

Evaluation of the Occlusion and Arch Dimensions in the Primary Dentition of an Iranian Population

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Abstract

Introduction: The objective of this study was to gather information about normal occlusion and arch dimensions in the primary teeth of the children belonging to an Iranian population. **Methods:** This descriptive cross-sectional study was performed on 68 children from the city of Mashhad in the 3-5 age range. Dental arch dimensions, interrelationships of primary canine and second molars, overbite and overjet were evaluated. **Results:** Primate space was observed on both sides of the arch in 82.2% of the subjects. The most prevalent type of primary molar relationship was flush terminal plane (52.1%) followed by distal step (31.3%) and then mesial step (16.7%). The primary canine relationship was ranked in the descending order of prevalence as Class I (77.1%), Class II (13.5%), end-to-end (5.2%) and Class III (4.2%). Normal overbite and normal overjet was observed in 50% and 81.3% of cases, respectively. **Conclusion:** This study provides an insight into the dental arch dimensions, occlusion, spacing and crowding in primary dentition in Iranian children. In most of the cases, primate space and flush terminal plane were observed.

Key Words: Arch dimensions, occlusion, primary dentition.

Introduction

Dental arch dimensions during childhood play significant roles in attaining a functionally stable occlusion (1,2), well-aligned teeth, a stable arch form, normal overjet and overbite and a balanced facial profile in the permanent dentition. Knowledge about dental dimensions is required to adequately assess overbite, overjet, molar and canine intercuspatation and occlusal stability (3).

Wide variation in mesiodistal crown width of primary teeth has been reported among populations. This is due to complex interactions between genetic and environmental factors (4). The dental arch is divided into various segments including incisor, canine and molar segments which are important in determining the space and occlusion in the permanent dentition. A balanced occlusion can be considered normal, even if it contains teeth that are slightly rotated or incisors that show slight buccal or lingual inclination (3).

Dental arch dimensions and generalized spacing in primary dentition largely determine the alignment of teeth in permanent dentition. After the complete eruption of primary dentition by the age of three, the entire arch and occlusion is relatively stable for the next years. During this static period, if proper prediction of arch changes and occlusion are done by the pediatric dentist, it helps in establishing an acceptable esthetic and functional occlusion at a later age (5).

Observation of the primary dentition provides the basis for studying occlusion and for predicting the occlusion of the permanent dentition. Therefore, the aim of this study was to gather normal data on occlusal relationships and dental arch characteristics of primary dentition in an Iranian population.

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Materials and Methods

This cross-sectional descriptive study was performed on preschool children in the 3-5 age range. Sixty-nine subjects (22 girls, 47 boys) with normal occlusion were selected out of 523 children from Mashhad kindergartens. Each child's parent signed an informed consent.

The following criteria were considered in the process of case selection:

- Complete primary dentition
- No loss of tooth structure in the mesiodistal dimension as a result of caries, interproximal restoration, fracture or excessive wear
- No erupted permanent teeth
- No congenital defects or deformed teeth

Polysilicone impressions (Coltenespeedex, Polysiloxane condensation type silicone elastomer, Whaledent Inc., Mahwah, New Jersey, USA) were taken from maxillary and mandibular arches. The impressions were poured by type IV plaster (Zhermack Elite Rock Gypsums, Elite Rock Class IV Die Stone, ZhermackSpA, BadiaPolesine, Italy) on the same day by an expert technician.

Data were obtained from dental cast measurements. Measurements were made by a single investigator with an electronic digital caliper (Zhenjiang Richoic Machinery Imp. & Exp. Co., Ltd. Jiangsu, China) with an accuracy of ± 0.02 mm and repeatability of ± 0.01 mm. To gain access to interdental spaces more easily, the measuring tips of the digital caliper were narrowed.

The following measurements were recorded:

1) Dental Arch Dimensions

- Molar segment length was measured from the most distal point on the crown of the second molar to the distal contact point of the canine (6).
- Canine segment length was measured from the distal contact point of the canine to the distal contact point of the lateral incisor (6).
- Incisor segment length was measured from the midpoint of arch between central incisors and the distal contact point of the lateral incisor (6).
- Inter canine width was measured from the cusp tip of the left canine to the cusp tip of the right canine (6).
- Arch circumference was calculated as the sum of incisor, canine and molar segments of both sides of the arch (6).
- Intermolar width was measured from the central fossa of the left second molar to the central fossa of the right second molar (6).
- Anteroposterior arch length was defined as a line passing through the midpoint between the distal surfaces of the deciduous second molars to the midpoint between the central incisors (6) (was measured as the perpendicular distance from the mesial contact point of

the central incisors to the line connecting the distal surfaces of the left and right second deciduous molars).

- Total spacing was calculated as the difference between dentition size and arch size (1).

2) Occlusion

Molar Relationship

- Molars were categorized as flush terminal when the distal surfaces of the upper and lower second primary molars were in the same vertical plane in centric occlusion (7).

- Molars were recorded as distal step when the distal surfaces of the lower primary second molars were posterior to the distal surfaces of the upper second molars in centric occlusion (7).

- Molars were recorded as mesial step when the distal surfaces of the lower primary second molars were anterior to the distal surfaces of the upper second molars in centric occlusion (7).

Canine Relationship

- Class I: The cusp tip of the upper primary canine was in the same vertical plane as the distal surface of the lower primary canine in centric occlusion (8,9).

- Class II: The cusp tip of the upper primary canine was anterior to the distal surface of the lower primary canine in centric occlusion (8,9).

- Class III: The cusp tip of the upper primary canine was posterior to the distal surface of the lower primary canine in centric occlusion (8,9).

- End-to-end: The long axis of the mandibular canine was coincident with the long axis of the maxillary canine (9).

Overjet

- Normal: The distance between the labial surfaces the most protruded maxillary central incisor and the opposing mandibular incisor varied between 0 and 4.0 mm (8).

- Increased: Overjet was more than 4.0 mm (8).

- Reversed: The maxillary incisors were lingual to the mandibular incisors (8).

Overbite

- Normal: The amount of vertical overlap between the maxillary and mandibular central incisors varied between 10% and 40% (8).

- Deep: The amount of vertical overlap between the maxillary and mandibular central incisors was more than 40% (8).

- Edge to Edge: The upper incisors did not overlap the lower ones but contacted each other (8).

- Open bite: The upper incisors did not overlap the lower ones and there was a gap between them.

Statistical Analysis

Descriptive statistics were applied as appropriate in data analysis.

Results

Dental Arch Dimensions

- Mean dental arch dimension was 73.71 ± 3.9 mm in the maxilla and 68.58 ± 3.24 mm in the mandible (Table 1).
- Mean intercanine width was greater in the maxilla (29.49 ± 1.5 mm) than in the mandible (23.35 ± 1.27 mm) (Table 1).
- Mean intermolar width was larger in the maxilla (39.87 ± 1.7 mm) than in the mandible (35.07 ± 1.65 mm) (Table 1).
- Mean anteroposterior arch length was greater in the maxilla (27.8 ± 1.67 mm) than in the mandible (24.69 ± 1.36 mm) (Table 1).
- The mean of total spacing in the maxillary arch (4.56 ± 2.45 mm) was greater than in the mandible (3.45 ± 1.89 mm).
- Generalized spaces were found in 75% and 70.8% of the upper and lower arches, respectively (Table 2).
- The mean of primate space was 1.7 ± 0.61 mm in the maxilla and 1.2 ± 0.45 mm in the mandible. Primate space was seen in both sides of the arch in 80.2% of subjects.
- Absence of primate space was observed more frequently in the mandible (14.6%) than in the maxilla (8.3%) (Table 2).

Occlusion

- Of 69 children, 52.1% showed flush terminal plane, 31.3% showed distal step and 16.7% showed mesial step.
- Assessment of canine relationship indicated that 77.1% of subjects had a Class I relationship, 13.5% had a Class II relationship, 5.2% had an end-to-end relationship and 4.2% possessed a Class III relationship.
- The distribution of overbite was as follows: normal overbite in 50%, deep overbite in 41.7%, edge to edge occlusion in 6.3% and anterior open bite in 2.1% of the subjects.
- The distribution of overjet was as follows: 81% of the children showed normal overjet, 16.7% had increased overjet and 2.1% had reversed overjet.

Discussion

This study provides insight into the state of dental arch dimensions, occlusal relationships, spacing and crowding in the primary dentition of an Iranian population in Mashhad. The mean intercanine widths in this study are similar to those reported by Parbhakarnet al. (5), Bisharaet al. (10), and Abu Alhaijaand Qudeimat (6). Intermolar widths are similar to those of Prabhakarn's study (5). It is difficult to compare arch dimensions with other studies due to differences in the measurement techniques. Researchers have used a variety of landmarks and techniques, which make the comparison difficult (Table 3).

Table 1. Dental arch dimensions (mean \pm standard deviation)

Arch Dimension	Circumference of arch	Max		Intercanine width		Intermolar width		Anterior-posterior length		Max		Min	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
Maxilla	73.71 ± 2.84	80.96	65.92	29.49 ± 1.5	31.95	24.58	39.87 ± 1.7	43.18	36.11	27.80 ± 1.67	31.44	24.33	
Mandible	68.58 ± 2.81	76.51	60.69	23.35 ± 1.27	21.07	25.91	35.07 ± 1.65	38.81	31.77	24.69 ± 1.36	28.22	22.08	

Table 2. Prevalence of general spacing and primate spaces in the maxilla and mandible

Spaces	Arch	
	Maxilla	Mandible
No spaces plus crowding	25.1%	29.2%
Primate plus other spaces	75%	70.8%
No primate spaces	8.6%	14.4%
Unilateral primate space	4.3%	13%
Bilateral primate spaces	87.1%	72.6%

Table 3. Comparison of selected dental arch measurements between the present study and other ethnic groups (both sexes combined)

Parameter	Ethnic Population					
	Present Study		India ⁽⁵⁾		Jordan ⁽⁶⁾	
Canine arch width	Mean	S.D.	Mean	S.D.	Mean	S.D.
Maxilla	29.49	1.5	30.01	1.06	29.58	1.06
Mandible	23.35	1.27	23.15	0.64	23.5	0.84
Molar arch width	Present Study		India ⁽⁵⁾		Jordan ⁽⁶⁾	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Maxilla	39.87	1.7	40.0	2.2	39.0	1.3
Mandible	35.07	1.65	34.7	1.7	34.77	1.2
Primate space	Present Study		Jordan ⁽⁶⁾			
	Mean	S.D.	Mean	S.D.		
Maxilla	1.7	0.61	1.138	0.31		
Mandible	1.2	0.45	0.93	0.26		

Primate space in this study was smaller than that reported by Abu Alhaija and Qudeimat (6) in maxilla. The prevalence of primate space in our study was greater in the maxilla than in the mandible, similar to the results Sapna's (11), Abu Alhaija and Qudeimat (6), and Foster's studies (1). Lower frequencies of primate space have been reported by Abu Alhaija and Qudeimat (6) (Table 3).

Sapna (11), Abu Alhaija and Qudeimat (6), and Otuyemi (12) found lower frequencies of generalized spaces than those recorded in the current study. Spacing of the primary dentition is common. The prevalence of spaced dentitions varies between different ethnic groups ranging from 42% to 98% (6) (Table 4).

Tooth contact and crowding of the primary dentition were less prevalent in our study than in Jordanian children (6), British children (1), Nigerian children (12) but were almost the same as Indian children (11) (Table 4). Prabhakaran et al. (5) have reported that mesiodistal dimensions of all teeth were significantly larger in crowded arches than in spaced dentition and that arch depth of spaced dentition was greater than that of crowded dentition. The presence of interdental spaces largely depends on the mesiodistal crown width and the intercanine arch width. Broad arches and small teeth result in interdental spacing of the deciduous teeth and vice versa (13).

The mesial step of primary molars was less prevalent in our subjects than in Jordanian (6) and Indian children (11,14). Abu Alhaija and Qudeimat (6) reported 47.7% of cases had a mesial step relationship. Nanda et al. (14) reported that 58% of Indian children had a flush terminal relationship. The prevalence of flush terminal in our study was less than

Farsi and Salam's (15) and Bishara's (10) studies (Table 4). The findings of Onyeaso et al. (16) indicated that 68% of Nigerian children who initially had a flush terminal relationship, showed a Class I molar relationship. Distal step relationship in our study was more prevalent than in other studies. This can predict Class II relationships in permanent teeth, but longitudinal studies on this change are recommended. According to Bishara et al. (10) the final molar occlusion depends on a number of genetic and environmental dental and facial skeletal changes, whose interaction may result in a normal occlusion.

Class I canine relationship was observed more frequently in our study than in Abu Alhaija and Qudeimat (6) study but less frequently than in Farsi and Sapna's work (11,15) (Table 4). Most children with a Class I canine relationship in the primary dentition, showed a flush terminal plane on their second primary molars (17). Normal overjet was more in our subjects than in Nigerian children (18). We also found a higher prevalence of deep bite and a lower prevalence of open bite than in other studies (6,12). It is widely accepted that variation in dental occlusion results from a multifactorial inheritance pattern, with both genetic and environmental influences playing important roles (19).

Onyeaso et al. (16) found significant positive correlations for all occlusal features (especially crowding) between primary and early mixed dentition. Therefore, further longitudinal studies are necessary to follow dental arch dimensions from the primary to the mixed dentition period.

Table 4. Comparison of frequency of spacing and dental arch relationships between present study and other ethnic groups (both sexes combined)

Parameter	Ethnic Population				
Generalized space	Present Study	Jordan ⁽⁶⁾	Egypt ⁽¹³⁾	Nigeria ⁽¹²⁾	
Maxilla	75%	61.8%	57%	37.7%	
Mandible	70.80%	61.1%	53%	44%	
Contact and crowding	Present Study	Britain ⁽¹⁾	Jordan ⁽⁶⁾	Nigeria ⁽¹²⁾	
Maxilla	8.30%	68%	38.2%	24.4%	
Mandible	14.60%		21.6%	26.3%	
Overjet	Present Study	Britain ⁽¹⁾	Nigeria ⁽¹²⁾	Saudi Arabia ⁽¹⁵⁾	
Normal	81%	28%	68.2%	76%	
Increased	16.70%	2.5%	14.4%	68.6%	
Reversed	2.1%	2%	9.7%	2%	
Overbite	Present Study	Jordan ⁽⁶⁾	Nigeria ⁽¹²⁾	Saudi Arabia ⁽¹⁵⁾	
Normal	50%	44.3%	76.6%	57%	
Deep	41.70%	28.2%	13.4%		
Edge to edge	6.30%	21.8%	4.9%	8-11%	
Open	2.1%	5.7%	3.5%		
Molar relationship	Present Study	Jordan ⁽⁶⁾	India ⁽⁵⁾	U.S.A ⁽¹⁷⁾	Saudi Arabia ⁽¹⁵⁾
Mesial step	16.70%	47.7%	25.5%	12%	12%
Ddistal step	31.30%	3.7%	9%	8%	8%
Flush terminal	52%	37%	52%	76%	8%
Canine relationship	Present Study	Jordan ⁽⁶⁾	Saudi Arabia ⁽¹⁵⁾		
Class I	77.10%	57%	86%		
Class II	13.50%	29%	11%		
Class III	4.20%	3.7%	3%		
End to end	5.20%				

Conclusion

This study gives us new insights into the dental arch dimensions, occlusion, spaces and crowding in primary dentition in a group of children from Mashhad. In most of the cases primate space and flush terminal plane were observed. These are valuable criteria in dental analysis, occlusal guidance and orthodontic treatment.

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