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Research Article

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Studying the relationship between inside-arch and dimensional indices with clinical crowding in the permanent teeth system of the Iranian race

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ABSTRACT

Introduction*: Irregular and protruding teeth have been posed as a problem for man since very long time ago, which have had devastating effects on beauty, function and occlusion of dental system. Meanwhile, dental crowding is considered as the most common type of malocclusion and one of the potential factors causing form and function imbalance in dental arches and distorting facial beauty. Therefore, this study was conducted to determine the relationship between inside-arc and dimensional indices of arch and clinical crowding frequency in mandible and maxilla permanent teeth in the Iranian race.* ***Materials and methods:*** *213 study casts were selected based on the following criteria among patients referred to the Orthodontics Department of Isfahan Dental School, including 97 high casts and 116 low casts. Then, inside-arc and dimensional indices of arch were calculated for each jaw. In addition, the inclusion criteria for each sample were considered based on the following criteria.*

1. All patients who were in the permanent dentition period and all the permanent teeth were available from the molar 1 of one side to the molar 1 of the other side in each maxillary arch.
2. The patients who had no orthodontic treatment experience
3. The casts that had no fracture in terms of quality so that the error rate to be reduced as possible
4. Lack of wide proximal fillings, abrasion, and decay
5. Lack of dental anomalies such as extra or missing tooth

Using Spearman statistical analysis, the relationship between the mentioned indices and crowding was obtained in each of three groups. ***Findings:*** *A significant relationship is observed between the degree of crowding and the specified indices, which can be seen in the Table 2. In addition, based on this analysis, the crowding increased with the increase in mesiodistal width of the tooth in both jaws (direct relationship), while crowding decreased as distance between inter-canine and inter-molar increased in the upper jaw. By increasing arch perimeter in both jaws, crowding reduced.* ***Discussion and conclusion:*** *According to the Spearman correlation coefficient, mesiodistal width of the teeth had the highest correlation with crowding among the inside-arch indices, and arch perimeter had the highest correlation with crowding among the dimensional indices of arch. In addition, comparing inside-arch and dimensional indices of arch, showed that arch perimeter had the higher relationship (P = 0.01) with crowding compared to other indices in both jaws. However, as such relationship was found in mesiodistal width of some teeth, but not in all of them, it seems that arch perimeter is more effective factor than Mesiodistal width.*

Keywords*: inside-arch, dimensional indices, clinical crowding*

INTRODUCTION

Irregular and protruding teeth have been posed as a problem for man since very long time ago that have had devastating effects on beauty, function and occlusion of dental system. Therefore, in orthodontics, we are trying to minimize this problem in order to find a balanced level of occlusion, function, and beauty. Meanwhile, dental crowding is the most common type of malocclusion (1) and one of the potential factors causing form and function imbalance of dental arches and distorting facial beauty. Crowding is the difference between the required space in dental arch and the available space known as *space discrepancy*. Therefore, crowding or *Spacing* can be explained as a change in the $\frac{tooth}{\text{tissue}}$ proportion or *dentoalveular* disproportion (2).

Although many researchers have considered evolutionary, genetics, and environmental factors effective in creating crowding, its causes and the way it is created are still unknown. For example, a group of scientists believes that the importance of environmental factors such as soft diet and reduced arc length caused by decay has been greater than genetic factors, especially when various groups of races are also considered (3).

Hootan suggested that crowding might be the result of reduction in face dimensions without decrease in the size of the teeth. (4) In another study conducted by David Normando et al, it was suggested that genetic factor plays greater role in dental crowding. (5) Mesiodistal dimensions of dental crown are important factor affecting the dental order in the arch and occlusion evolution during dental system transmission. (6) Msislam found the same results and realized that there is a significant relationship between crowding of anterior teeth arch and mesiodistal width of maxilla and mandible permanent incisors (7).

In total, according to studies cited, although there are diverse and sometimes controversial views on the effect of each of inside-arc and dimensional factors of arch in crowding, it seems that dimensional factors of arch play more effective role in this regard. Identifying the factors that have higher correlation with crowding contributes greatly in determining the therapeutic plans. This means that if the arch dimensional factors have a greater role, the therapeutic plan will use the techniques that increase the arch dimensions rather than the techniques that reduce the width or number of teeth and vice versa.

Crowding is one of the main multi-factorial problems in orthodontics and has a relatively high prevalence among communities. Therefore, conducting different studies in various ethnic groups to determine the severity of crowding and to identify effective factors involving in its creation seem to be necessary in order to provide efficient treatment plan.

Therefore, this study was conducted to determine the relationship between inside-arch and dimensional arch indices and clinical crowding frequency in mandible and maxilla permanent teeth in the Iranian race.

Materials and methods: 213 study casts were selected based on the following criteria among patients referred to the Orthodontics Department of Isfahan Dental School including 97 high casts and 116 low casts.

The inclusion criteria of the study included as follows:

1. All patients who were in the permanent dentition period and all the permanent teeth were available from the molar 1 of one side to the molar 1 of the other side in each maxillary arch.

2. The patients who had no orthodontic treatment experience

3. The casts that had no fracture in terms of quality so that the error rate to be reduced as possible

4. Lack of wide proximal fillings, abrasion, and decay

5. Lack of dental anomalies such as extra or missing tooth

The casts were divided into three groups of quality based on crowding degree as shown in the following table.

Table 1

crowding degree	severe	moderate	without crowding
upper maxilla	32	31	34
lower maxilla	41	41	34

Classification system of crowding in this study is as follows:

1. The arches with space shortage of 5.1mm or more were considered as severe discrepancy

2. The arches with a space shortage of more than 0.1mm and less than 5 mm were considered as the moderate discrepancy

3. The arches with no shortage of space or Spacious were considered as the arches without crowding.

Measurement method

Research findings were measured as follows:

The most mesiodistal width of each tooth in each arch was calculated from mesial anatomic touch point to distal anatomical contact point by a digital caliper with precision of 0.01mm (Caliper vernier). The crown ratio of canine tooth $\frac{MD}{BL}$ was the ratio of the most mesiodistal width of canine to its most buccolingual width of which the mesiodistal width was performed as described above. To calculate buccolingual width, the maximum distance between buccal and lingual surfaces of canine tooth was measured by caliper.

Inter-canine width as the distance between the highest point of incisal edge of canine tooth in one side to the same point in canine in the other side was measured by caliper. The inter-molar distance as the distance between tooth central fossa of the first molar in one side to the tooth central fossa of the first molar in the other side was measured by caliper.

Width ratio was obtained by numerical division of inter-canine distance of each arch into its inter-molar distance. A*rch perimeter* using *Brass wire* was calculated so that one end of the wire at mesial contact of the first molar of one side of the arch was passed through the central groove of the occlusal surface of the premolars, and canine incisal edge, and incisor and it was stretched to the mesial contact of the first molar in the other side. Then, we made the wire straight and the distance between those two points was measured by a ruler.

Findings

As the crowding degree was measured as ratings, the Spearman correlation coefficient was used to investigate the relationship between inside-arc and arch dimensions' factors and crowding degree.

A significant relationship is observed between crowding degree and the specified indices that the results are shown in the following table.

Table2

Mesiodistal tooth size	r	Mesiodistal tooth size	r	Mesiodistal tooth size	r	Mesiodistal tooth size	r
MD1MXR	-.399**	MD4MXR	-.177	MD1MNR	-.437**	MD4MNR	-.173
MD1MXL	-.361**	MD4MXL	-.209*	MD1MNL	-.453**	MD4MNL	-.252**
MD2MXR	-.282**	MD5MXR	-.287**	MD2MNR	-.487**	MD5MNR	-.241**
MD2MXL	-.327**	MD5MXL	-.207*	MD2MNL	-.451**	MD5MNL	-.184*
MD3MXR	-.027	MD6MXR	-.271**	MD3MNR	-.292**	MD6MNR	-.074
MD3MXL	.090	MD6MXL	-.233*	MD3MNL	-.327**	MD6MNL	-.132

MD:Mesiodistal tooth size Mn:Mandible Mx:Maxilla R:Right L:Left

Additionally, based on this analysis, the crowding increased with the increase in mesiodistal width of the teeth in both jaws (direct relationship), while the crowding decreased with increasing the distance between inter-canines and inter-molar in upper jaw. In the case of arch perimeter, crowding reduced in both jaws as it increased.

Table3

Dimensional factors	r	Dimensional factors	r	Dimensional factors	r
INTERCMX	.227*	WIDTHRMX	.022	CCPMXR	.031
INTERCMN	-.006	WIDTHRMN	-.076	CCPMXL	-.070
INTERMMX	.255*	ARCHPMX	.427**	CCPMNR	.061
INTERMMN	.095	ARCHPMN	.379**	CCPMNL	.119

Inter C: Intercanin width Inter M: Intermolar width Width R: Width ratio Arch P: Arch perimeter CCP:Canine crown proportion

Discussion

The results show that mesiodistal width of the teeth had the direct correlation with crowding among the inside-arch indices, and arch perimeter in both jaws, and inter-canine and inter-molar width in upper jaw had the reverse correlation with crowding among the dimensional indices of arch.

In 2005, Eduardobernabe and Carlosflores-mir found in their research that the mesiodistal width and crown ratio of the teeth are directly correlated to crowding, while their buccolingual width did not show a significant difference among three groups of crowding. Their results were in line with results of our study. Additionally, among dimensional indices, only inter-molar width and Arch perimeter were different among the three groups, and finally they concluded that the most important factor associated with crowding is Arch perimeter. However, in this study, the inter-canine and inter-molar width showed significant relationship and only in upper and arch perimeter showed a significant relationship in both jaws (8)

In a study conducted by Bugaighis on the Lebanese population, it was found that increasing mesiodistal width of the teeth has a direct impact on dental crowding. (9) Bernard and Doris showed that mesiodistal width of the teeth has a significant relationship with the severity of crowding and this result is in line with result of the present study. (10)

However, Lundstrom and D.Radnzic did not find any significant relationship between mesiodistal width of the teeth and crowding degree in their research.

Hossein also showed that mesiodistal width of the teeth has no significant relationship with the severity of crowding (6) while this relationship was significant for some teeth in this study. (11, 2)

Millis (1964) and SYED SHAZIL HUSSAIN (2014) found a significant relationship between crowding and width of the arch in their study. (12, 13) Howe found in his study that statistically the groups with and without crowding cannot be distinguished from each other on the base of mesiodistal width of the teeth, which it is in contrast with results of the current study. (14)

Conclusion

According to the Spearman correlation coefficient, mesiodistal width of the teeth had the highest correlation with crowding among the inside-arch indices, and arch perimeter had the highest correlation with crowding among the dimensional indices of arch. In addition, comparing inside-arch and dimensional indices of arch, showed that arch perimeter had the higher relationship ($P = 0.01$) with crowding compared to other indices in both jaws. However, as such relationship was found in mesiodistal width of some teeth, but not in all of them, it seems that arch perimeter is more effective factor than Mesiodistal width.

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