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A Clinico-Observational Study of Proximal Contacts in Primary Molars Among Bengali Children

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Key Words:

Proximal contacts, Primary molars, Clinical examination, Study models

Abstract:

Background: A well-contoured, properly positioned, firm proximal contact between teeth maintains the stability and integrity of the dental arches and the health of supporting structures. Earlier literature portrayed the presence of interproximal contacts in primary molars as open/closed, O, X, I, S contacts in different populations, but there is no study of interproximal contacts among Bengali children. Aim: To find the prevalence of different interproximal contact areas of primary molars in Bengali children. Methodology: 124 contacts of 34 Bengali children of 3 to 6 years of age who reported Out Patient Department of Paediatric Dentistry of the institute as well from randomly different schools were the study population. The clinical examination of the contact areas in primary molars followed by study model assessment was done and the data of pattern of proximal contact areas in primary molars was recorded and was subjected to statistical analysis. Results: The prevalence of type of contact is O (6.4%), X (3.2%), I (78.2%) and S (12%). No statistical significant difference was found in inter-arch and intra-arch comparison. Conclusion: The knowledge of morphology of proximal contacts may help the clinician in caries risk assessment, as well it helps to re-establish the contact characteristics through restorative procedures.

1. Introduction:

A tooth's contact area is the region of the proximal height and contour of the proximal surface that makes contact with the neighbouring tooth in the same arch.[1]Maintainingthe stability and integrity of the dental arches as well as the overall health of the supporting tissues requires a properly positioned contact. The possibility of developing periodontal disease, caries, and tooth movement increases on food impaction due to improper contacts.

There is initially a contact point when teeth erupt to make proximal contact with previously erupted teeth. During physiologic tooth movement the two adjacent tooth surfaces undergo abrasion with each other, as a result the contact point increases in size to become a proximal contact area in course of time.

Existing literature depicts the contacts between primary molars are broader, flatter, and further cervically located compared to permanent molars.[2-5]A review of the literature showed the presence of two types of contacts: open and closed.[6-8]Muthu MS et al

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(2018)[9] proposed OXIS criteria for classification of interproximal contact areas in primary molars. Several studies[10-12] were also done using the same criteria later. Contact area assessment can be done by different methods- clinical examination, CBCT images, study model assessment by dental loupes, stereomicroscope images etc.[9-12,18]

For the purpose of estimating the risk of caries, it is crucial to understand the proximal contact area of primary molars. Additionally, changes in the contact area type (open or closed) may have an impact on how primary molar cavity preparations done particularly in class II cases. By carrying out suitable restorative procedures, the contact must be restored.

The studies regarding interproximal contact morphology of primary teeth using OXIS contact criteria were done in Puducherry[10,12], Ajman[12]and South Korea[11]. Thus, the present study is an attempt to find the prevalence of different types of contact areas in primary molars among Bengali children.

2. Methodology:

A protocol for the proposed project was submitted to the institutional ethical committee of the institute. Requisite ethical clearance & permission to undertake the study was obtained from the respective committee.

Cases were selected (convenience sampling) from the out-patient-department of the Department of Paediatric and Preventive Dentistry of the institute, as well from randomly different schools where dental camps were organised. 34 children who fit into the inclusion and exclusion criteria were selected. Sample size chosen was 124 contact areas of 34 children by the formula, $N = Zpq/ d^2$; where p: expected prevalence (most common contact from previous study[12]) = 53%, and q: 1-p (100 – 53 = 47) and Relative precision (d) = 20% of p = 10.6. So n =1.96x1.96x53x47/10.6x10.6 = 86 and after considering 10% non-response, desired sample size (N) = 95 contact areas. So final sample size chosen is 124 contact areas.

Inclusion criteria for observational study:

- 3 to 6 years aged children
- Children with caries-free (International Caries Detection and Assessment System = 0) primary molars at least in one quadrant
- Children who cooperated throughout the taking of impressions
- Children whose parents signed a written consent form
- Children whose chosen quadrant for taking an impression is free of dental plaque or other material.

Exclusion criteria for observational study:

- Children with special healthcare needs.
- Children having developmental anomalies in the shapes and sizes of their teeth.
- Children who have a strong gag reflex

Inclusion criteria for study model analysis

- Children whose parents signed a written consent form
- Models of children with caries-free (International Caries Detection and Assessment System = 0) primary molars at least in one quadrant
- Good-quality models (absence of porosities).

Exclusion criteria for study model analysis:

- Porous or damaged study models.

The written consent was taken from the parents of the children and a verbal assent was taken from the child before including the child in the study. The clinical examination was conducted by means of sterile mouth mirror and probe. Sectional die impressions or full arch impressions of the children were made using alginate and poured using Type IV die stone.

Using OXIS criteria as seen from an occlusal view, the clinical assessment of the contact area between the distal surface of the primary first molar and the mesial surface of the primary second molar in both arches was performed. To evaluate whether the contact areas were closed or open, dental floss was used. Resistance felt in a contact area was rated according to the predetermined shape. The contact area was rated as open if there was no resistance present.

The study model assessment of the type of contact area was also done using OXIS criteria, as seen from an occlusal view with a minimum distance of 12 inches by means of mini dental loupes with 2.5x magnification in the selected quadrants. Comparison

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(interclass correlation coefficient [ICC]) of clinical evaluation against study model analysis method in accurately determining the type of contacts between primary molars by arch and side was also done. The data were properly recorded and statistically analysed.

Statistical analysis was performed with the SPSS 23.0 software (Statistical Package for Social Sciences 23). Numbers and percentages were used to denote the prevalence of the types of contact areas. The association of contact areas in each quadrant across genders was determined by chi-square test. McNemar's test was used to assess the intra- and interarch variability. Spearman's rho was also calculated to measure overall correlation of contacts measurement during the examination with the two different methods.

3. Results:

In the present study a total of 124 contacts were obtained from 34 children with an age range of 3-6 years with a mean age of 4.53 years with an almost equal distribution of gender (M=17; F=17). The highest number of participants were of children of age group 4.1-5 years which also had the highest number of quadrants. The lowest number of participants were of children of age group 5.1-6 years, which also had the lowest number of quadrants.

Table 1: Age, gender and quadrant distribution of OXIS contacts

Age (in years)	Number of children n(%)	Sex	N (%)	Number of quadrants (%)	O (%)	X (%)	I (%)	S (%)
3-4	10 (29.41)	M	5 (50)	33 (26.61)	3 (2.4)	1 (0.8)	25 (20.1)	4 (3.2)
		F	5 (50)					
4.1-5	17 (50)	M	7 (41.18)	65 (52.42)	4 (3.2)	2 (1.6)	51 (41.1)	8 (6.4)
		F	10 (58.82)					
5.1-6	7 (20.59)	M	5 (71.43)	26 (20.97)	1 (0.8)	1 (0.8)	21 (16.9)	3 (2.4)
		F	2 (28.57)					
Total	34	M	17 (50)	124	8 (6.4)	4 (3.2)	97 (78.2)	15 (12)
		F	17 (50)					

Table 2: Prevalence and percentages of primary molar contacts by gender, arch and side

Types of contacts	Maxilla						Mandible						Overall Total (%)	p-value*
	Right		Left		Total		Right		Left		Total			
	M	F	M	F	M	F	M	F	M	F	M	F		
O	1	1	2	1	3 (2.4)	2 (1.6)	1	1	0	1	1 (0.8)	2 (1.6)	8 (6.4)	0.016

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X	1	0	0	0	1 (0.8)	0 (0)	0	1	1	1	1 (0.8)	2 (1.6)	4 (3.2)	0.035
I	11	14	12	13	23 (18.5)	27 (21.77)	12	11	13	11	25 (20.1)	22 (17.74)	97 (78.2)	0.000
S	2	3	1	2	3 (2.4)	5 (4)	2	1	3	1	5 (4)	2 (1.6)	15 (12)	0.069
Total	15	18	15	16	30	34	15	14	17	14	32	28	124	

*P<0.05 statistically significant

Inference made from Table 2is- the most frequent contact is "I" type of contact and the least frequent contacts is "X" type of contact with respect to both arches and in both genders.

Table 3: Association of contacts in arches and quadrants across genders

	Chi-square Value	**P-Value***
Gender*Right Maxilla	5.840	0.211
Gender*Left Maxilla	1.040	0.792
Gender*Right Mandible	3.577	0.466
Gender*Left Mandible	7.667	0.105

*P<0.05 statistically significant

Table 3 showed the gender wise comparison of contacts between arches which entails the chi-square value and the p-value where a value less than 0.05 indicates statistical significance. The left mandibular quadrant was showing the highest chi-square value but the p value is >0.05, which suggested that the gender and the quadrant wise distribution of contacts are not truly associated with each other.

Table 4: Inter-arch and intra-arch comparisons (p-value) within individuals*

Type of contact	Maxilla	Mandible	Right	Left
	Right vs. left side	Right vs. left side	Maxillary vs. mandibular	Maxillary vs. mandibular
O	1.000	1.000	1.000	0.625
X	NA**	1.000	1.000	NA**
I	1.000	1.000	0.791	1.000
S	0.727	1.000	1.000	1.000

*P<0.05 statistically significant; McNemar's Test

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**In Maxillary left side the no of 'X' contact is '0'. As the McNemar's Test computed for P*P Table Here P must be greater than 1.

McNemar's test was performed to assess the intra- and inter-arch variability within individuals. No statistical significant difference was found.

Table 5: Changes in the Prevalence and percentages of primary molar contacts by arch and side as per the two different methods

Types of contact	Overall total OXIS contacts (%) in Clinical evaluation					Overall total OXIS contacts (%) in Study Model Analysis					Mean Difference	P value
	Maxilla		Mandible		Total (%)	Maxilla		Mandible		Total (%)		
	Right (%)	*Left (%)*	*Right (%)*	*Left (%)*		*Right (%)*	*Left (%)*	*Right (%)*	*Left (%)*			
O	2 (1.6)	3 (2.4)	2 (1.6)	1 (0.8)	8 (6.4)	2 (1.6)	3 (2.4)	2 (1.6)	1 (0.8)	8 (6.4)	0.000	Not significant
X	1 (0.8)	0 (0)	1 (0.8)	2 (1.6)	4 (3.2)	1 (0.8)	0 (0)	1 (0.8)	2 (1.6)	4 (3.2)	0.000	Not significant
I	25 (20.1)	25 (20.1)	23 (18.5)	24 (19.3)	97 (78.2)	25 (20.1)	**24 (19.3)**	**22 (17.74)**	24 (19.3)	**95 (76.6)**	**2.000**	Not significant
S	5 (4)	3 (2.4)	3 (2.4)	4 (3.2)	15 (12)	5 (4)	**4 (3.2)**	**4 (3.2)**	4 (3.2)	**17 (13.7)**	**2.000**	Not significant

Table 5. Depicted the changes in the 'I' (20.1% to 19.3% in left maxillary quadrant and 18.5% to 17.74% in right mandibular quadrant) and 'S' contacts (2.4% to 3.2% in both left maxillary quadrant and right mandibular quadrant) has been observed during the study model analysis of the obtained casts. However, the mean difference between the two group were not statistically significant.

Reliability Statistics:

Table 6: Comparison (interclass correlation coefficient [ICC]) of clinical evaluation against study model analysis method in accurately determining the type of contacts between primary molars by arch and side

Methods comparison (N=34)	Arch and Side comparison		r†	P-value*	ICC	95%CI (U, L)	P-Value*
Clinical evaluation Vs	Maxilla	Right	1.000	<0.01	1.000	(1.000-1.000)	<0.01
		Left	0.988	<0.01	0.987	(0.994-	<0.01

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Study model analysis						0.975)	
	Mandible	Right	0.963	<0.01	0.990	(0.995-0.980)	<0.01
		Left	1.000	<0.01	1.000	(1.000-1.000)	<0.01

r†: Spearman's Rho Correlation Coefficient

ICC: Interclass Correlation Coefficient

P-value </= 0.01: statistically significant
[Correlation is significant at the 0.01 level (2-tailed)]

Spearman's rho was calculated to measure overall correlation of contacts measurement during the examination with the two different methods. Table 6 presents a rho value > 0.9 to 1 with a p value of < 0.01; which is indicative of a very strong significant and positive correlation between the measurements of contacts with the two methods.

Our estimated reliability between the two methods were found to be > 0.9 (ICC) with a wide range of Confidence Interval when compared across arch and sides of the jaws. The p value was found to be statistically significant. So, we can conclude that we have enough evidence to support the reliability of the measurements of the OXIS contacts in primary molars between the two methods.

4. Discussion:

The present study is clinically in accordance with Kirthiga and Muthu's OXIS classification of contact areas[9] in primary molars. This is the first study conducted where variations in the prevalence of OXIS contacts were studied in Bengali children.

A prior study[11] by Kirthiga et al. (2020) evaluated various types of noncarious interproximal contact areas of primary molars in children and concluded that the contact area was primarily present at the occlusal level, which is contrary to the conventional idea that the contact areas are broad, flat, and located further gingivally. This discovery also suggested that a clinical examination would be sufficient to determine the various contact areas. The epidemiological studies that followed were built on the scientific foundation provided by this paper.

Only two of the three studies[10–12] that used the OXIS classification and were conducted on children from Puducherry and Ajman[10,12] were epidemiological studies. As a result, it was unable to generalise OXIS contacts to all ethnic communities, which provided the scientific foundation for the current study to confirm the prevalence of OXIS contacts in Bengali children. Although there was a clause called "others" if any other shape was seen, OXIS was the only contact area type that was present. This result was consistent with that of the prior investigation[10].

The present study was done by clinical examination using mouth mirror, probe and dental floss, followed by impression making and obtaining die models for scoring OXIS contacts.

In the previous epidemiological study[10] by Muthu MS et al (2020) performed in 1,119 children aged 3–4 years, OXIS contacts were assessed by clinical examination. For the record-keeping purposes, models were also made. Also, the OXIS criteria were used after dental floss was passed through the interproximal contact point to determine whether the contact point was closed or open. This was not possible in the second epidemiological study[12], since only die models were used for the outcome assessment, and not clinical examination. Thus in present study, clinical examination was done followed by impression making and obtaining die models for the outcome assessment.

A previous study[18]by Cortes A et al (2018) used stereomicroscopic photos of the models taken at a right angle from the occlusal-cervical direction at (1.6x magnification). The study[12]by Walia et al (2020) utilized dental loupes to assess the contact area types, which provided only two-dimensional views. In present study, dental loupes were also used to study pattern of interproximal contacts on study models. Another recent study[11] by Kirthiga M et al used cone beam computed tomography (CBCT) and clinical photographs (2020) to correlate between the types of

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OXIS contact areas. The study's correlation result of 0.958 showed that scoring the various OXIS contact areas only required a two-dimensional evaluation. Therefore, visual examination of the study models was used for finding different types of contact areas between the primary molars in the present study.

The percentage of 'O'-type contacts in present study was 6.4%, which was similar to 6% in Puducherry children in a study done by Walia et al (2021)[12]. The result observed was similar to the study[10] of Muthu MS et al (2020) but differed from other studies[9,11]. The current investigation also revealed that the maxilla has more type O contacts than the mandible. This finding was in agreement with studies by Kisling[15] et al (1976) and Subramaniam[7] et al (2012) which were conducted earlier. Between 2.5 and 3years of age, according to Baume, the space between the first and second primary molars disappears, especially in the mandible.[16]

The percentage of 'X' contacts in present study was 3.2%, which was way similar to 1.5% in Puducherry children in a study done by Walia et al (2021)[12]. The result observed was similar to the study[10] of Muthu MS et al (2020) but differed from other studies.[9,11]

The percentage of 'I' contacts in present study was 78.2%. The study by Walia et al (2021)[12] observed the percentage of 'I' contacts as 75.5% in Puducherry children. 'I' contacts showed the highest prevalence in the present study as well as the previous studies.[9-11].

The percentage of 'S' contacts in present study was 12%, which was similar to 17% of Puducherry children[12]. The prevalence of 'S' contacts was similar in study by Muthu MS et al (2020)[10] but it differed in other studies.[9,11]

Overall, the order from the most to the least common types of contact areas in the present study is I>S>O>X which was similar to Puducherry children and in contrast to Ajman children as I>X>O>S in study by Walia et al (2021)[12]. The most common contact observed was type 'I' in all studies. This finding was in agreement with those of previous studies.[9-11]

The least common contacts observed in the present study was 'X' which was similar to Puducherry children as 'X' and in contrast to Ajman children as 'S' in study by Walia et al (2021)[12]. Additionally, the results for the least frequent contact varied across all of the earlier studies.[9-11] The ethnic composition of the populations, sample size, and age ranges used can all have an impact on this discrepancy.

The percentages of closed contacts (X, I, S) in the present study was 93.5%. This finding was similar to those of previous studies, where prevalence of 81% and 88%[12], 94.1%[10], 90.5%[9], 90%[7], and 84%[6] were reported.

The gender wise comparison of contacts between arches using chi-square test(Table 3) suggested that the gender and the quadrant wise distribution of contacts are not truly associated with each other. McNemar's test (Table 4) which was performed to assess the intra- and inter-arch variability within individuals found no significant difference.

The difference between prevalence and percentages of types of primary molar interproximal contact area by arch and side as determined by two different methods namely clinical examination and study model assessment was found statistically non-significant. (Table 5 & 6)

There were strengths and drawbacks to this study. This is the first study that evaluated the type of primary teeth's contact areas in Bengali children. For each and every child that was included, impressions were also taken. For this reason, the models acted as records for later use. Another strength is we did comparison (interclass correlation coefficient [ICC]) of clinical evaluation against study model analysis method in accurately determining the type of contacts between primary molars by arch and side. Spearman's rho was also calculated to measure overall correlation of contacts measurement during the examination with the two different methods.

In terms of limitations, the results cannot be generalised to different racial or ethnic groups. The smaller sample size is also another drawback. Additionally, it was impossible to compare the results of this study because studies that followed a similar methodology were scarce. Further studies should be performed in a greater sample size of individual racial/ethnic groups to confirm these results.

5. Conclusion:

The knowledge of morphology of proximal contacts may help the clinician in caries risk assessment, as

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well it helps to re-establish the contact characteristics through restorative procedures. Future research should use the standardised methods to examine the prevalence of primary molar contact areas in populations of different ethnicities. Long-term prospective studies are also necessary to assess the relationship between the primary molars' contact areas and the development of dental caries as well as the changes in those contact areas following the placement of a stainless steel crown.

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