestodistal tooth width
	81	99	4.59±90.11	Space deficiency>4	

Conclusion

Clinical implications of these findings are important in treatment planning for the cases of crowding in dental arches. A number of the researchers states that crowding can be treated by expansion of arch dimensions. However, others tend more to decreasing the tooth mass and believe that treatment through expansion of arches is not stable. Findings of the present study suggest the treatments through arch expansion especially in the upper arch.

However, in lower arch, regarding the effect of the size of the teeth in crowding and limitations of this arch(absence of middle suture), decreasing the tooth mass is worth more attention.

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