

Evaluation of different occlusion and dental arch types in 3 to 5 years old children in Kerman, Iran, 2019: A cross-sectional study

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Original Article

Abstract

BACKGROUND AND AIM: Existence of developmental spaces during the primary dentition period is essential for the permanent dentition period and results in regular eruption of permanent teeth. The wide class of different occlusion and dental arch types during the primary dentition period, based on factors such as race, conducted to research the prevalence of these two occlusion factors in 3 to 5 years old children in Kerman-Iran.

METHODS: 520 caries-free children attending different kindergartens were selected to evaluate occlusion parameters in Kerman City, Iran, 2019. The oral examination of children was performed by a senior dental student using a tongue depressor and in a room with sufficient light. Collected data were analyzed by SPSS software using t-test, chi-squared, and analysis of variance (ANOVA) tests. The significant level less than 0.05 was considered.

RESULTS: The children had predominantly open arch and prevalence of occlusion types was 73.4% for mesial step (MS), 10.5% for flush terminal plane (FTP), and 1.4% for distal step (DS), respectively. The statistical analysis explained a significant association between MS occlusion and open arch in the mandible ($P = 0.013$) and between dental arch types and sex in the maxilla ($P = 0.028$), so that the boys had a higher prevalence of open arch than the girls. The presence of developmental spaces in both jaws had a significant association with the upper mean age of the children ($P = 0.001$).

CONCLUSION: The dental arches often had developmental spaces and molar relationship of MS during the primary dentition.

KEYWORDS: Dental Occlusion; Dental Arch; Tooth; Deciduous; Prevalence

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Delabarre in 1819 was the first to describe interproximal spacing in the anterior primary teeth of 4-6-year-old children and to suggest that this space is replaced by permanent teeth.

The presence of developmental spaces during the primary dentition period is called open arch (Figure 1). In the absence of such developmental spaces, the dental arch is called the closed arch (Figure 2), and crowding is rarely observed in the primary teeth.¹



Figure 1. Open arch in primary dentition

During the primary dentition period, there are two types of space between the teeth:

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primate space or anthropoid space that is present between lateral incisor and canine in the maxilla and between canine and primary first molar in the mandible as well as generalized space or developmental space that is present between the anterior teeth and sometimes between the primary molars in addition to the anterior teeth.²



Figure 2. Closed arch in primary dentition

The prevalence of interdental spaces in different races has been reported in the range of 32% to 98%. For example, spaced primary dentition is present in 32% of Nigerian children, 90% of British children, 96% of Polish children, and 98% of Burlington children.³

The occlusion during the primary dentition period is classified into three groups according to the location of the second primary molar (the palmer system):

- A) Flush terminal plane (FTP): the distal surface of second primary molars lies in the similar vertical plane
- B) Distal step (DS): the distal surface of the lower jaw second primary molar is distal to the distal surface of the upper jaw second primary molar.
- C) Mesial step (MS): the distal surface of the lower jaw second primary molar is mesial to the distal surface of the upper jaw second primary molar⁴ (Figure 3).

The prevalence of occlusion types in 3-year-old children was reported to be 76% for FTP, 14% for MS, and 10% for DS.⁵

There are limited studies available on the relationship between occlusal parameters in primary dentition. The aim of this study was to examine the prevalence of different

occlusion and dental arch types during the primary dentition period and then to evaluate the association between different occlusion and dental arch types in Kerman, Iran.

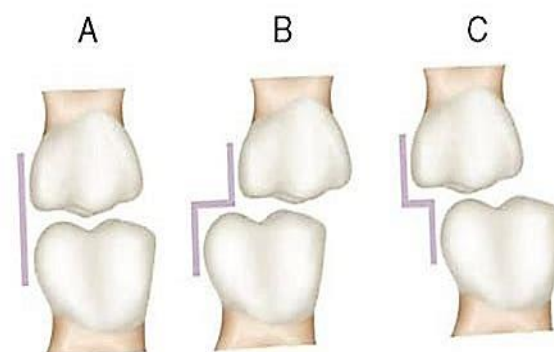


Figure 3. Occlusion type in primary dentition; A: Flush terminal plane (FTP), B: Distal step (DS), C: Mesial step (MS)

Methods

In the current cross-sectional study, 2000 children of the 15 kindergartens in different parts of Kerman City were examined and 520 caries-free children aged 3 to 5 years by simple random sampling method were selected to evaluate different occlusion and dental arch types.

The inclusion criteria were apparently healthy children and complete primary dentition. The exclusion criteria were presence of interproximal caries, premature loss of primary teeth, eruption of any permanent first molar/incisor tooth, having undergone any kind of orthodontic treatment, malocclusion, fusion, gemination, oligodontia, and every congenital dental malformation.

The oral examination of children was performed by a pediatric dentist-calibrated senior dental student using a tongue depressor and disposable plastic gloves in a room with daylight.

A checklist containing information on age, sex, and different occlusion and dental arch types on each side of the jaw was completed for each child. Children's oral examinations were performed with the informed consent of the parents and obtaining the necessary

permits from the relevant organizations. The information recorded in the checklist was anonymous and with no child details.

The study was approved by the Ethical Committee of Kerman University of Medical Sciences. The Ethical Approval Code is IR.KMU.REC.1396.1615.

The collected data were analyzed by SPSS software (version 21, IBM Corporation, Armonk, NY, USA) using chi-squared test, t-test, analysis of variance (ANOVA), and Tukey's test. To compare age and occlusal characteristics (dental arch, type of occlusion, and space), t-test, ANOVA, and Tukey's test were executed. Additionally, chi-squared test was used to assess the proportions and interrelationship between qualitative variables (spaced dentition, upper and lower arches, dental arch, and type of occlusion and space). A value of $P < 0.05$ was considered as significant.

Results

A total of 286 (55.0%) boys and 234 (45.0%) girls were examined. Of these, 123 (23.7%) were 3 years old, 194 (37.3%) were 4 years old, and 203 (39.0%) were 5 years old with a mean age of 4.15 ± 0.70 years.

Table 1 shows the prevalence of various occlusal characteristics in primary dentition. It should be noted that some children due to asymmetries of spaces or different occlusion in right and left sides were excluded during the statistical analysis. The statistical analysis

indicated significant association between dental arch types in maxilla and mandible and types of occlusion in both left and right sides ($P = 0.0001$).

Table 2 shows the prevalence of different spaces, based on the occlusion types in children with open arch. The statistical analysis demonstrated a significant association between MS occlusion and open arch in the mandible ($P = 0.013$) as well as the molar relationship of MS often during the primary dentition period in the open arch status.

Table 3 shows the prevalence of two dental arch types based on occlusion types in children. The statistical analysis revealed no significant association between different occlusion and dental arch types ($P > 0.050$).

At the open arch, there was a statistically significant association between gender and the presence of developmental spaces in both jaws and the presence of developmental spaces was significantly higher in boys than in girls ($P < 0.050$).

There was a significant association between dental arch types and sex in the maxilla ($P = 0.028$), so that the boys had a higher prevalence of open arch than the girls, whereas this association was not significant in the mandible ($P = 0.890$).

The statistical analysis revealed no significant association between occlusion types and sex ($P > 0.050$).

Table 4 represents the prevalence of various occlusal parameters based on sex.

Table 1. The prevalence of dental arch types and developmental and primate spaces in children with open arch and dental occlusion on both the left and right sides

Jaw	Dental arch	Mandible			Maxilla		
		Open arch	Closed arch	Excluded	Open arch	Closed arch	Excluded
n (%)		414 (79.6)	60 (11.5)	46 (8.9)	387 (74.7)	94 (18.1)	39 (7.2)
Total		520 (100)			520 (100)		
P		0.0001					
Interdental space		Developmental	Primate	Both	Excluded	Developmental	Primate
n (%)		33 (6.3)	109 (21.0)	273 (52.5)	105 (20.2)	51 (9.8)	85 (16.3)
Total		520 (100)			520 (100)		
P		0.0001					
Occlusion type		MS	FTP	DS	Excluded	MS	FTP
n (%)		379 (72.9)	58 (11.2)	6 (1.2)	77 (14.8)	384 (73.8)	51 (9.8)
Total		520 (100)			520 (100)		
P		0.0001					

MS: Mesial step; FTP: Flush terminal plane; DS: Distal step

Table 2. The prevalence of different spaces (developmental, primate, and both) based on the occlusion types [mesial step (MS), flush terminal plane (FTP), and distal step (DS)] in both the right and left sides in children with open arch

Jaw Space Occlusion	Mandible						Maxilla					
	Left			Right			Left			Right		
	Developmental	Primate	Both	Developmental	Primate	Both	Developmental	Primate	Both	Developmental	Primate	Both
MS [n (%)]	21 (5.4)	87 (22.2)	235 (59.9)	21 (5.4)	83 (21.2)	231 (58.9)	38 (10.6)	73 (20.4)	202 (56.4)	38 (10.6)	68 (19.0)	201 (56.1)
FTP [n (%)]	9 (2.3)	13 (3.3)	21 (5.4)	8 (2.0)	17 (4.3)	27 (6.9)	9 (2.5)	8 (2.2)	21 (5.9)	9 (2.5)	13 (3.6)	24 (6.7)
DS [n (%)]	0 (0)	1 (0.3)	5 (1.3)	1 (0.3)	1 (0.3)	3 (0.8)	1 (0.3)	1 (0.3)	5 (1.3)	1 (0.3)	1 (0.3)	3 (0.8)
Total	30 (7.7)	101 (25.8)	261 (66.6)	30 (7.7)	101 (25.8)	261 (66.6)	48 (13.4)	82 (22.9)	228 (63.7)	48 (13.4)	82 (22.9)	228 (63.7)
P	0.013			0.035			0.364			0.313		

MS: Mesial step; FTP: Flush terminal plane; DS: Distal step

Table 3. The prevalence of two dental arch types (open arch and closed arch) based on occlusion types [mesial step (MS), flush terminal plane (FTP), and distal step (DS)] in both right and left sides

Jaw Occlusion	Dental arch	Mandible				Maxilla			
		Left		Right		Left		Right	
		Open	Closed	Open	Closed	Open	Closed	Open	Closed
MS [n (%)]		342 (77.2)	42 (9.5)	334 (75.4)	45 (10.2)	313 (70.7)	71 (16.0)	307 (69.3)	72 (16.3)
FTP [n (%)]		43 (9.7)	8 (1.8)	52 (11.7)	6 (1.4)	38 (8.6)	13 (2.9)	46 (10.4)	12 (2.7)
DS [n (%)]		6 (1.4)	2 (0.5)	5 (1.1)	1 (0.2)	7 (1.6)	1 (0.2)	5 (1.1)	1 (0.2)
Total		391 (88.3)	52 (11.7)	391 (88.3)	52 (11.7)	358 (80.8)	85 (19.2)	358 (80.8)	85 (19.2)
P		0.197		0.773		0.473		0.890	

MS: Mesial step; FTP: Flush terminal plane; DS: Distal step

Table 4. The prevalence of occlusal parameters based on sex

Jaw Space	Mandible			Maxilla		
	Developmental	Primate	Both	Developmental	Primate	Both
Male [n (%)]	26 (6.3)	63 (15.2)	138 (33.3)	38 (9.8)	56 (14.5)	125 (32.4)
Female [n (%)]	7 (1.7)	46 (11.1)	135 (32.5)	13 (3.4)	29 (7.5)	125 (32.4)
Total	33 (8.0)	109 (26.3)	273 (65.8)	51 (13.2)	85 (22.0)	250 (64.8)
P		0.006			0.001	
Dental arch	Open arch	Closed arch		Open arch	Closed arch	
Male [n (%)]	226 (47.7)	32 (6.8)		220 (45.7)	41 (8.5)	
Female [n (%)]	188 (39.7)	28 (5.9)		167 (34.7)	53 (11.0)	
Total	414 (87.3)	60 (12.7)		387 (80.5)	94 (19.5)	
P		0.890			0.028	
Occlusion	MS	FTP	DS	MS	FTP	DS
		Right			Left	
Male [n (%)]	202 (45.6)	31 (7.0)	4 (0.9)	203 (53.5)	31 (7.0)	3 (0.7)
Female [n (%)]	177 (40.0)	27 (6.1)	2 (0.5)	181 (40.9)	20 (4.5)	5 (1.1)
Total	443 (85.6)	58 (13.1)	6 (1.4)	384 (86.7)	51 (11.5)	8 (1.8)
P		0.868			0.367	

MS: Mesial step; FTP: Flush terminal plane; DS: Distal step

At the open arch, there was a statistically significant association between gender and the presence of developmental spaces in both jaws and the presence of developmental spaces was significantly higher in boys than in girls ($P < 0.050$). There was a significant association between dental arch types and sex in the maxilla ($P = 0.028$), so that the boys had a higher prevalence of open arch than the girls, whereas this association was not significant in the mandible ($P = 0.890$).

The statistical analysis revealed no

significant association between occlusion types and sex ($P > 0.050$).

At the open arch, the presence of different developmental spaces in both jaws had a statistically significant association with the upper mean age of the children ($P < 0.050$). The statistical analysis indicated no significant association of mean age of children with dental arch types ($P > 0.050$), but statistically significant association of MS occlusion type with the upper age on the left side was revealed ($P = 0.001$).

Table 5. The prevalence of occlusal parameters based on mean age

Jaw Space	Mandible			Maxilla		
	Developmental (D)	Primate (P)	Both (B)	Developmental (D)	Primate (P)	Both (B)
Age [n (mean \pm SD)] (year)	33 (4.7 \pm 0.7)	109 (4.7 \pm 0.8)	273 (4.9 \pm 0.7)	51 (4.5 \pm 0.8)	85 (4.0 \pm 0.8)	250 (4.0 \pm 0.8)
Total	415 (4.1 \pm 0.8)			386 (4.1 \pm 0.8)		
P	D with P = 0.001, D with B = 0.001, P with B > 0.050			D with P = 0.002, D with B = 0.001, P with B > 0.050		
Dental arch	Open arch	Closed arch		Open arch	Closed arch	
Age [n (mean \pm SD)] (year)	414 (4.1 \pm 0.8)	60 (4.1 \pm 0.8)		387 (4.1 \pm 0.8)	94 (4.2 \pm 0.8)	
Total	474 (4.1 \pm 0.8)			478 (4.1 \pm 0.8)		
P		0.970			0.111	
Occlusion type	MS	FTP	DS	MS	FTP	DS
		Right			Left	
Age [n (mean \pm SD)] (year)	379 (4.1 \pm 0.8)	58 (4.2 \pm 0.8)	6 (4.5 \pm 0.5)	384 (4.1 \pm 0.8)	51 (4.5 \pm 0.6)	8 (4.4 \pm 0.7)
Total	443 (4.1 \pm 0.8)			443 (4.1 \pm 0.8)		
P		0.238		FTP with MS = 0.001, FTP with DS and DS with MS > 0.050		

MS: Mesial step; FTP: Flush terminal plane; DS: Distal step; SD: Standard deviation

Discussion

In the current study, the occlusion and dental arch types and the association between them were evaluated in 3- to 5-year-old children.

In this study, the prevalence of open arch was 74.4% in the maxilla and 79.6% in the mandible. Indian children had open arch of 54% and maximum spacing was found in the upper anterior teeth.⁶ Taiwanese children had an open arch, 85.0% in the maxilla and 72.1% in the mandible.⁷ Vegesna et al. reported that the anterior interdental spacing appeared to be a common result in children.⁸ However, spacing between the teeth is common in primary dentition.⁹ In addition, this difference could be due to the importance of role of ethnicity in the presence or absence of different spaces in primary dentition period.

In this study, 9.8% had developmental space, 16.3% had primate space, and 48.1% had both spaces in the maxilla. Moreover, 6.3% had developmental space, 21.0% had primate space, and 52.5% had both spaces in the mandible. Alexander et al. reported that 81.0% of children had spaced primary dentitions.¹⁰ Sun et al. in Taiwan surveyed 365 children aged 3 to 6 years and selected 147 samples; 85.0% had maxillary arch space (91.0% boys and 75.9% girls) and 72.1% had mandibular arch space (78.7% boys and 62.1% girls).⁷ This difference could be due to the different sampling selection in children.

In this study, the prevalence of occlusion types was 72.9% for MS, 11.2% for FTP, and 1.2% for DS on the right as well as 73.8% for MS, 9.8% for FTP, and 1.5% for DS on the left. Fernandes et al. reported the prevalence of occlusion in 383 children aged 3 to 5 years. 55.35% had FTP, 43.34% had MS molar relationship, and 1.31% had DS molar relationship.¹¹ Abu Alhaja and Qudeimat conducted a similar study on 1048 Jordanian preschoolers and found that the prevalence of occlusion was 47.7% for MS, 37.0% for FTP, and 3.7% for DS, and 11.6% in asymmetric molar relationship.¹² Ferreira et al. examined 356 preschool children in Brazil, and found that the MS patterns were the most frequent

normal occlusal patterns for molar relationships.¹³ Srinivasan et al. examined 603 children in India, and found that FTP occlusion was the most common primary molar occlusion.¹⁴ Khan et al. measured the prevalence of occlusion types in 453 children aged 3 to 6 years, which was 31.3% for MS, 6.4% for DS, and 62.3% for FTP.¹⁵ Hegde et al. examined 200 Indian children and reported that FTP was more common at 3-4 years of age and MS at 4-5 years.¹⁶ Anitha and Asokan studied 1836 children in India and found that FTP was the most commonly seen type of primary molar relation and there was a low prevalence of asymmetric molar relationship.¹⁷ Therefore, some studies reported the highest prevalence of occlusion as FTP type, but the present study found the highest prevalence to be MS type. This difference emphasizes the importance of role of ethnicity in the presence of different types of occlusion.

In the present study, the developmental spaces were significantly higher in the boys than in the girls, and children with open arch had a higher mean age than children with closed arch. In a study by Mugonzibwa et al., it was found that spacing was more often found in the upper jaw, while crowding was more common in the lower jaw. Crowding was more constantly found in Caucasian children than in African children.¹⁸ Facal-Garcia et al. examined 267 white Caucasian children and reported that the prevalence of interdental space was high in primary dentition and also spacing was more frequent in boys than in girls.¹⁹ Hughes et al. examined 412 European children in Australia, and reported that the primate space was more seen in the maxilla than in the mandible and also, in the boys than in the girls.²⁰ Janiszewska-Olszowska et al. studied 141 Polish children aged 5 to 6 years for interdental space and reported that the prevalence of primate space was higher in the boys than in the girls.²¹

There was more significant interdental space in higher mean age and during the transition of the permanent anterior teeth. These findings are in line with this study.

The limitation of this research was noncooperation of the child to engage in mouth closure in the centric occlusion position, in which case, the child was excluded and then replaced.

Conclusion

The dental arches often had open arch type and molar relationship of MS during the

primary dentition period among the children in Kerman.

Conflict of Interests

Authors have no conflict of interest.

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