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Occlusal Characteristics of Primary Dentition in Pre-schoolers: A Hospital Based Analytical Cross-Sectional Study

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ABSTRACT

Introduction: The common terminal molar relations are flush terminal, mesial step and distal step. Along with that the normal features of primary dentition are physiological spaces, flush terminal plane, low overjet and overbite and ovoid arch form. Variations in these features would be carried to the succeeding permanent dentition in a more distinct form.

Objective: The study aimed to assess the occlusal characteristics of primary dentition in preschoolers visiting one of the tertiary hospitals in Nepal.

Methods: An analytical cross-sectional study was conducted in pre-schoolers selected by convenience sampling method. Occlusal characteristics of primary dentition such as molar relation, canine relation, overbite, overjet, crowding and cross bite were recorded.

Results: The most common type of molar relation was flush terminal plane (50.8- 51.2%) followed by mesial step (48.1- 48.5%) and distal step (0.4 - 1.2%). Canine relation was predominantly Class I (92-93%) followed by class II (5-6%) and class III. The prevalence of crowding, ideal overjet, ideal overbite, physiological spaces was 9.6%, 79.6%, 60.8%, 60% respectively. The median overjet and overbite were identical across the compared groups at 2 mm (1–2 mm) and 2 mm (2-3 mm) respectively.

Conclusions: The most common type of occlusal characteristics were flush terminal plane and class I canine relation. This may be attributed to balanced growth of craniofacial region and anteroposterior arch in most of the children suggesting lower probability of malocclusion in permanent dentition.

Keywords: Canine relation; deciduous tooth; malocclusion**;** terminal molar relation.

INTRODUCTION

The understanding of occlusal characteristics of primary dentition is of utmost importance as it plays a crucial role in the overall growth and development of the jaw.

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Along with that, its major function is to guide permanent teeth eruption, development of masticatory and phonetic functions, and prevention of future malocclusion, unesthetic facial appearance and psychological impact.[1] The normal developmental features of primary dentition are physiological spaces, a flush terminal plane, a low overjet, a deep overbite, and an ovoid arch form. Variations in these features would be carried to the succeeding permanent dentition in a more distinct form.[2] Several previous studies have suggested that certain occlusal patterns are correlated with some malocclusions.[3, 4]

Also, it has been established that occlusal features have a varied presentation among different populations and ethnic groups.[4] Therefore, it is crucial to understand the occlusal relationship of primary dentition and educate people to anticipate and start interceptive treatment at an early stage. But very limited literature is available regarding occlusal characteristics in the Nepalese population. Hence, the study aims to fill the gap by providing data on the occlusal characteristics of primary dentition, including molar relation, canine relation, overjet, and overbite among pre-schoolers.

METHODS

An analytical cross-sectional study was conducted in patients visiting the Department of Paediatric and Preventive Dentistry of a tertiary hospital. Ethical approval for the research was obtained from Kathmandu University School of Medical Sciences, Institutional Review Committee (Ref 95/24). The sample size was calculated using Cochran's formula**:** $n = z^2 \cdot p \cdot q / e^2$**,** where *n* is the required sample size, *z* is the standard normal deviate (1.96 for 95% confidence level), *p* is the estimated prevalence taken from a study by Sadana et al.[5] (0.78), *q* is (1−p), and *e* is the margin of error, set at 5% (0.05).

A total sample size of 260 was calculated using the given formula. Patients with Frankl's positive and definitely positive behaviour, within the age of 3-6 years, having primary dentition, were included in the study. Children with special health care needs, mixed and complete permanent dentition, and missing primary molars and anterior teeth were excluded. Data was collected using a non-probability convenience sampling technique. Informed consent was obtained from the parents or guardians of the patients after giving them complete information regarding the study.

In the selected patients, the terminal plane relationship of the second primary molar was recorded as a flush terminal plane, a mesial step molar relation, or a distal step molar relation. Similarly, the primary canine relationship was recorded as class I, class II, or class III. After that, overjet was recorded in the maximum distance between the incisal edges of maxillary and mandibular primary incisors in the occlusal plane. Overjet was considered ideal when the distance was up to 1-2mm, increased overjet when the distance was more than 2mm, and edge-to-edge relation when there was no distance. Likewise, overbite was recorded by measuring the distance between the mandibular incisor and the most protruded fully erupted maxillary incisor. Overbite was considered ideal when the distance was up to 1-2mm, increased overbite when the distance was more than 2mm, and decreased overbite when the distance was less than 1mm.

Physiological spacing was considered present if any one kind of developmental spaces, such as primate spaces, interincisal spaces, or intermolar spaces, was present. Similarly, crowding was recorded in the presence of incisors overlapping or rotation. Crossbite was recorded when one or more of the maxillary teeth occluded lingually to the mandibular teeth, both in the anterior or posterior region of the jaw. The data was entered and analysed using IBM Statistical Package of Social Sciences (SPSS) Statistics for Windows, version 24 (IBM, Inc., Chicago, IL, USA). Mean, standard deviation, frequency, and percentage were calculated in descriptive statistics. Chi-square test or Fisher's exact test was used to determine the association of occlusal characteristics among males and females.

RESULTS

Among 260 study participants examined, mean age of study participants were 4.76±0.997 years (Median=5, IQR=4-6, Range=3-6 years), where 51.9% were males, 48.1% were females. (Table 1). The most common type of molar relation was flush terminal plane (132, 50.8% on right side and 133, 51.2% on left side) followed by mesial step (125, 48.1% on right side and 126, 48.5% on left side) and distal step (3, 1.2% on right side and 1, 0.4% on left side).There was no significant difference in molar relation in both right and left side. Canine relation was predominantly Class I on both sides across all age groups (240, 92.3% on right side and 242, 93.1%) followed by class II (17, 6.5% on right side and 14, 5.4% on left side) and class III(3, 1.2% on right side and 4,1.5% on left side).(Table 2)

Table 1: Demographic characteristics of study participants.

Characteristics	Category	No. of study participants(n) %
Age in years	3	27 (10.4)
	4	86 (33.1%)
	5	69 (26.5)
	6	78 (30.0)
Sex distribution	Male	135 (51.9)
	Female	125 (48.1)

Table 2: Molar and canine relationship of study participants according to age.

Age in years	No. of study participants	Right side n (%)			Left side n (%)		
		Flush terminal	Mesial step	Distal step	Flush terminal	Mesial step	Distal step
Molar relationship							
3	27	20 (74.1)	7 (25.9)	-	19 (70.4)	8 (29.6)	-
4	86	45 (52.3)	40 (46.5)	1 (1.2)	47 (54.7)	39 (45.3)	-
5	69	34 (49.3)	34 (49.3)	1 (1.4)	34 (49.3)	35 (50.7)	-
6	78	33 (42.3)	44 (56.4)	1 (1.3)	33 (42.3)	44 (56.4)	1 (1.3)
Total n (%)	260	132 (50.8)	125 (48.1)	3 (1.2)	133 (51.2)	126 (48.5)	1 (0.4)
Canine relationship		**Class I**	**Class II**	**Class III**	**Class I**	**Class II**	**Class III**
3	27	26 (96.3)	1 (3.7)	-	26 (96.3)	1 (3.7)	-
4	86	80 (93.0)	6 (7.0)	-	79 (91.9)	6 (7.0)	1 (1.2)
5	69	64 (92.8)	4 (5.8)	1 (1.4)	66 (95.7)	2 (2.9)	1 (1.4)
6	78	70 (89.7)	6 (7.7)	2 (2.6)	71 (91.0)	5 (6.4)	2 (2.6)
Total n (%)	260	240 (92.3)	17 (6.5)	3 (1.2)	242 (93.1)	14 (5.4)	4 (1.5)

There was no significant difference between sex on both sides in relation to molar (p= 0.663) and canine relation (p=0.722). (Table 3). The prevalence of crowding was 9.6% and there was no statistically significant difference between male and female (p value = 0.668). There was a presence of physiological spaces in 60% of the study participants with no statistically significant difference between males and females (p value = 0.612). The prevalence of cross-bite was 2.3%, with no statistically significant difference between sexes (p value = 0.99). Overjet and overbite values were described using medians and interquartile ranges (IQR), The median (IQR) overjet and overbite were identical across the compared groups at 2 mm (1–2 mm) and 2 mm (2-3 mm), respectively (p value = 0.781 and p value= 0.277), respectively. (Table 4).

Table 3: Molar and canine relationship of study participants according to sex.

Age in years	No. of study participants	Right side n (%)			p value*	Left side n (%)			p value*
Molar relationship		Flush terminal	Mesial step	Distal step		Flush terminal	Mesial step	Distal step	
Males	135	70 (51.9)	63 (46.7)	2 (1.5)	0.850	71 (52.6)	63 (46.7)	1 (0.7)	0.663
Females	125	62 (49.6)	62 (49.6)	1 (0.8)		62 (49.6)	63 (50.4)	-	
Canine relationship		**Class I**	**Class II**	**Class III**		**Class I**	**Class II**	**Class III**	
Males	135	125 (92.6)	9 (6.7)	1 (0.7)	0.923	124 (91.9)	9 (6.7)	2 (1.5)	0.722
Females	125	115 (92.0)	8 (6.4)	2 (1.6)		118 (94.4)	5 (4.0)	2 (1.6)	

***Fisher's exact test**

Table 4: Distribution of other occlusal characteristics of study participants.

Variables	Category	Males (135)	Females (125)	Total	p value
Crowding n (%)	No	121 (89.6)	114 (91.2)	235 (90.4)	0.668*
	Yes	14 (10.4)	11 (8.8)	25 (9.6)	
Physiological spaces n (%)	No	56 (41.5)	48 (38.4)	104 (40.0)	0.612*
	Yes	79 (58.5)	77 (61.6)	156 (60.0)	
Cross-bite n (%)	No	132 (97.8)	122 (97.6)	254 (97.7)	<0.99[a]
	Yes	3 (2.2)	3 (2.4)	6 (2.3)	
Overjet (mm)	Median (IQR)	2 (1-2)	2 (1-2)	2 (1-2)	0.781[b]
Overbite (mm)	Median (IQR)	2 (2-3)	2 (2-3)	2 (1-3)	0.277[b]

***Chi-square test [a]Fisher's exact test, [b]Mann-Whitney U test**

An ideal overjet was observed in (207, 79.6%), increased overjet in (44, 16.9%) and edge to edge in (9, 3.5%). No statistically significant difference between male and female was observed (p value = >0.99). (Table 5). Ideal overbite was observed (158, 60.8%), increased overbite in (93, 35.8%), and decreased overbite (9, 3.5%). No statistically significant difference was observed between male and female (p>0.99) (Table 6)

Table 5: Distribution of overjet among males and females.

Characteristics	Category	No. of study participants	Ideal n (%)	Increased n (%)	Edge to edge n (%)	p value*
Overjet	Male	135	107 (79.3)	23 (17.0)	5 (3.7)	>0.99
	Female	125	100 (80.0)	21 (16.8)	4 (3.2)	
	Total	260	207 (79.6)	44 (16.9)	9 (3.5)	

***Chi-square test**

Table 6: Distribution of overbite among males and females.

Characteristics	Category	No. of study participants	Ideal n (%)	Increased n (%)	Decreased n (%)	p value
Overbite	Male	135	82 (60.7)	48 (35.6)	5 (3.7)	>0.99
	Female	125	76 (60.8)	45 (36.0)	4 (3.2)	
	Total	260	158 (60.8)	93 (35.8)	9 (3.5)	

DISCUSSION

The seamless transition from primary to permanent dentition can be predicted earlier with the help of predisposing factors like primary molar relation, canine relation, and developmental spacing of the primary dentition. In the present study, among 260 study participants examined, the most common type of molar relation observed was flush terminal plane (50.8-51.2%), followed by mesial step (48.1- 48.5%) and distal step (0.4 -1.2%). There was no significant difference in the molar relation in both the right and left sides. The finding of this

study is consistent with a previous study, which found the flush terminal plane to be the most common primary molar relation.[2,4,6] In contrast to these studies, some found the mesial step terminal plane to be the most common.[3,7] As the data suggested majority of participants had a flush terminal plane, and it could develop into an unfavourable molar relationship in the permanent dentition,[8] therefore these cases should be closely observed to initiate orthodontic treatment if needed.

Moreover, the flush terminal plane was most common at age 3, approximately 70–74%, but this gradually decreased with age to about 42% by age 6. Conversely, the mesial step increased from around 25–30% at age 3 to 56% by age 6. This may be attributed to the fact that with the growth of children from ages 3 to 6, there is a natural transition from a flush terminal to a mesial step molar relation. This is favourable for the development of class I molar relation in the permanent dentition.

Similarly, distal step molar relationships were least across all age groups, similar to other literature.[3,5] The previous study suggested that the presence of a distal step in the deciduous dentition developed into a Class II molar relationship in the permanent dentition, and none of them were self-corrected; hence, it is advised to initiate treatment as early as possible.[8] The presence of a less distal step population in the present study suggests the probability of favourable occlusion in the future.

In the present study, around 48% of the participants had mesial step primary molar relation. The presence of a mesial step in the primary dentition suggests a higher chance of a Class I molar relationship and a lower probability of a Class II molar relationship in the permanent dentition.[8] In addition, an increase in the value of the mesial step increases the incidence of a Class III molar relationship in permanent dentition.[8] However, the value of the mesial step was not measured in the present study.

Canine relation was predominantly Class I on both sides across all age groups (92-93%), followed by Class II and Class III. The data is consistent with almost all the prior studies.[3,5,6] The predominance of Class I canine relationships may be attributed to balanced growth of the anteroposterior arch in most children, with less probability of development of malocclusion in permanent dentition.

The physiological spaces were present in 60% of children, which may contribute to crowding and malocclusion in permanent dentition. This agrees with a study by Fernandes et al.[9] (56.7%) in the Indian population; however, contradictory data were reported by Rai et al.[4](77%) in other part of the Nepalese population.

In our study, an ideal overjet was observed in 79.6% of study participants. This result aligns with findings of past literature.[2,7,10] However, it was in opposition to some earlier observations by Shah et al.[3] (68.4%) and Rai et al.[4](53.5%) in other parts of Nepal. This difference might be attributed to the genetic and ethnic variance of the study population. Likewise, increased overjet was seen higher (17%) in our study as compared to the study by Shah et al.[3] (9.4%) in Kathmandu. Also, in contrast to Shah et al.[3] report (15.3%), a lower prevalence of edge-to-edge bite (3.5%) was observed.

The ideal overbite was observed in 60.8% which was like a study done by Shah et al.[3] and Yadav et al.[11] (68.9%), but it does not align with a study by Rai et al.[4](41.1%) and Bhayya et al.[10] (81.6%) in the Indian population. Likewise, in the present study, increased overbite was observed in 35.8% and decreased overbite was observed in 3.5% in contrast to the study by Shah et al.[3] (15% and 14.7%) in Kathmandu. Children had a mean overjet of 2.4 ± 0.8 mm, and the mean overbite was 0.8 ± 1.2 mm. The average mean value was close to the normal value, which suggests the presence of balanced craniofacial growth, neuromuscular functions, and absence of oral habits in the study population.

The prevalence of crowding in the present study was found to be 9.6% which predisposes the probability of crowding in permanent dentition. This data was lower than the study conducted in eastern Nepal[4] (13.3%) and in Nigeria[12] (18%), but higher than the study conducted in Saudi children[13] (6%) and Fernandes et al.[9](1.3%) in the Indian population. In the present study, crossbite was found to be present in only 2.3% of study participants, similar to findings of Gupta et al.[5] (3.3%) in India and Baral et al.[14](3%) in Kaski of Nepal. On the other hand, the data was opposite to the study of Rai et al.[4] (7.2%) in Nepal and Bhat et al.[6] (0.4%) in India. Nevertheless, the sample may not completely represent the diversity of children across different geographic and ethnic groups of the country. Moreover, the cross-sectional nature of the study cannot determine causal relationships or observe changes in occlusal development over time. Therefore, future research should consider longitudinal studies with larger and more diverse sample sizes.

CONCLUSION

Flush terminal plane and Class I canine relation were the most frequently observed occlusal relationships, suggesting a lower probability of malocclusion in permanent dentition in the studied population. The present study not only adds to the existing literature on occlusal traits in primary dentition but also provides overall data on occlusal characteristics at a specific age, which is useful for identifying developmental patterns or early malocclusion signs. However, the sample may not represent children from varied socioeconomic, geographical, or ethnic backgrounds. Hence, we recommend longitudinal studies with larger sample sizes in the future, reflecting the diversity of children across different geographic and ethnic groups of the country.

Conflict of interest: None

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