

## Interdental Spacing and Dental Caries in the Primary Dentition of 4-6 Year Old Children

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### Abstract

**Objective:** There are various risk factors which play an essential role in the multifactorial disease “dental caries.” Although absence of interdental spaces in the primary dentition may increase the risk of dental caries, not many studies have been carried out to assess this correlation. This study was performed to assess the relationship between interdental spacing and dental caries in primary dentition.

**Materials and Methods:** Five hundred 4-6 year-old children were enrolled into this study. Dental caries was recorded using the criteria given by Warren et al. Following this, impressions were made for the upper and lower arches and dental casts were poured. Interdental spaces were measured on the dental casts using a digital verniercaliper. The data obtained were subjected to statistical analysis.

**Results:** The number of sites with interdental spaces was higher in the maxillary arch in comparison to the mandibular arch. The highest number of interdental spaces was observed between the maxillary anteriors. The number of demineralized, but non-cavitated tooth surfaces ( $d_1$ ) were higher than the number of cavitated tooth surfaces. This difference was significant in the mandibular anterior segment. Dental caries showed a negative correlation with interdental spacing. A significant correlation was found between dental caries and interdental spacing in the posterior segment of the mandibular arch.

**Conclusion:** This study showed that children with no interdental spacing in the primary dentition are at higher risk for dental caries.

**Key Words:** Dental Caries; Interdental Spaces; Interproximal Caries

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### INTRODUCTION

Dental caries in primary dentition has been mentioned as an important matter in the recent years because it may be predictive of later caries and also special attention is necessary to overcome this problem [1].

A complex of etiologic factors controls the development of dental caries in children. The relative influence of each factor differs noticeably in individuals and is not completely recognized [2]. Aberrant anatomic and morphologic configurations, such as deep pits and grooves

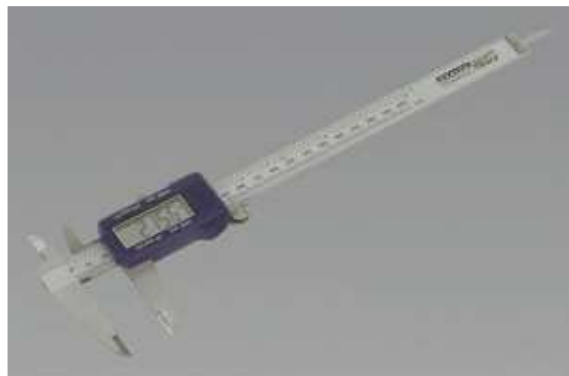


Fig 1. Digital Vernier Calliper

and broad flat proximal contact areas will greatly increase its susceptibility [2].

The pattern of caries occurrence in primary dentition seems to be initially more on the occlusal surface than the proximal surface. Interproximal caries in both the anterior and buccal segments of the primary dentition usually does not occur until proximal contact develops [3]. It has been suggested that if the proximal surfaces of the primary teeth do not become carious by the age of 6-8 years, the risk of developing dental disease is very low for the remaining mixed dentition period [4]. This statement suggests that the role of different tooth sites in the natural history of caries is important to understand [5].

Absence of interdental spaces leads to a greater extent of decay in the primary dentition [6]. Crowding is said to decrease the accessibility to hygiene measures; thereby, increasing plaque accumulation and promoting caries [2]. If this is the case, one could hypothesize that open contacts would be less prone to caries than closed contact points as they are less likely to accumulate plaque and this hypothesis has to be eminently testable in the primary dentition where gaps between the teeth are very common and even normal [5].

Not many studies have assessed the relationship between the presence/absence of interdental spacing and dental caries in the primary dentition. Therefore, the purpose of the present study was to assess the relationship between interdental spacing and dental caries in the primary dentition.

#### MATERIALS AND METHODS

This study was conducted on 4 to 6-year-old healthy, cooperative children from 21 kindergartens and play schools in Bangalore city, India. The city of Bangalore was divided into four zones, and play schools and kindergartens from each zone were randomly selected. Each of these play schools and/or kindergartens had about 35-40 children.

Table 1. Percentage of Children with Interdental Spacing According to Dental Arch and Site

Dental Arch	Site	Number of Interdental Spaces	Number of Children with Interdental Spacing (%)
Maxillary	Anterior	1450	423 (84.6)
	Posterior	443	238 (47.6)
	<b>Anterior + Posterior</b>	<b>1893</b>	<b>432 (86.4)</b>
Mandibular	Anterior	957	320 (64.0)
	Posterior	337	196 (39.2)
	<b>Anterior + Posterior</b>	<b>1294</b>	<b>346 (69.2)</b>
<b>Maxillary + Mandibular</b>		<b>3187</b>	<b>448 (89.6)</b>

Prior to the study, ethical clearance was obtained from the institutional review board as well as written consent was obtained from parents/guardians and concerned school authorities. An initial screening of 731 children was carried out. Children with permanent teeth, missing primary teeth due to exfoliation or extraction, presence of intraoral/extraoral swelling and uncooperative children were not included. Children with supernumerary teeth, fused teeth and teeth in infraocclusion were excluded from the study. Presence of such teeth disrupts the natural spacing of the dentition. Five hundred and fifty children with primary dentition and all 20 primary teeth erupted were included for the study. Parental consent could not be obtained for 50 of the children; thus, 500 children formed the study group. Visual examination of the teeth was done under natural daylight using a mouth mirror with a good reflecting surface. The teeth were dried with sterile cotton initially to identify white spot lesions.

An explorer was used at times only to remove the debris present on the tooth surfaces and to confirm presence of cavitations in cases of questionable pits.

When necessary, a magnification lens was used to help decide whether or not there was cavitation.

The examination time per child was 3-5 minutes after the teeth were dried [7].

Surface-specific dental caries data (dfs) was recorded by a single examiner using the criteria given by Warren et al. [1].

Criteria includes lesions with evidence of demineralization, but no loss of enamel structure ( $d_1$ ); lesions with loss of enamel structure that are confined to the enamel layer only ( $d_2$ ); and lesions with loss of enamel structure that penetrate into dentin ( $d_3$ ).

Those teeth with clinical pulp involvement ( $d_4$ ) were also considered under cavitated lesions. In the present study, caries in the enamel ( $d_2$ ) and dentin ( $d_3$ ) were considered as single entity ( $d_{2-3}$ ) [1].

Following examination and recording of caries, upper and lower alginate impressions were made for every child. To avoid any error, the dental casts were poured immediately using dental stone. Interdental spaces on upper and lower casts were measured using the digital vernier calliper (reading to the nearest of 0.1 mm was taken).

**Table 2.** Mean DFS Score and Distribution of Dental Caries

Dental Arch	Site	DFS Score (Mean $\pm$ S.D)	Number of Children (%)
Maxillary	Anterior	1.88 $\pm$ 2.70	260 (52.0)
	Posterior	1.47 $\pm$ 1.91	277 (55.4)
	<b>Anterior + Posterior</b>	<b>3.35 <math>\pm</math> 3.76</b>	<b>356 (71.2)</b>
Mandibular	Anterior	0.70 $\pm$ 1.42	137 (27.4)
	Posterior	2.30 $\pm$ 2.42	347 (69.4)
	<b>Anterior + Posterior</b>	<b>3.00 <math>\pm</math> 3.09</b>	<b>379 (75.8)</b>
<b>Maxillary + Mandibular</b>		<b>6.35 <math>\pm</math> 6.00</b>	<b>400 (80)</b>

Absence of spacing was confirmed by passing silk ligature wire or by blowing air from chip blower.

Evaluation of tooth spacing was performed by the same examiner on a space-by-space basis, using the criteria given by Warren et al. (2003) [6].

From the stone casts, each interdental area was categorized as: (1) space > 1 mm, (2) space < 1 mm, (3) no space, teeth in contact, or (4) no space, teeth overlapped.

These categories were collapsed into presence or absence of space for each interdental site and counted for each individual. Analyses assessed the relationships between interdental spacing and caries experience with separate analyses for anterior spacing, posterior spacing and total spacing [6].

To minimize intra-examiner variability, 5% of the casts were reassessed. The data obtained were tabulated and subjected to statistical analysis using Pearson correlation coefficient and Chi-square test.

## RESULT

Nearly 90% of children had interdental spacing and more children had anterior interdental spacing in both arches (Table 1).

The number of sites with interdental spaces was higher in the maxillary arch in comparison to the mandibular arch and the highest number of interdental spaces was observed between the maxillary anteriors (Table 1). Eighty percent of the children had dental caries and the mean dfs score was 6.35 (Table 2). Forty-five percent of the children had interproximal caries in both arches; 178 children showed interproximal caries only in the maxillary arch and 125 children had interproximal caries only in the mandibular arch.

The proximal surfaces of the maxillary teeth showed the highest number of cavitated tooth surfaces ( $d_{2-3}$ ) (Table 3). Dental caries showed an inverse relation with interdental spacing. A significant correlation was found between dental caries and interdental spacing in the posterior segment of the mandibular arch (Table 4). An inverse relation was also found between interproximal caries and interdental spacing (Table 5).

## DISCUSSION

One of the risk factors in the complex etiology of dental caries is interdental spacing. There can be generalized spacing present between the primary teeth.

**Table 3.** Number of Non-Cavitated ( $D_1$ ), Cavitated ( $D_{2-3}$ ) and Filled (F) Tooth Surfaces According to Site

Dental Arch	SITE	$d_1$	$d_{2-3}$	f
Maxillary	Anterior	521	421	0
	Posterior	336	400	0
	Anterior + Posterior	<b>857</b>	<b>821</b>	0
	Proximal Surfaces Only	156(18.20%)	500(60.90%)	0
Mandibular	Anterior	290	60	0
	Posterior	447	701	7
	Anterior + Posterior	<b>737</b>	<b>761</b>	<b>7</b>
	Proximal Surfaces Only	57(7.73%)	228(29.96%)	0
Maxillary + Mandibular	Anterior + Posterior	<b>1594</b>	<b>1582</b>	<b>7</b>
	Proximal Surfaces Only	213(13.36%)	728(46.02%)	0

According to Baume, two consistent morphologic arch forms of the primary dentition are found: either spaces between the teeth were present at all stages (type I) or the teeth were in proximal contact at all stages (type II) [8]. Spacing in the primary dentition is apparently congenital rather than developmental. Spaced arches frequently exhibit two distinct diastemas: one between the mandibular canine and the first primary molar and the other between the maxillary lateral and the canine. Baume referred to these spaces as 'primate spaces' [8]. A secondary spacing of the maxillary primary incisors occasionally occurs when the still underdeveloped maxillary arch is widened somewhat by the eruption of the mandibular permanent central incisors [8].

Hence, in our study children with only primary dentition were selected. In the primary dentition, the occlusal surface is the most susceptible to carious attack, attributable to its anatomy of pits and fissures. However, with the eruption of the permanent first molars, the normal developmental spaces of the primary dentition begin to close.

With space closure and formation of the contact areas, the incidence of proximal caries greatly increases [2]. Thus, children aged between 4 and 6 years with no permanent tooth erupted were selected.

Almost 90% of the children in the present study had interdental spaces in at least one site and 10.4% of the children had absolutely no interdental spaces.

This was in accordance with studies who reported a prevalence of 84-99% [9-12]. A study on 3-year-old Danish children showed higher spacing in the maxillary than the mandibular arch [13].

A Nigerian study also reported incisor crowding in both arches [14].

In our study, the anterior segments in both arches showed a higher prevalence of spacing than the posterior segments.

The initial arrangement of tooth germs in the maxilla as well as the mandible is an important determinant of interdental spaces.

During postnatal development, intensified lateral growth of the alveolar processes was found to occur during the formation of deciduous arches following the period of lactation. Both lateral and frontal growth of the alveolar processes during the formation of deciduous arches manifest in spaced deciduous anteriors [8].

Apparent spacing of the primary incisors may also occur as a result of occlusal attrition. The wider incisor part of the teeth worn away to leave apparently larger spaces between the narrower remaining parts [15].

**Table 4.** Correlation Between Dental Caries and Interdental Spacing

Dental Arch	SITE	r	P Value
<b>Maxillary</b>	Anterior	-0.011	0.804
	Posterior	-0.035	0.430
	<b>Anterior + Posterior</b>	-0.051	0.250
<b>Mandibular</b>	Anterior	-0.038	0.399
	Posterior	0.140	0.000*
	<b>Anterior + Posterior</b>	+0.066	0.138
<b>Dental Caries</b>		-0.017	0.698

p<0.05 significant

There have been discussions in dental literature which have emphasized the need for including what are termed “pre-cavitated” or “non-cavitated” lesions in caries evaluation/assessment criteria leading to development of more sensitive criteria [6,16,17].

These criteria were originally developed by the World Health Organization [18,19] and have been subsequently modified [6,16,17,20].

Most studies have used the DMF/def index to detect caries [21-25].

Although this method is simple and can be modified to suit special circumstances, it does not evaluate initial caries, such as the white spot lesion.

A mean dfs of 6.35 was observed which was in contrast to Warren et al. [1] who reported a lower mean dfs of 2.02 in the primary dentition. Both studies used the same criteria for caries recording and included the non-cavitated lesions in their evaluation.

The occurrence of both non-cavitated and cavitated tooth surfaces in the maxillary anterior segment reiterates the rapidity and pattern of caries spread in these teeth. Although a high number of interdental spaces are seen in the anterior region, these teeth are more susceptible to caries because they are exposed to a highly cariogenic environment resulting from improper feeding practices.

The protective action of the tongue and opening of salivary gland ducts in the floor of the mouth could be mainly responsible for the comparatively lower number of non-cavitated and cavitated tooth surfaces in the mandibular anterior segment.

When the distribution of dental caries was analyzed, posterior tooth surfaces of the mandibular arch showed more caries when compared to the anterior tooth surfaces. This difference was significant only when cavitated lesions were considered.

The complex fissure topography of posterior teeth compounded by gravitational forces could make these teeth more prone to dental caries. Other contributing factors include absence of interdental spacing, inaccessibility to maintain oral hygiene in these areas and genetic pattern [2, 21, 25]. This explains the significant association between dental caries and interdental spacing in the mandibular posterior region. However, it should not be inferred that susceptibility to occlusal caries mandates the prevalence on proximal surfaces or vice versa, because these lesions are similar but independent of each other in development [26]. When the relative susceptibility of proximal surfaces in the primary dentition is analysed, a general trend of increased caries incidence in a distal direction occurs.

The equal frequency of proximal caries on adjacent sites in primary molars requires time to develop, but generally the lesions do not appear simultaneously because of differences in eruption sequence [2].

Keeping in mind the concerns of exposing children to radiation strictly for research purposes [6], the costs involved and risk of bias from the refusal of some study participants to undergo radiography [27]; bitewing radiographs were not utilized for diagnosis of proximal caries in our study.

**Table 5.** Correlation between Interproximal Caries and Interdental Spacing

SITE	r	P Value
Maxillary (Anterior + Posterior)	-0.024	0.593
Mandibular (Anterior + Posterior)	0.082	0.066
Maxillary + Mandibular	-0.016	0.720

This could have resulted in the diagnosis of a higher number of cavitated proximal surfaces when compared to the non-cavitated proximal surfaces.

### CONCLUSION

The present study found an inverse relationship between dental caries and interdental spacing. Interproximal caries also showed an inverse relation with interdental spacing.

The present study supports the belief that absence of interdental spaces in the primary dentition may increase the risk of dental caries.

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