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Original Article

Dentistry Section

Prevalence of OXIS Contacts between the Primary Molars in 3 to 9 Years Old Children: A Cross-sectional Study

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ABSTRACT

Introduction: Interproximal contacts between primary teeth have traditionally been reported as broad and flat. A new system of classification for contacts called OXIS- O (open contact), X (point contact), I (straight contact), and S (curved contact) was introduced in 2018, based on the shapes observed occlusally. Understanding interproximal contacts in primary teeth is essential to comprehend the caries risk of the individual.

Aim: To assess the prevalence of OXIS contact areas between non carious primary molars in 3 to 9 years old children and to determine the most common type of contact before and after the eruption of the first permanent molar.

Materials and Methods: A cross-sectional study was conducted to determine the prevalence of the types of contacts between primary teeth through direct observation in a sample size of 260 contact areas. The study was carried out in the Department of Paediatric and Preventive Dentistry, Navi Mumbai, India, between August 2022 to February 2023. Ethical clearance from the university was obtained. A single calibrated examiner examined photographs of the interproximal contacts between primary molars. The contacts were assessed as O (open contact), X (point contact), I (straight contact), and S (curved contact) using the OXIS classification system. The prevalence of each contact type was recorded. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) 18.0 software. The prevalence of contact types was recorded in numbers and percentages. A comparison of contact types before and after the eruption of the first permanent molar was conducted using the Chi-square test.

Results: The most common contact type was I (65.00%) both before and after the eruption of the first permanent molar. This was followed by S (19.62%), X (11.15%), and O (4.23%) in the primary dentition. After the eruption of the first permanent molars, I contact was the highest at 66.41%, followed by S (20.90%), X (12.68%), and O (0%).

Conclusion: This study confirms the presence of O, X, I, and S types of interproximal contact areas in caries-free primary molars in 3 to 9 years old children.

Keywords: Deciduous teeth, Morphology, Proximal

INTRODUCTION

Interproximal contact has been defined as the area of a tooth that is in close association, connection, or touch with an adjacent tooth in the same arch [1]. The proximal surface of teeth creates an area of contact between two adjacent teeth [2]. A properly positioned contact is important to maintain the dental arch in proper occlusion, prevent food impaction, and interproximal caries [3].

Literature reveals that spacings are commonly seen in primary dentition [4], and closed primary posterior proximal contacts are more prone to caries than open contacts [5]. Several studies have been conducted to understand the proximal contact between primary teeth. Sun KT et al., stated that approximately 40% of the primary molars in their study showed tight contacts [6]. Cortes A et al., classified the surface morphology of adjacent primary molar teeth as concave and convex [7]. Cho VY et al., described marginal ridge contacts as straight-concave, straight-straight, concave-concave, concave-convex, straight-convex, and convex-convex [8]. Kirthiga M et al., proposed a new classification based on the shape of contact areas between the primary molars called OXIS [9].

The contact area between the first and second primary molars is usually established around the third and fourth years of life [10]. The type of contact is transient and may change with the eruption of new teeth and the direction of the growth pattern of the child [11]. As the eruption and growth continue, an increase in jaw dimensions to accommodate developing permanent first molars is expected.

There is a definite need to understand the contact areas between primary teeth and analyse changes observed in the contact as age advances. Considering the ease of identification of OXIS contacts, the OXIS classification system was used in the present study. The aim of the present study was to evaluate the prevalence of OXIS contact types between primary molars and determine the most common type of contact before and after the complete eruption of first permanent molars in children.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Paediatric and Preventive Dentistry at D Y Patil University School of Dentistry, India, between August 2022 and February 2023. The study was approved by the University Institutional Ethics and Review Board (IREB/2022/PEDO/08), and informed consent was obtained from the parents of the children involved.

Sample size: was calculated using OpenEpi, Version 3, based on the findings of a previous study that evaluated the prevalence of OXIS contacts in 3 to 4 years old [12].

Inclusion criteria: Children aged 3 to 9 years with non- carious primary molars with Frankel ratings of 3 and 4 and those co-operative for intraoral photography were included in the study.

Exclusion criteria: Children with caries, restorations, space maintainers or missing primary molars, those with special healthcare needs, a hyperactive gag reflex and partially erupted first permanent molars were excluded from the study.

Study Procedure

Prior to the start of the study, the primary examiner underwent training supervised by an expert. This training included evaluating intraoral photographs to identify the type of contact. The second phase of

training involved assessing contact areas in a clinical dental setting. The developers of the OXIS classification system also designed online training and calibration for the examiner (https://www.oxiscalibration.com), which consisted of 20 questions, including identifying contact areas in photographs. The examiner successfully completed this evaluation process with an acceptable score. Subsequently, the examiner assessed 30 non-carious contacts and categorised them according to the OXIS classification system [12]. After three weeks, the same patients were re-examined by the same examiner. Inter-examiner reliability was calculated using kappa statistics (k=0.80), indicating a good level of agreement.

All patients aged 3-9 years who visited the Department of Paediatric and Preventive Dentistry were screened for non-carious contacts by the trained examiner. Cotton rolls were used to remove any food debris, following which the teeth were dried. Initially, the teeth were assessed wet after oral prophylaxis and then air-dried using a three-way syringe, and intraoral photographs were taken from the occlusal view using an Eos Rebel T5 1200D camera. The camera lens was fixed at a distance of 36 inches from the intraoral mirror, and the occlusal aspect photograph was captured by the examiner.

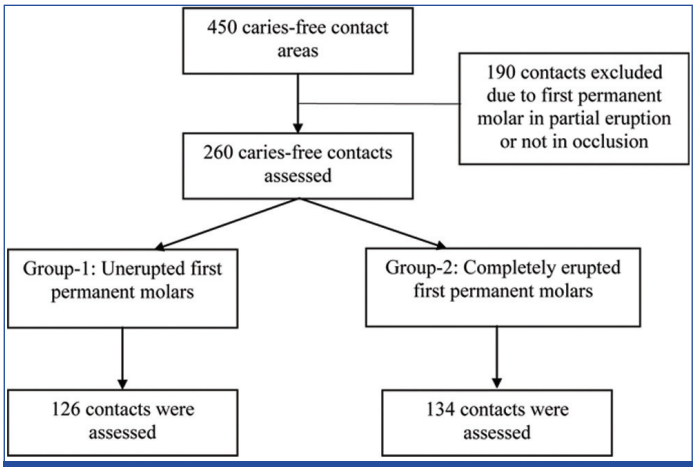
A total of 450 non-carious contact areas were identified. Children were evaluated either before the eruption of the first permanent molar or after its complete eruption. Children with the first permanent molar erupting, partially erupted, or not in occlusion were excluded from the study. A total of 190 contact regions had the first permanent molar in an erupting or partially erupted stage in that quadrant and were therefore excluded. The study included a total of 260 non-carious contacts between the primary molars.

The children were divided into two groups based on the eruption of the first permanent molars:

Group 1: Unerupted first permanent molars (n=126).

Group 2: Completely erupted first permanent molars (n=134).

[Table/Fig:1] depicts CONSORT flow chart for all participants of the study.

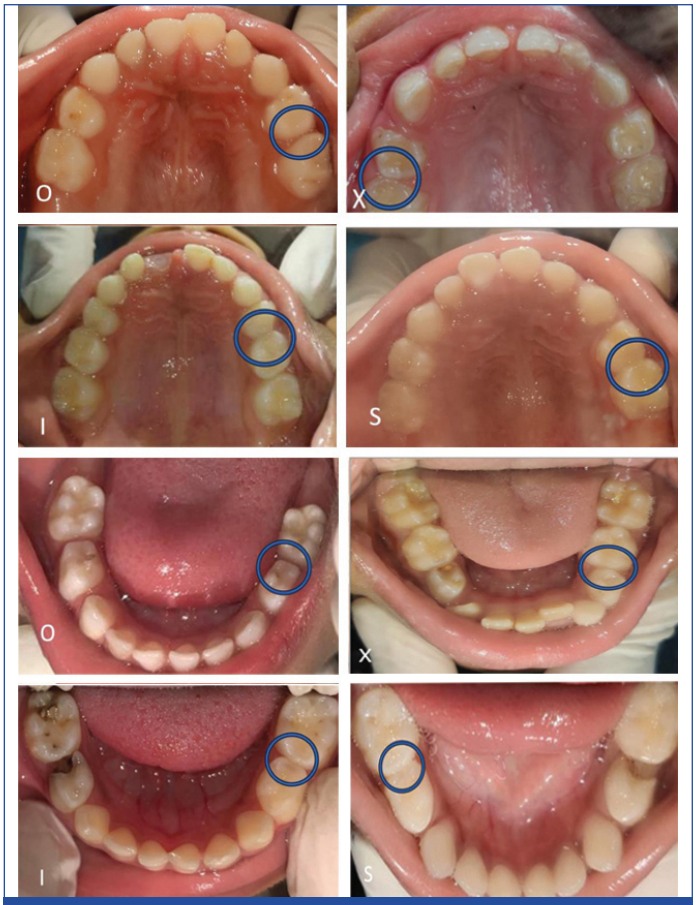


[Table/Fig-1]: CONSORT Flowchart for group distribution.

The assessed contact areas were recorded as O (open contact), X (point contact), I (straight contact), and S (curved contact) as shown in [Table/Fig-2]. A total of 126 caries-free contacts were observed in Group 1, and 134 caries-free contacts were observed in Group 2.

STATISTICAL ANALYSIS

Statistical analysis was conducted using Statistical Package for Social Sciences (SPSS) 18.0 software (SPSS, Chicago, Ill., USA). The prevalence of the types of contact areas was presented in numbers and percentages. The Chi-square statistical test was employed, with a p-value of less than 0.05 considered to indicate statistical significance.



[Table/Fig-2]: Interproximal contacts of primary molars as per OXIS classification in maxillary (upper four images) and mandibular teeth (lower four images).

RESULTS

A total of 260 caries-free contact areas in 128 children were examined. The mean age of the children was five years (mean age±SD=5.84±1.85 years). [Table/Fig-3] summarises the prevalence and percentages of contacts between the primary molars based on the location of the contact. The I type of contact was the most prevalent (65.00%) in the present study, followed by S (19.62%), X (11.15%), and O (4.23%).

Contact type	Maxilla				Mandible				Overall	
	Right	Left	Total	%	Right	Left	Total	%	Total	%
O	5	1	6	2.31	2	3	5	1.92	11	4.23
X	5	10	15	5.77	5	9	14	5.38	29	11.15
I	55	46	101	38.85	37	31	68	26.15	169	65.00
S	18	20	38	14.62	5	8	13	5.00	51	19.62

[Table/Fig-3]: Prevalence and percentages of OXIS contacts according to the location of the contact in the jaw.

The prevalence of OXIS contacts observed in the presence or absence of permanent first molars is depicted in [Table/Fig-4]. The most common contact before and after the eruption of the first permanent molars was the I type. In Group 1, I was followed by S, X, and O. The same pattern was also observed in Group 2.

Groups	Total	O	X	I	S
Group 1	126	11 (8.73%)	12 (9.52%)	80 (63.49%)	23 (18.25%)
Group 2	134	-	17 (12.68%)	89 (66.41%)	28 (20.90%)
Z value	-0.52	3.46	-0.85	-0.66	-0.43
p-value	0.59	**<0.001**	0.39	0.50	0.66

[Table/Fig-4]: Prevalence of OXIS contacts observed in absence (Group 1) and presence (Group 2) of permanent first molars.

DISCUSSION

This study confirms the presence of OXIS contact areas between primary molars. The prevalence of the O-type of contact was 4.23%,

X-type was 11.15%, I-type was 65%, and S-type was 19.62% in the study population. OXIS contacts have also been observed between deciduous canines and deciduous incisors, and between deciduous canines and deciduous first molars [13]. It is reported to be applicable in permanent posterior teeth, with a modification for anterior permanent teeth [14]. However, no study has compared the contact areas before and after the eruption of the first permanent molars, as the eruption of first permanent molars may alter the type of contact [11].

The present study was conducted in children aged 3 to 9 years since the primary dentition is fully established by the age of three years and maintained in the dental arches until the age of 9 years [15]. Previous studies have assessed contact areas using CBCT images [13,16,17], sectional die models [12,18], dental floss [12], or intraoral photographs [17]. In this study, the contact areas of primary molars were evaluated using standardised intraoral images captured with a digital camera. It has been suggested that the contact area occurs at the occlusal third of the tooth, correlating to occlusal views in the clinical photographs [17]. The online calibration developed by the creators of this classification system (https://www.oxisclassification.com) also included occlusal photographs. Therefore, the present study also assessed the contact areas of primary molars using the same method.

Previous studies conducted in Puducherry [11,12], Mathura [16], Ajman [11], and Seoul [17] have shown the I type to be the most prevalent contact, similar to the findings of the present study. Similar studies from the literature have been compiled in [Table/Fig-5] [11,12,16-18]. In the present study, the S type was the second most prevalent type of contact, consistent with the findings of Walia T et al., and Muthu MS et al., [11,12]. This finding is significant as I and S types were observed to be the most susceptible to caries [18]. This susceptibility could be attributed to the higher plaque accumulation that may occur beneath these closed contact areas compared to O and X types. Additionally, the retained plaque in these areas may be difficult to remove using standard tooth brushing methods, as the bristles may not reach between these closed contacts. Therefore, dental floss may be beneficial in the presence of I and S contact types [12].

Previous studies	Place	No. of contacts examined	Prevalence of OXIS contacts	Correlation with dental caries
Kirthiga M et al., 2023 [18]	Puducherry	3812	-	S-type had the greatest prevalence of caries and O-type has the least prevalence of caries
Walia T et al., 2020 [11]	Puducherry	200	I > S > O > X	-
Muthu MS et al., 2020 [12]	Puducherry	4,476	I > S > O > X	-
Gupta S et al., 2023 [16]	Mathura	65	I > O > X > S (maxilla) O > X > I=S (mandible)	-
Kirthiga M et al., 2020 [17]	Seoul	1459	I > X > S > O	-
Present study	Mumbai	260	I > S > X > O	-

[Table/Fig-5]: Studies conducted on prevalence of OXIS contact areas and its correlation with caries (O – O-type of contact, X – X-type of contact, I – I-type of contact, S – S-type of contact; '>' stands for more prevalent than, '=' stands for same prevalence eg. I>S (I type of contacts is more prevalent than S type of contacts) and I=S (I type and S type have the same prevalence) [11,12,16-18].

In the present study, only 11% showed X-type contact. This prevalence is similar to the prevalence of X contact in South Korea, which was 10.4% [17]. However, in the UAE and Puducherry, the prevalence was 22.5% and 21.6%, respectively [11,12]. This further emphasises the fact that OXIS contact areas cannot be generalised across different ethnic populations.

The O type of contact was observed only in Group 1 (4%), i.e., prior to the eruption of the first permanent molars. None were noted in Group 2 (p=<0.001). In Puducherry [11,12], Seoul [17], Mathura [16], and Ajman [11], the prevalence of O type contact was 6%, 5.8%, 3.7%, 32.87%, and 19%, respectively. O type was greater in the 5 to 6 years age group than the 3 to 4 years age group. [11]. Similarly, in the present study, authors found O contacts in the 3 to 5-year age group. However, authors noted that there were no O contacts posteruption of molars. This is in contrast to a recent study by Gupta S et al., who reported the prevalence of O contact to be 20% and 45% in three to nine years old children, in the maxillary and mandibular arch, respectively, but only the right side was assessed in their study [16]. From this finding, it could be hypothesised that the eruption of the first permanent molars would significantly alter the type of contact. When a permanent first molar tooth is not in contact with a deciduous second molar tooth, both maxillary and mandibular permanent first molars tend to tip mesially [19]. This may explain the absence of O contact after the eruption of the first permanent molar in the present study. The interpretation of this finding, however, cannot be generalised since the same child was not assessed over time. Therefore, prospective studies using the same study subjects should be conducted to confirm the same. The assessment of contact areas is essential to understand caries risk, to account for differences in proximal cavity preparation, and maintenance of appropriate contact after the placement of crowns [17].

Limitation(s)

The present study does not take into account any possible changes in the type of OXIS contact that could occur over a period of time. Further long-term studies can be conducted to observe if any such changes occur in OXIS contacts.

CONCLUSION(S)

This study validates the presence of O, X, I, and S types of interproximal contact areas between caries-free primary molars, following the OXIS classification. Among the four types of contacts, the most common type was the I contact both before and after the eruption of the first permanent molars. O contact was observed only before the eruption of the first permanent molars.

REFERENCES

[1] Ferro KJ (editor). Interproximal contact area. In: Glossary of Prosthodontic Terms. 10th ed. J Prosthet Dent. 2023;130(5S):e1-3.
[2] Roberson T, Heyman H, Swift E. Sturdevant JR. Clinical significance of dental anatomy, histology, physiology, and occlusion. In: Sturdevant's Art and Science of Operative Dentistry. 7th ed. Batavia, Illinois, USA: Elsevier; 2019; Pp.11.
[3] Waggoner WF, Nelson T. Restorative dentistry for the primary dentition. In: Pediatric Dentistry: Infancy Through Adolescence. Nowak AJ. 6th Ed. Batavia, Illinois, USA: Elsevier; 2019: Pp. 304-328.e3.
[4] 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):386-93.
[5] Arora D, Gupta A, Garg S, Shrivastava A, Dogra S, Joshi S, et al. Caries Pattern in primary molars with early pulpal involvement in mixed dentition. International Healthcare Research Journal. 2021;4(10):OR1-OR6.
[6] Sun KT, Li YF, Hsu JT, Tu MG, Hung CJ, Hsueh YH, et al. Prevalence of primate and interdental spaces for primary dentition in 3- to 6-year-old children in Taiwan. J Formos Med Assoc. 2018;117(7):598-604.
[7] Cortes A, Martignon S, Qvist V, Ekstrand KR. Approximal morphology as predictor of approximal caries in primary molar teeth. Clin Oral Investig. 2018;22(2):951-59.
[8] Cho VY, King NM, Anthonappa RP. Role of marginal ridge shape and contact extent in proximal caries between primary molars. J Clin Pediatr Dent. 2021;45(2):98-103.
[9] Kirthiga M, Muthu MS, Kayalvizhi G, Krithika C. Proposed classification for interproximal contacts of primary molars using CBCT: A pilot study. Wellcome Open Res. 2018;3:98. Doi: 10.12688/wellcomeopenres.14713.2. eCollection 2018.
[10] Gross EL, Nowak AJ. The dynamics of change. In: Pediatric Dentistry: Infancy through adolescence. Nowak AJ. 6th Ed. Batavia, Illinois, USA: Elsevier; 2019: Pp.196.
[11] Walia T, Kirthiga M, Brigi C, Muthu MS, Odeh R, Mathur VP, et al. Interproximal contact areas of primary molars based on OXIS classification - a two centre cross sectional study. Wellcome Open Res. 2021;5:285. Doi: 10.12688/wellcomeopenres.16424.2. eCollection 2020.

[12] Muthu MS, Kirthiga M, Kayalvizhi G, Mathur VP. OXIS classification of interproximal contacts of primary molars and its prevalence in three- to four-year-olds. Pediatr Dent. 2020;42(3):197-202.
[13] Aarthi J, Muthu MS, Kirthiga M, Kailasam V. Modified OXIS classification for primary canines. Wellcome Open Res. 2022;7:130. Doi: 10.12688/wellcomeopenres.17775.2. eCollection 2022.
[14] Kailasam V, Muthu MS, Rao U, Krithika C, Kirthiga M, Aarthi J, et al. An evaluation of the interproximal contacts of the permanent dentition - A study cast based classification. Wellcome Open Res. 2023;8:176. https://doi.org/10.12688/wellcomeopenres.18973.1
[15] Nelson SJ, Ash MM. Development and eruption of the teeth. In: Wheeler's Dental Anatomy, Physiology and Occlusion. 9th ed. Missouri, USA: Elsevier; 2010, Pp. 23.
[16] Gupta S, Das A, Patra A, Saket A. Comparison of prevalence of oxis contact in primary maxillary and mandibular teeth: A retrospective cohort study. Ann Res Rev Biol. 2023;38(6):38-43.
[17] Kirthiga M, Muthu MS, Lee JJC, Kayalvizhi G, Mathur VP, Song JS, et al. Prevalence and correlation of OXIS contacts using Cone Beam Computed Tomography (CBCT) images and photographs. Int J Paediatr Dent. 2021;31(4):520-27.
[18] Kirthiga M, Muthu MS, Kayalvizhi G, Mathur VP, Jayakumar N, Praveen R. OXIS contacts and approximal caries in preschool children: A prospective cohort study. Caries Res. 2023;57(2):133-40.
[19] Sabeti AK, Karimizadeh Z, Rafatjou R. Maximum equivalent stress induced and the displacement of the developing permanent first molars after the premature loss of primary second molars: A finite element analysis. Dent Med Probl. 2020;57(4):401-09.

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