Facial Profile and Characteristics of Occlusal Features in Primary Dentition among Children Aged 2-5 Years in Southern Nigeria

Philip Uwaezuoke **OGORDI**
[Paediatric Dentistry Unit, Department of Preventive Dentistry, University of Benin and University of Benin Teaching Hospital, Benin City, Edo State Nigeria]

Correspondence
Dr. Philip U Ogordi

[Paediatric Dentistry Unit, Department of Preventive Dentistry, University of Benin and University of Benin Teaching Hospital, Benin City, Edo State Nigeria]
Email: philip.ogordi@uniben.edu

ABSTRACT

Objective: To assess the facial profile and characteristic features of occlusion in primary dentition among paediatric dental patients in a teaching hospital in Southern Nigeria.

Methods: A cross-sectional study comprising 224 children aged 2 to 5 years who visited the paediatric dental clinic over one year with the full complements of their primary dentition. All the children were screened for molar and canine relations, overjet, overbite, anthropoid and developmental spaces, as well as their facial profiles, and the data were recorded. Data were analyzed using statistical software (SPSS version 21.0, Chicago). The Chi-square test analyzed categorical data with a level of significance for all statistical tests set at a probability value of less than 0.05.

Results: Bilateral flush terminal plane molar relationship was the most prevalent in 126(56%), followed by the mesial step 84(37.5%). Molar relationship and gender were statistically significant (P= 0.001). Bilateral canine class I was the most common relationship in 189(84.4%), bilateral normal overjet in 191(85.3%) and bilateral normal overbite in 183(81.7%). The majority of the developmental spaces were in the maxilla 136(60.7%) and mostly among males (69%); this was statistically significant (p=0.023). Anthropoid spaces were most prevalent in the maxilla 198(88.4%) and among males (94%), which was statistically significant (p=0.019). Straight facial profile was the most common profile 147(65.6%), although more in males (67%), it was not statistically significant (p=0.823).

Conclusion: The study's most prevalent facial and occlusal characteristics were the straight facial profile, bilateral flush terminal relationship, class 1 canine, normal overjet, normal overbite, and maxillary anthropoid and developmental spaces. Revealed in this study were mostly desirable occlusal features but with some occlusal characteristics that deviate from the norm.

Keywords: facial profile, occlusal characteristics, primary dentition

Philip U Ogordi
https://orcid.org/0000-0002-0627-1309

Received: 2-March, 2023
Revision: 23 May, 2023
Accepted: 25 May, 2023

Citation: Ogordi PU. Facial profile and characteristics of occlusal features in primary dentition among children aged 2-5 years in Southern Nigeria. Nig J Dent Res 2023; 8(2):53-61.https://dx.doi.org/10.4314/njdr.v8i2.3

INTRODUCTION

Childhood is seen as the mirror that reflects future adulthood. An ideal primary dentition in childhood indicates a potential normal acceptable permanent dentition in adulthood. This is because the occlusion seen in permanent dentition is influenced by the already existing framework made available by primary dentition.[1] The predictability of permanent dentition/occlusion can easily be achieved after observing the characteristic features of childhood dental and alveolar systems in the formative years.[2]

In dental parlance, preschool children are expected to have fully erupted all their primary dentition and still maintain the full complement of the primary dentition. In this dentition, features like the presence of developmental spacing and anthropoid spaces, normal or shallow overbite and overjet, class 1 cuspid and flush terminal molar relationships are normal and required for the smooth transition from primary to permanent dentition and the eventual development of ideal occlusion.[3] These spaces will undoubtedly aid in positioning and accommodating the larger permanent incisors into the arch. In addition, the overjet, overbite and cuspid relationships will aid in proper adult tooth alignment and the primary molar relationship will influence the eventual adult molar relationship. The facial profile of a child indicates the growth pattern of his/her craniofacial skeleton. So when there is a deviation from the normal features in primary dentition, it could be transferred in a noticeable degree to the succeeding permanent dentition, [4] leading to one form of malocclusion or the other.

Malocclusion per se is not a disease but a morphological variation of the normal occlusion that may or may not be associated with any pathological condition. It ranks third among global dental public health priorities, after caries and periodontal disease, which account for the first and second dental public health problems respectively.[5] It does not only compromise maintaining better oral hygiene and the health of investing tissue but also can lead to social rejection and a sense of marginalization. This can affect the social integrity of an individual negatively.[6]

The establishment and maintenance of normal occlusion constitute one of the crucial objectives of paediatric dentistry treatment, whether preventive, interceptive, or corrective.[7] According to Moyers RE concerning primary dentition, the flush terminal plane molar relationship and generalized spacing are relatively common features observed.[8] Moreso, several observational studies on primary dentition have confirmed that the occlusal features vary among populations and ethnic groups.[9] Such data seems to be deficient in the Southern Nigeria population. So this study was carried out to assess the occlusal characteristic features among preschool children attending the paediatric dentistry clinic of the University of Benin teaching hospital, Ugbowo, Benin City, Edo state, Nigeria.

MATERIAL AND METHODS

The protocol for this study was reviewed, and approval was granted by the Ethics and Research Committee of the University of Benin Teaching Hospital, Benin City, Nigeria and with protocol number ADM/E 22//A/Vol.V12/148289. Permission was obtained from the Head of the Department of Paediatric and Preventive Dentistry, University of Benin Teaching Hospital, Benin City, Nigeria. Written informed consent was obtained from a parent/ guardian of each child before the participation.

The study was a hospital-based cross-sectional survey of 224 children who visited the Paediatric unit of the Department of Preventive Dentistry, University of Teaching Hospital, Benin City, Edo State, from December 2021 to November 2022. The study participants conveniently recruited included those aged 2 to 5 years with the full complement of the primary dentition and without any erupted permanent dentition. Excluded were those with special health care needs, those with clinically observed interproximal caries, oral habits or those who were unwilling to participate in the study. Trained and calibrated clinicians examined all participants in a well-lit dental clinic room and with an optimal inter-examiner reliability test indicated by K (Cohen's kappa) at (k=0.94).

An oral examination was performed on each participant using an explorer and a dental mirror. All the participating children were screened for certain occlusal characteristics namely, primary molar relation, canine relation, overjet and overbite using Foster and Hamilton[10] criteria with the teeth in centric occlusion; the presence or absence of anthropoid spaces and developmental spaces were assessed and Esmaeilzadeh et al[11] criteria were utilized for the assessment of the shape of the facial profiles. The sociodemographic variable considered was age and gender.

Description of occlusal characteristics

Primary molar relation

Flush or terminal plane: The distal surfaces of the mandibular and maxillary primary second molar are on the same vertical plane.

Mesial step: The distal surface of the mandibular primary molar is anterior to the distal surface of the maxillary primary second molar.
Distal step: The distal surface of the mandibular primary molar is posterior to the distal surface of the maxillary primary second molar.

Primary canine relation

Class I: The maxillary canine cusp tip is in the same vertical plane as the distal surface of the mandibular primary canine or the embrasure between the lower canine and first primary molar.
Class II: The maxillary canine cusp tip is mesial to the distal surface of the mandibular primary canine or biting anterior to the embrasure.
Class III: The maxillary canine cusp tip is distal to the distal surface of the mandibular primary canine or biting posterior to the embrasure.

Overjet assessment

Overjet was measured using a standard gauge as the distance from the incisal edge of the maxillary primary incisor to the labial surface of the mandibular primary incisors in the occlusal plane. Normal was recorded with a 2-3mm measurement. Reduced or edge-to-edge relationship is less than 2mm; increased is greater than 3mm and reversed if there was anterior cross-bite

Overbite assessment

Vertical occlusal relation was graded based on the coverage of the mandibular incisor by the fully erupted maxillary incisor in centric occlusion. Recorded as normal when the lower primary incisal edges were contacting the palatal surfaces of the upper primary central incisors; increased when the mandibular incisors were touching the palate; decreased if the incisal tips of the lower primary incisors were not contacting the upper incisors or the palate; and open bite when a gap existed between the incisal edges of incisors.

Space availability

Recorded were the presence of anthropoid and developmental spaces in the maxillary and mandibular arches. Anthropoid spaces are spaces located mesial to the maxillary canines and distal to the mandibular canines, while developmental spaces are those spaces other than anthropoid spaces in the maxillary and mandibular arches, e.g., anterior spaces

Facial profile evaluation

In the facial profiles of the participants, three categories were considered. First, the participants were examined from the side and with the Frankfort plane parallel to the occlusal plane and using two imaginary lines (X and Y) in the anterior-posterior profile. The X line was depicted from the bridge of the nose to the base of the upper lip. The Y line from the base of the upper lip 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 an angle less than 180 degrees to the facial soft tissue. B) The concave profile was assigned to an angle of more than 180 degrees to the facial soft tissue. C) The straight profile was assigned to the cases where these two lines were along each other. [**Legend I**]

Steps for data acquisition

For the determination of the occlusal characteristics, the participant sat on a well-lit dental chair with the examiner in front and to the right of the participant. Next, the participants were asked to open their mouths and try to swallow saliva and then close their mouths in order to properly locate their centric occlusion. With their teeth in occlusion, the molar and canine relation, overjet and overbite relations were assessed while the anthropoid spaces and developmental spaces were examined with the mouth opened. The facial profile was examined by allowing the participant to stand in profile close to the clinic wall while the examiner stood close to and on the side, either left or right of the participant.

Data analysis

Data obtained, which was recorded on a data collection sheet, were stored on an Excel sheet and analyzed using statistical software (SPSS version 21.0, Chicago). Categorical data were analyzed by Chi-square test. Significance for all statistical tests was predetermined at a probability value of less than 0.05.

RESULT

Two hundred and twenty-four children aged 2 to 5 years with a mean age of 3.79 $\pm$ 0.98 participated in this study. Females accounted for 55.6%, 4-year-olds accounted for 35.7% and the least were 2-year-olds at 12.1% [Table 1]

The recorded occlusal characteristics and facial profile of the study participants revealed that bilateral flush terminal plane molar relationship was found in 126(56%), bilateral canine class 1 was found in 189(84.4%), bilateral normal overjet was found in 191(85.3%) and bilateral normal overbite in 183(81.7%). Others are the developmental spaces in the maxilla found in 136(60.7%) and in the mandible 105(46.9%), anthropoid space in the maxilla was 198(88.4%) and the mandible was 126(56.3%). The most prevalent facial profile was the straight facial

profile which was found in 147(65.6%) of the participants. [Table 2]

Table 3 provides information on the percentage of occlusal characteristics and facial profiles in relation to gender. Regarding the molar relationship, bilateral flush terminal plane molar relationship was slightly more among females 66(52.4%), bilateral mesial steps were more prevalent among females 55(65.5%) and the distal step was mostly among males 11(91.7%). The difference between gender and primary molar relationship was statistically significant (P=0.001). Bilateral class 1 and class II primary canine relation was slightly more among females at 54.5% and 57.1% respectively, while bilateral class III was mostly (70%) seen among males. Bilateral normal overjet was seen in 56.0% of females, while bilateral reduce overjet was majorly (60%) among females and increased overjet was seen in 58.8% among males. Normal, reduced and deep bites were seen in 55.9%, 50% and 61.9% among females. The relationship between gender with primary canine relation, overjet and overbite was not statistically significant (P>0.05). The presence of maxillary anthropoid space was slightly over half (52.5%) and the absence was majorly (77%) among females. This finding was statistically significant (p=0.019). Developmental spaces in the maxillary arch were seen in 50.7% of males, while the absence of maxillary developmental space was seen majorly (64.8%) in females, which was statistically significant (p=0.023). Among females, convex, concave and straight facial profiles were seen in 56.3%, 66.7% and 54.4% respectively. This finding was not statistically significant. (P>0.05).

Table 4 shows the prevalence of occlusal parameters in the primary dentition in children between 2 to 5 years old. Most prevalent occlusal characteristic in sagittal directions across ages 2,3 and 4 years was the flush terminal plane with 66.7%, 56.4% and 62.8% respectively, but at 5 years, the mesial step became the most prevalent with 46.8%. This finding was not statistically significant (p=0.237). Normal overbite was prevalent across all studied ages and was more at age 4(85.5%) than at age 2(70.4%). This was statistically significant (p=0.000). Maxillary anthropoid space is prevalent across the ages studied and was more at age 2(100.0%) than at age 5(80.6%). This was statistically significant (p=0.005). And the straight facial profile is also prevalent across ages, more at age 2(70.4%) than at age 4(56.3%). This was statistically significant (p=0.026).

Table 1: Sociodemographic characteristics of the study participants

Sociodemographic Variable	Frequency (N)	Percent (%)
Age(years)		
2.00	27	12.1
3.00	55	24.6
4.00	80	35.7
5.00	62	27.7
Gender		
Male	100	44.6
Female	124	55.4

Table 2: Prevalence of occlusal characteristics and facial profile of the study participants

Variable	Types	Number	Percent
Primary molar relation	Bilateral Flush terminal	126	56.3
	Bilateral Mesial step	84	37.5
	Bilateral Distal step	12	5.4
	Unilateral Flush terminal	2	0.9
Primary canine relation	Bilateral Class 1	189	84.4
	Bilateral Class II	21	9.4
	Bilateral Class III	10	4.5
	Unilateral Class 1	4	1.8
Overjet relation	Bilateral Normal	191	85.3
	Bilateral Reduce	10	4.5
	Bilateral Increase	17	7.6

	Bilateral Reverse	4	1.8
	Unilateral Normal	2	0.9
Overbite relation	Bilateral Normal	187	83.4
	Bilateral Decreased	12	5.4
	Bilateral Deep bite	21	9.4
	Bilateral Open bite	4	1.8
Anthropoid space			
Maxillary arch	Present	198	88.4
	Absent	26	11.6
Mandibular arch	Present	126	56.3
	Absent	98	43.8
Developmental space			
Maxillary arch	Present	136	60.7
	Absent	88	39.3
Mandibular arch	Present	105	46.9
	Absent	119	53.1
Facial profile	Convex	71	31.7
	Concave	6	2.7
	Straight	147	65.6

Table 3: Percentage of the occlusal characteristics and facial profile in relation gender

Variable	Types	Male		Female		P value
		n	%	n	%	
Primary molar relation	Bilateral Flush terminal	60	47.6	66	52.4	0.001*
	Bilateral Mesial step	29	34.5	55	65.5	
	Bilateral Distal step	11	91.7	1	8.3	
	Unilateral Flush terminal	0	0.0	2	100.0	
Primary canine relation	Bilateral Class 1	86	45.5	103	54.5	0.622
	Bilateral Class II	9	42.9	12	57.1	
	Bilateral Class III	3	30.0	7	70.0	
	Unilateral Class 1	2	50.0	2	50.0	
Overjet relation	Bilateral Normal	84	44.0	107	56.0	0.194
	Bilateral Reduce	4	40.0	6	60.0	
	Bilateral Increase	10	58.8	7	41.2	
	Bilateral Reverse	0	0.0	4	100.0	
	Unilateral Normal	2	100.0	-	-	
Overbite relation	Bilateral Normal	82	44.1	105	55.9	0.907
	Bilateral Decreased	6	50.0	6	50.0	
	Bilateral Deep bite	8	38.1	13	61.9	
	Bilateral Open bite	2	50.0	2	50.0	
Anthropoid space						
Maxillary arch	Present	94	47.5	104	52.5	0.019*
	Absent	6	23.0	20	77.0	
Mandibular arch	Present	54	43.5	72	56.5	0.542
	Absent	46	46.9	52	53.1	
Developmental space						
Maxillary arch	Present	69	50.7	67	49.3	0.023*
	Absent	31	35.2	57	64.8	
Mandibular arch	Present	49	46.7	56	53.3	0.567
	Absent	51	42.9	68	57.1	

Facial profile	Convex	31	43.7	40	56.3	0.823
	Concave	2	33.3	4	66.7	
	Straight	67	45.6	80	54.4	

Table 4: Distribution of occlusal parameter according to age.

Variable	**Prevalence by age n (%)**				**Total**	**P value**
	2years	3 years	4 years	5 years	n (%)	
Primary molar relation						
Bilateral Flush terminal	18(66.7)	31(56.4)	49(62.8)	28(45.2)	126(56.3)	0.237
Bilateral Mesial step	7(25.9)	23(41.8)	25(32.1)	29(46.8)	84(37.5)	
Bilateral Distal step	2(7.4)	1(1.8)	4(5.1)	5(8.1)	12(5.4)	
Asymmetry	2(0.9)	-	-	-	2(0.9)	
Primary canine relation						
Bilateral Class 1	22(81.5)	46(86.8)	70(88.8)	51(85.0)	189(84.4)	0.152
Bilateral Class II	1(3.7)	5(9.4)	8(10.0)	7(10.0)	21(9.4)	
Bilateral Class III	4(14.8)	2(3.8)	1(1.3)	3(5.0)	10(4.5)	
Asymmetry	-	2(0.9)	-	2(0.9)	4(1.8)	
Overjet relation						
Bilateral Normal	21(77.8)	49(89.1)	69(88.5)	52(83.9)	191(85.3)	0.131
Bilateral Reduce	0(0.0)	2(3.6)	4(5.1)	4(6.5)	10(4.5)	
Bilateral Increase	6(22.2)	4(7.3)	3(3.8)	4(6.5)	17(7.6)	
Bilateral Reverse	0(0.0)	0(0.0)	2(2.6)	2(2.6)	4(1.8)	
Asymmetry	2(0.9)	-	-	-	2(0.9)	
Overbite relation						
Bilateral Normal	20(70.4)	48(85.5)	70(88.5)	49(80.0)	187(83.4)	0.000*
Bilateral Decreased	0(0.0)	4(7.3)	6(7.7)	2(3.3)	12(5.4)	
Bilateral Deep bite	4(14.8)	4(7.3)	3(3.8)	10(16.7)	21(9.4)	
Bilateral Open bite	4(14.8)	0(0.0)	0(0.0)	0(0.0)	4(1.8)	
Anthropoid space						
Maxillary arch						
Present	27(100.0)	45(81.8)	76(95.0)	50(80.6)	198(88.4)	0.005
Absent	0(0.0)	10(18.2)	4(5.0)	12(19.4)	26(11.6)	
Mandibular arch						
Present	18(66.7)	33(60.0)	36(45.0)	39(62.9)	126(56.3)	0.081
Absent	9(33.3)	22(60.0)	44(55.0)	23(37.1)	98(43.8)	
Developmental space						
Maxillary arch						
Present	19(70.4)	33(60.0)	54(67.5)	30(48.4)	136(60.7)	0.087
Absent	8(29.6)	22(40.0)	26(32.5)	32(51.6)	88(39.3)	
Mandibular arch						
Present	12(44.4)	29(52.7)	38(47.5)	26(41.9)	105(46.9)	0.701
Absent	15(55.6)	26(47.3)	42(52.5)	36(58.1)	119(53.1)	
Facial profile						
Convex	8(29.6)	12(21.8)	35(43.8)	16(25.8)	71(31.7)	0.026
Concave	0(0.0)	2(3.6)	0(0.0)	4(6.5)	6(2.7)	
Straight	19(70.4)	41(74.5)	45(56.3)	42(67.7)	147(65.6)	

DISCUSSION

It is within the purview of a paediatric dentist to recognize early the conditions that predispose young children to malocclusion, so that early interceptive procedure will be applied to prevent further consequences.[12] On the strength of early recognition of malocclusion, early institution of education for parents to seek dental care at a young age will be

fostered, and children at risk will get early treatment and the additional benefits of a regular follow-up.[13] Early detection of any discrepancy in the primary dentition is crucial for preventing malocclusion in the adult dentition. The present study was designed and performed to provide early information about the prevalence of the characteristic features of occlusion and soft tissue facial profile among the study participants

This study revealed that the most common molar relationship was the flush terminal plane, followed by the mesial step and then the distal step. This finding in our study is similar to the findings of some previous studies [2,11, 14, 15, 16,17,18, 19] but at variants in studies by Shah P et al. [20] and Ferreira et al. [21] that reported mesial step as the most prevalent molar relationship. However, Talebi et al. [22] reported that the distal step relation is higher in Iranian populations. Moreso, the relationship between molar relationships and gender in this study was statistically significant. Geographical and racial differences would have contributed to these finding variations. The flush terminal plane relationship was more at age 2 and decreased at age 5, while the mesial step was less at age 2 and increased at age 5. There is an increase in mesial step relation with increasing age. Such similar changes in molar relationships with increasing age have been found in some previous studies on different populations.[3, 23, 24] Such changes may be attributed to the effect of the erupting first permanent molars as well as the forward growth of the mandible.

This study showed that class I canine relation was more prevalent in primary dentition. Our findings corroborate observations made in previous studies. [3,21,23,25] Contradictory findings were reported by Keski-Nisula et al[26] among Finnish children revealed that class II canine was observed to be more prevalent, followed by class I and then class III. Racial differences would have also accounted for this observation.

Normal overjet is the most prevalent in this study at 85.3%, followed by increase overjet 7.5% and the least was reverse overjet at 1.8%. This finding is consistent with Nigerian children, as reported by Onyeaso and Isiekwe.[25] Moreso, Indian children had ideal overjet as seen in this study.[24] On the contrary, Ravn[27] reported increased overjet in 27% of Copenhagen children and Foster and Hamilton[10] found increased overjet in 72% of $2^1/_2$- to 3-year-old children. Normal overjet is prevalent across gender (male and female) and all ages in this study. Although males recorded no reverse overjet, 3.2% reverse overjet was reported among females. This was not statistically significant.

An ideal overbite was found in 83.4 % of children, while 10.2% had deep bite, 1.6% had anterior open bite, and 4.8% had reduced bite. The higher prevalence of normal overbite seen in our study is similar to reports from Onyeaso and Isiekwe,[25] Bhayya et al. [3] but contrary to Rai et al.,[16] study among Mongolian and Caucasian race reported an ideal overjet of 41.1%. The prevalence of anterior open bite was 1.6% at age 2, but none was recorded across other ages and was significantly less than that found in the Western population. The rationale behind this may be due to the lesser prevalence of habits like dummy sucking in this study population.

Anthropoid space is most prevalent in the maxillary arch than in the mandibular arch. This is similar to the findings of Ferreira et al.[21] The prevalence of maxillary anthropoid space was found more among males than females. This was statistically significant (p=0.019). Moreso, anterior spaces were also seen more in the maxilla than in the mandible. The prevalence of maxillary anterior space was found more among males than females. This was statistically significant (p= 0.023). The likelihood of lower anterior crowding among females in this study cannot be overemphasized. This study found no significant change in developmental spaces and anthropoid spaces with increasing age. Even with increasing age, the mesial force of erupting mandibular molar could not necessarily cause any significant arch-length loss in the anterior region.

Straight facial profile was commonest, followed by convex and concave profile. This finding is similar to the reports of Rai et al.,[16] Yadav et al.,[28] and Fernandes et al.[15] On the contrary, Bhayya & Shyagali[29] and Mahmoodian et al[30] reported among Indians and Iranian children respectively that the convex profile was the most prevalent. Also, Alexander and Prabhu[31] mentioned the convex profile as the most prevalent among male children; however, the straight profile had the highest prevalence among female children in that study. This may be due to ethnic variation in different geographic locations.

CONCLUSION

The study's most prevalent facial and occlusal characteristics were the straight facial profile, bilateral flush terminal relationship, class 1 canine, normal overjet, normal overbite, and maxillary anthropoid and developmental spaces. Revealed in

this study were mostly desirable occlusal features but with some occlusal characteristics that deviate from the norm. However, future longitudinal studies are needed to observe whether the transition of these occlusal characteristics will lead to favourable occlusion in permanent dentition.

Source of support
Nil

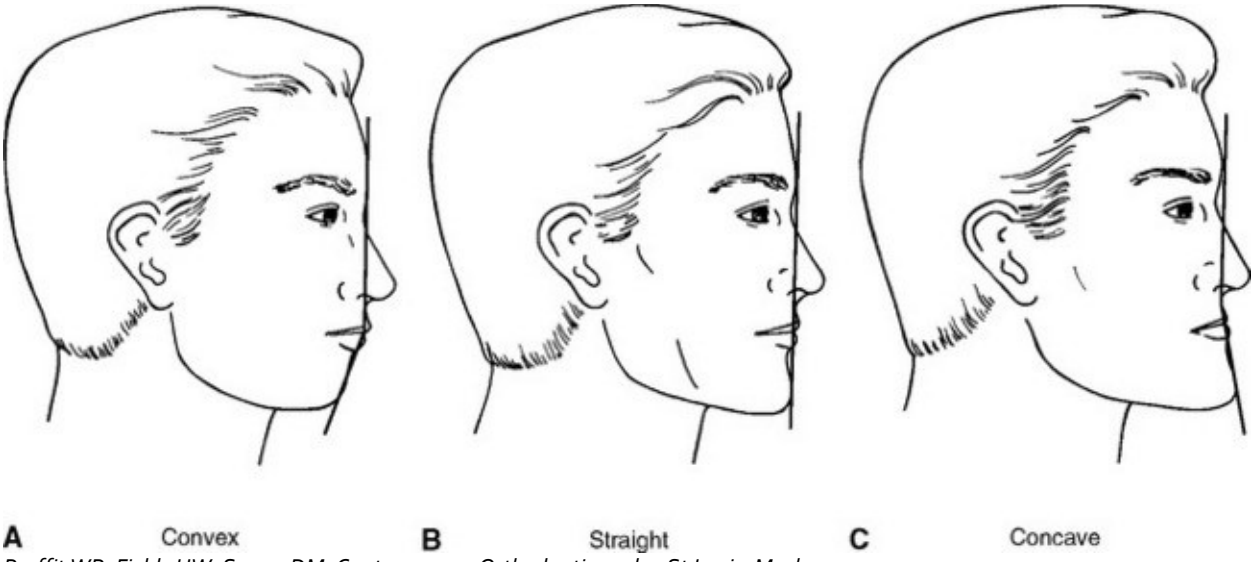
Conflict of interest
None Declared

REFERENCES

1. Wright GZ KD. "Space control in the primary and mixed dentitions," Dental Clinics of North America.1978; 22: 579–601.
2. Hegde KS, Bhat SS, Rao HA. Characteristics of Primary Dentition Occlusion in Preschool Children: An Epidemiological Study. Int J Clin Pediatr Dent. 2012; 5:93-97. doi:10.5005/jp-journals-10005-1143
3. Bhayya D, Shyagali T, Dixit U, Shivaprakash. Study of occlusal characteristics of primary dentition and the prevalence of malocclusion in 4 to 6 years old children in India. Dent Res J (Isfahan). 2012; 9(5):619. doi:10.4103/1735-3327.104883
4. Otuyemi OD, Sote EO, Isiekwe MC, Jones SP. Occlusal relationships and spacing or crowding of teeth in the dentitions of 3-4-year-old Nigerian children. Int J Paediatr Dent. 1997;7(3):155-160. doi:10.1046/j.1365-263x.1997.00232.x
5. Redžepagić Vražalica L, Ilić Z, Laganin S, Džemidžic V TA. An epidemiological study of malocclusion and occlusal traits related to different stages of dental development. South Eur J Orthod Dentofac Res. 2017: 9-13.
6. Shavi GR, Hiremath NV, Shukla R, Bali PK, Jain SK AS. Prevalence of spaced and non-spaced dentition and the occlusal relationship of primary dentition and its relation to malocclusion in school children of Davangere. J Int Oral Heal. 2015; 7:75.
7. Foster TD, Grundy MC. Occlusal changes from primary to permanent dentition. Br Dent Orthod. 1986; 13:187-193
8. Moyers RE. Handbook of Orthodontics, 3rd edn. Chicago: Yearbook Medical Publishers; 1972
9. Vegesna M, Chandrasekhar R, Chandrappa V. Occlusal characteristics and spacing in primary dentition: A gender comparative cross-sectional study. Int Sch Res Notices. 2014; 2014:512680
10. Foster TD and MC Hamilton. Occlusion in the primary dentition. Study of children at 2 and one-half to 3 years of age. Br Dent J. 1969; 126(2)76-79
11. Esmaeilzadeh M, Donyavi Z, Mahjoub P, Tayebi S, Ilampour G. The facial profiles, occlusal plane relationships, and dental spacing in children aged 3-6 years. J Chem Pharm Sci. 2016; 9(2):765-770.
12. Shavi GR, Hiremath NV, Shukla R, Bali PK, Jain SK AS. Prevalence of spaced and non-spaced dentition and the occlusal relationship of primary dentition and its relation to malocclusion in school children of Davangere. J Int Oral Heal. 2015; 7:75.
13. Shah P, Acharya J, Khanal S. Occlusal traits of primary dentition among children visiting a dental hospital in Kathmandu, Nepal. Nepal Med Coll J. 2019; 21(2):122-127. doi:10.3126/nmcj.v21i2.25111
14. Otuyemi OD, Sote EO, Isiekwe MC, Jones SP. Occlusal relationships and spacing or crowding of teeth in the dentitions of 3-4-year-old Nigerian children. Int J Paediatr Dent. 1997;7(3):155-160. doi:10.1046/j.1365-263x.1997.00232.x
15. Fernandes S. Occlusal traits of primary dentition among preschool children of Mehsana district, North Gujarat, India. J Clin Diagnostic Res. 2017; 11(1):92-96. doi:10.7860/jcdr/2017/22515.9266
16. Rai A, Koirala B, Dali M, Shrestha S, Shrestha A, Niraula SR. Occlusal characteristics of primary dentition among school going children. J Nepal Health Res Counc. 2020; 18(3):386-393. doi:10.33314/jnhrc.v18i3.2237
17. Lochib S, Indushekar KR, Saraf BG, Sheoran N, Sardana D. Occlusal characteristics and prevalence of associated dental anomalies in the primary dentition. J Epidemiol Glob Health. 2015; 5(2):151-157. doi:10.1016/j.jegh.2014.07.001
18. Badr SBY, Yahfoufi, Sara HY. Assessment of the occlusal characteristics of the primary dentition among Lebanese preschool children: a baseline study cross-sectional study. BAU J - Health and Wellbeing. 2020: 2: 1-5
19. Gupta S, Grover R, Bhargawa A. Assessment of occlusal characteristics in primary dentition of preschool children in Amritsar, Punjab, India. AMEI's Curr Trends Diagnosis Treat. 2018;2(1):15-21. doi:10.5005/jp-journals-10055-0031

20. Shah P, Acharya J, Khanal S. Occlusal traits of primary dentition among children visiting a dental hospital in Kathmandu, Nepal. Nepal Med Coll J. 2019; 21(2):122-127. doi:10.3126/nmcj.v21i2.25111
21. Ferreira RI, Barreira AK, Soares CD AA. Prevalence of normal occlusion traits in deciduous dentition. Pesqui Odontol Bras. 2001; 15:23-28.
22. Talebi M, Ajami B SR. Evaluation of the Occlusion and Arch Dimensions in the Primary Dentition of an Iranian Population JDMT. JDMT. 2013; 2(1):11-16.
23. Yilmaz Y, Gürbüz T, Şimşek S, Dalmiş A. Primary canine and molar relationships in centric occlusion in three to six-year-old Turkish children: A cross-sectional study. J Contemp Dent Pract. 2006; 7(3):059-066. doi:10.5005/jcdp-7-3-59
24. Hegde S, Panwar S, Bolar DR SM. Characteristics of occlusion in primary dentition of preschool children of Udaipur, India. Eur J Dent. 2012; 6.51-55.
25. Onyeaso CO, Isiekwe MC. Occlusal changes from primary to mixed dentitions in Nigerian children. Angle Orthod. 2008; 78(1):64-69. doi:10.2319/021207-66.1
26. Keski-Nisula K, Lehto R, Lusa V, Keski-Nisula L VJ. Occurrence of malocclusion and need of orthodontic treatment in early mixed dentition. Am J Orthod Dentofac Orthop. 203AD; 124:631-638.
27. Ravn JJ. Occlusion in the primary dentition in 3-year-old children. Scand J Dent Res. 1975; 83(3):123–30.
28. Yadav NR, Prasad S, Rajashekharappa CB TS. Gender influence on occlusal characteristics in the primary dentition. APOS Trends Orthod. 2014; 4(4):87-92.
29. Bhayya DP, Shyagali TR Gender influence on occlusal characteristics of primary dentition in 4- to 6-year-old children of Bagalkot City, India. Oral Heal Prev Dent. 2001; 9(1):17–27.
30. Mahmoodian J, Afshar H & HM. Determination of primate space on 4 to 5 Years Old Children of Tehran's Kindergarten In 2000. J Dent. 2004; 1:21-26.
31. Alexander S, & Prabhu N. Profiles, Occlusal Plane Relationships and spacing of teeth in the dentitions of 3 to 4-year-old children. J Clin Pediatr Dent. 1997; 22:329-334.

Legend I: Facial profiles



Proffit WR, Fields HW, Sarver DM: Contemporary Orthodontics, ed 4, St Louis, Mosby, 2007.