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The facial profiles, occlusal plane relationships, and dental spacing in children aged 3-6 years

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ABSTRACT

Background: The primary dentition is the basis for predicting the occlusion of the permanent dentition. Accordingly, the present study was set to investigate the facial profiles, occlusal plane relationships, and dental spacing of children aged between three to six years in Hamadan, Iran.

Methods: This cross-sectional study was conducted on 400 children (54.5% boys and 45.5% girls) aged 3-6 years. The prevalence of facial profiles, occlusal plane relationship, and primate and developmental spacing in the dental arches of the children were determined according to standard criteria. The Chi-square test was used to investigate the difference between genders.

Results: The most prevalent occlusal molar relationship was flush terminal plane (55.5%). Moreover, the most prevalent type occlusal relationship of primary canine was observed to be class I. Most participants had a normal overjet and overbites, and the convex facial profile was the most prevalent one observed in the present study. The primate and developmental spacing in the dental arches of the participants were satisfactory.

Conclusion: This study showed FTP and the class I was the most molar and canine relationships respectively in Iranian children as well as many other populations. The majority of the children had a convex facial profile.

KEY WORDS: Dental occlusion, Primate Space, Developmental space, Facial profile, Primary dentition.

1. INTRODUCTION

Nowadays, it is well accepted any abnormality or disorder in the growth and development of the primary teeth can lead to orthodontic disorders and malocclusion in the succeeding permanent teeth (Infante, 1975). The occlusal relationships of primary teeth and the presence/absence of various types of malocclusion including overbite or overjet, crossbites, and also interdental spacing are some determining factors of occlusal condition of permanent dentition in future (Dean, 2011).

The location of primary teeth in the dental arch and their occlusal relationship in children completely developed up to the age of three years and normally would not change until the age of six years. However, some factors such as interdental carries, restoration, or pulling can alter the occlusal relationships of teeth (Proffit, 2014). The distal surface of primary second molar is the key guide in predicting the dentition pattern of permanent first molars which are the most important teeth determining the occlusal condition of individuals in the future, so the assessment of these surfaces would enable us to predict if individuals have orthodontic problems in future. In addition to primary second molars, occlusal relationships of primary canines also are helpful in this regard. By considering the occlusal relationships of primary teeth and monitoring the transition period from losing primary teeth to replacement of them by permanent teeth, many of malocclusion can be prevented by simple orthodontic interventions in the cases that any abnormality has identified in those periods.

Primate spaces in maxilla are normally located between the lateral incisors and canine, whereas in mandible, these spaces are located between canines and first molars. These spaces alongside developmental ones naturally are present from when the teeth started to grow. Developmental spaces are also of high importance in the positioning of permanent incisors (Proffit, 2014).

In the other hand, the facial profile of a child is indicative of the growth pattern of his/her craniofacial skeleton. Facial profile are categorized it three group; concave, convex, and straight.

Being aware of this growth pattern would help us to decide on the need for adopting preventive orthodontic treatment.

Accordingly, the present study was set to investigate the facial profiles, occlusal plane relationships, and dental spacing of children aged between three to six years in Hamadan, Iran.

2. MATERIAL AND METHODS

Participants of the study: This cross-sectional study was carried out in Hamadan, Iran, during 2013-2014. The participants of the study were 400 children who aged between three and six years. They were selected based on the random cluster sampling from twenty kindergartens located in Hamadan, Iran during 2014. The children were included if; they were aged between three to six years, they had no impacted tooth, all of their primary teeth were

healthy and caries free, they cooperated well during the examination, and they were healthy children without any particular disease. Moreover, they were excluded from the study in the following situations; if any of their permanent teeth had begun to grow, if they lost any of their primary teeth, the cases with orthodontic or other dental treatments, and the cases with an asymmetric occlusion. The participants were composed of 218 boys with the average age of 5.01±1.126 and 182 girls with the average age of 4.75±1.03.

Variables of the study: Age, sex, primary molar occlusal relationship, primary canine occlusal relationship, overjet, overbite, primate space, developmental space, and the shape of the facial profile were the variables investigated in the study. They were measured using equipment such as tongue depressor, disposable dental mirror, and intraoral caliper.

The occlusal relationship of primary second molar: three relationships were used in assessing this variable (Yilmaz, 2006),

a) Flush Terminal Plane (FTP); the distal surfaces of primary second molars of mandible and maxilla are positioned in line with each other.

b) Distal Step (DS); the distal surface of the mandibular primary second molar is located posterior to the distal surface of the corresponding tooth of maxilla.

c) Mesial Step (MS); the distal surface of the mandibular primary second molar is located anterior to the distal surface of the corresponding tooth of maxilla.

The occlusal relationship of primary canine: according to the occlusion of the primary canines, this relationship has three states, as follows (Yilmaz, 2006),

a) Class I: The cusp tip of the mandibular primary canine is positioned in line with the cusp tip of maxillary primary canine.

b) Class II: The cusp tip of the mandibular primary canine is located posterior to the cusp tip of the corresponding tooth of maxilla.

c) Class III: The cusp tip of the mandibular primary canine is located anterior to the cusp tip of the corresponding tooth of maxilla.

Overjet: this variable was evaluated by measuring the horizontal distance between upper and lower incisors in the centric occlusion position. The variable has four states;

a) Normal overjet; the distance is in the range of 2- 3 mm,

b) Decreased overjet; the distance is lower than 2 mm,

c) Increased overjet; the distance is higher than 3 mm, and

d) Reversed overjet; the upper incisors are located behind the lower ones.

Overbite: the state of the variable was determined by measuring the vertical overlap of upper incisors on the lower ones. Based on the amount of overlap, the variable has four states;

a) Normal overlap: the vertical overlap is equal to 2 mm,

b) Decreased overlap: the vertical overlap is lower than 2 mm,

c) Deep bite: the vertical overlap is higher than 2 mm,

d) Open bite: there is no vertical overlap and the upper and lower incisors are not directly connected.

Primate space: in the maxillary arch, the space refers to the gap located between the primary canines and lateral incisors, in the mandibular arch, the space refers to the gap located between the first molars and the canines (Pinkham, 2005).

Developmental space: in addition to the primate spaces, there are spaces between other primary teeth which are known as the developmental space (Pinkham, 2005).

Facial profile; as mentioned before, the facial profiles of children were categorized in three groups. Two imaginary lines in the anterior-posterior profile were used in this regard. The first line was depicted from the bridge of the nose to the base of upper lip and the other was directed from this point to the most prominent point of the chain. The angle formed between these two lines determined the facial profile.

a) The convex profile was assigned to the cases with the angle more than 180 degrees,

b) The concave profile was assigned to the angle lower than 180 degrees, and

c) The straight profile was assigned to the cases that these two lines were along each other.

Data acquisition procedure: The examinations for determining the above-explained variables were carried out in a room with sufficient light. The participant and the examiner were sat on two chairs in front of each other. In the first step, the participant was conducted to locate in the centric occlusion position using the chin-point method. The overbite and overjet rates were determined in this position using an intraoral caliper, see Figure.1 and Figure.2 . Then the angle of mouth was pushed backward by a disposable dental mirror in order for assessing the occlusal relationship of primary canines and molars. The primate and developmental interdental spaces of participants were assessed in the situation that their mouth were fully open. In order to determine the facial profile of children, an image was taken

from their profile and using the criteria explained in the previous section the profile type was determined. Other demographic characteristics of participants including age and sex were also recorded.

Statistical analysis: All required statistics including chi-squared test was performed employing the SPSS software package version 20.

Figure.1. Measuring overjet using intraolar caliper

Figure.2. The procedure for measuring the overbite using intraoral caliper

The Chi square test was used for statistical analysis and the test was applied using SPSS software package version 20.

3. RESULTS

Table.1. represents the prevalence of various occlusion types of primary second molar. According, the majority of the participants (55.5 %) had the occlusion of FTP type, whereas the DP type had the least prevalence (3%). In addition, among female children, FTP (24 percent) and DP (2 percent) were the most and the least prevalent types of occlusion observed in the present study, respectively. The same distribution furthermore was observed among male children so that, as shown in Table.1, FTP with a prevalence of 31.5 percent was the most common and DP with a prevalence of 1 percent was the least common types of occlusion.

Moreover, the Chi square test results revealed that the occlusal relationship of the primary second molar was not affected by the gender (p-value=0.25).

Table.1. The occlusion of the primary second molar

Primary second molar relationship	Male children (%)	Female children (%)	Total (%)	p-value
Flush terminal plane	126 (31.5)	96 (24)	222 (55.5)	0.25
Mesial step	88 (22)	78 (19.5)	166 (41.5)	
Distal step	4 (1)	8 (2)	12 (3)	
Total	218 (54.5)	182 (45.5)	400 (100)	

Likewise, Table.2 provides the information related to the distribution of various occlusal relationships among the male and female participants; it is observable from this table that the majority of cases had the class I occlusal relationship in their primary canines (88%) while the class III had the lowest prevalence (4%). As represented in Table.2, among female as well as male children, the occlusal relationship type I was observed to be the most prevalent type, where as in both genders the type III was the least prevalent one.

The chi square test also indicated that the prevalence of occlusal relationships of primary canines were significantly different between male and female (p-value < 0.05).

Table.2. The prevalence various types of primary canine occlusion among male and female children

Primary canine relationship	Male children (%)	Female children (%)	Total (%)	p-value
Class I	182 (45.5)	170 (42.5)	352 (88)	0.000
Class II	21 (5.25)	11 (2.75)	32 (8)	
Class III	15 (3.75)	1 (0.25)	16 (4)	
Total	218 (54.5)	182 (45.5)	400 (100)	

Table.3 also represents the prevalence of overjet types among the participants. The results outlined that the majority of participants (63.25%) had the normal overjet, whereas the inverse type was the least prevalent one. Moreover, in contrast to other overjet types, the prevalence of the normal overjet was observed higher among female

children (32.25%) in comparison with that among male children (29%). In contrast, the inverse overjet type was the least frequent one observed among female (0.25 percent) and male (0.75 percent) children.

Table.3. The prevalence of various types of overjet in male and female children

Overjet type	Male children (%)	Female children (%)	Total (%)	p-value
Normal	116 (29)	137 (35.25)	253 (63.25)	0.000
Decreased	31 (7.75)	8 (2)	39 (9.75)	
Increased	68 (17)	36 (9)	104 (26)	
Inverse	3 (0.75)	1 (0.25)	4 (1)	
total	218 (54.5)	182(45.5)	400 (100)	

The prevalence of various categories of overbite is represented in Table.4; the prevalence of the normal overbite among female children (34.5%) was higher than that among male children (32.5%). Moreover, among all participants, the normal and decreased overbite were the overbite types with the highest and lowest prevalence, respectively. Among female children, as also observed among male ones, the decreased overbite type was the least prevalent among both genders.

The distribution of overbite type was significantly different between two genders (P-value<0.05).

Table.4. The prevalence of various types of overbite in male and female children

Overbite type	Male children (%)	Female children (%)	Total (%)	p-value
Normal	130 (32.5)	138 (34.5)	268 (67)	0.000
Deep bite	53 (13.25)	35 (8.75)	88 (22)	
Open bite	29 (7.25)	7 (1.75)	36 (9)	
Decreased	6 (1.5)	2 (0.5)	8 (2)	
Total	218 (54.5)	182 (45.5)	400 (100)	

From **Error! Reference source not found.**, it is evident that the most prevalent facial profile observed among participants was the convex one, while the facial profile type concave was the least prevalent one among both genders. Moreover, the facial profile did not differ significantly between the male and female children.

Table.5. Prevalence of various types of facial profile

Facial profile	Male children (%)	Female children (%)	Total (%)	p-value
straight	18 (4.5)	8 (2)	27 (6.5)	0.086
convex	197 (49.25)	173(43.25)	373 (92.5)	
concave	3 (0.75)	1 (0.25)	4 (1)	
Total	218 (54.5)	182 (45.5)	400 (100)	

Finally, the results related to the presence of interdental spaces are represented in Table.5. From this table, it is evident that the most prevalent type of interdental space among the participants was the maxillary primate space which was observed in 93 percent of participants. In contrary, the least prevalent interdental space type was the mandibular developmental space which was noticed in 75 percent of participants. Furthermore, as shown in Table.5, the prevalence of all types of interdental spaces was higher among female children. However, the only significant difference in this regard was the maxillary developmental space.

Table.5. The presence of interdental space among the participants

Interdental space	Male (%)	Female (%)	Total (%)	p-value
maxillary primate space	198 (90.8%)	174 (95.6%)	372 (93%)	0.062
mandibular primate space	174 (79.8%)	150 (82.4%)	324 (81%)	0.509
maxillary developmental space	178 (81.7)	166 (91.2%)	344 (86%)	0.006
mandibular developmental space	158 (72.5%)	142(78%)	300 (75%)	0.202

DISCUSSION

The study of occlusal relationships and interdental spaces in a specific population provides valuable information about the causes of malocclusion occurrence in that population. The information obtained from such studies can be utilized to determine the orthodontic treatment needs in future. The present study was designed and performed to provide information about the prevalence of various types of occlusal relationships and interdental spaces in a sample of 400 children randomly selected from twenty kindergartens located in Hamedan, Iran.

The results of the present study demonstrated that the most prevalent type of primary second molar occlusal relationship was FTP, the finding is in agreement with the studies conducted by other researchers, including (Onyeaso and Isiekwe, 2008; Farsi and Salama, 1996). However, the results differ from those obtained by Ferreira (2001), Abu Alhajia and Qudeimat (2003), and Yilmaz (2006).

In the present study, the DS occlusal relationship was only identified in 3 percent of the participants. The prevalence of this type of occlusal relationship has significantly varied among studies with a range from 1.8 to 34.3 percent (Onyeaso and Isiekwe, 2008, Infante, 1975). It seems that geological and racial differences play an important

role in this regard, because the prevalence of the DS occlusal relationship ontained in the present is similar to those reported by other studies conducted in Jordon (3.7 percent), Turkey (4.4 percent), Saudi Arabia (7 percent), Iran (Tehran) (7.8 percent), and Nigeria (1.8 percent) (Farsi and Salama, 1996; Abu Alhaija and Qudeimat, 2003; Yilmaz, 2006). The prevalence of this type of occlusal relationship has been reported much higher by other studies conducted in other regions of the world. For example, its prevalence was reported as 34.3 percent in United States, 33.1 percent in Finland, and 19.1 percent in Colombia (Infante, 1975; Bishara, 1988; Keski-Nisula, 2003). Moreover, in the study carried out by Anderson (2006), it was demonstrated that there was an association between the prevalence of the DS relationship and race. However, the prevalence of this type of occlusal relationship was reported as 18.41 percent by another study conducted in a different region of Iran, which is much higher than that obtained in the present study (Mahmoodian, 2004).

In the present study, we observed that the class I primary canine occlusal relationship was the most prevalent one followed by class II and class II. The same pattern of prevalence was reported by Abu Alhaija and Qudeimat (2003), Yilmaz (2006), and Almeida (2008). In contrast, the different results were observed by Keski-Nisula (2003), in that study, class II was reported as the most prevalent one. Onyeaso (2008) also reported that the class I was the most prevalent, followed by class II and class II.

Furthermore, in the present we found that the increased overjet was the most prevalent type of overjet in the population. (Kluemper, 2000; Mistry, 2010).

In addition, the results of the present study made it apparent that most of children had a normal condition with regard to overbite. The second most prevalent type was the increased overbite. The same pattern was obtained by Abu Alhaija and Qudeimat (2003). However, Almeida (2008) reported that the least prevalent overbite was the increased one. The increased overbite obtained by the present study was much lower than those reported by other studies such as Granville-Garcia (2010), Vasconcelos (2011), and Gross (1994). These variations can be due to several causes, including feeding and oral habits (Vasconcelos, 2011).

The prevalence of the primate space in maxilla and mandible were 93 and 81 percent, respectively. The finding is similar to what observed by Mahmoodian (2004) and Ferreira (2001). In contrast to the study performed by Bhayya and Shyagali (2011), there was not found any significant difference between the male and female children in terms of the prevalence of the primate and developmental spaces in their upper and lower dental arches.

Moreover, it was observed that the convex profile was the most frequent profile in both genders. The finding is in agreement with the results obtained by Mahmoodian (2004). However, in that study about 25 percent of the participants had a straight profile which was only observed among 6.8 percent of participants. Alexander and Prabhu (1997) also reported the convex profile as the most prevalent one among male children, however the straight profile was the one with the highest prevalence among female children in that study.

4. CONCLUSION

It can be concluded from the present study that the most prevalent molar occlusal relationship among both male and female children was FTP. The prevalence of overjet was higher in female in comparison with male children. Most of the children had a normal overbite and overjet. Both primate and developmental spaces were observed to be prevalent in the participants. The convex profile also was the prevalent one among the children.

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