# Effect of non-functional teeth on accumulation of supra-gingival calculus in children

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## Abstract

**AIM:** To evaluate the occurrence of supra-gingival calculus in children aged 6-9 years with disuse conditions such as: presence of dental pain, open-bite or erupting teeth. **METHODS:** A cohort of 327 children aged 7.64±2.12 (range: 6-9) years (45% girls) were screened for presence of supra-gingival calculus in relation to open bite, erupting teeth and dental pain. Presence of dental calculus was evaluated dichotomically in the buccal, palatinal/lingual and occlusal surfaces. Plaque index (PI) and gingival index (GI) were also evaluated. **RESULTS:** Supra-gingival calculus was found in 15.9% of the children mainly in the mandibular incisors. Children aged 6-7 years had a higher prevalence of calculus as compared to children aged 7-8 years (23% vs. 13.5%, p=0.057) or 8-9 years (23% vs. 12.4%, p=0.078), respectively. No statistical relation was found between plaque and gingival indices and presence of calculus. The prevalence of calculus among children with open-bite was significantly higher than that of children without open-bite (29.4% vs. 10.7%, p=0.0006, OR=3.489). The prevalence of calculus among children with erupting teeth in their oral cavity was higher than that of children without erupting teeth (17.7% vs. 9%, respectively, p=0.119). No statistical correlation was found between presence of dental pain and calculus (15.4% vs. 15.9%; p=0.738). **CONCLUSION:** Accumulation of calculus in children aged 6-10 years was found mainly in the mandibular incisors, decreased with age and was correlated with open-bite.

## Introduction

Different epidemiological studies have shown that periodontal disease is not limited to adults and may affect children and adolescents as well; in a prevalence of 1-9% at age 5-11 years and 1-46% at age 12-15 years [Durward and Wright, 1989; Miyazaki et al., 1989; Bhat, 1991; Loe and Brown, 1991; Bimstein, 1992; Bimstein, et al., 1994; Levin et al., 2006; Demmer and Papapanou, 2010]. Several local factors were found to be associated with periodontal disease in children. These include: deep proximal caries lesions associated with loss of inter-dental space, defective proximal restorations and presence of calculus [Ranney, 1986; Durward and Wright, 1989; Bimstein et al., 1993; Bimstein, et al., 1994; Bimstein and Garcia-Godoy, 1994; Bimstein et al., 1996; Bimstein et al., 1998]. Generally, calculus is formed by calcification of the plaque, however, the calcification increases with age; in adults calcification starts after 2-16 days without tooth brushing, but in children aged 5-12 years, 30% of the children had no calculus accumulation even after one month [Hugoson et al., 1981].

Several aetiologies were correlated with higher calculus accumulation such as ethnicity and systemic disease. Calculus was found in 89%, 34%, 55% and 2% of children aged 12-17 in Thailand, USA, Vietnamese living in Sweden and in local Swedish children, respectively [Jamison, 1963; Matsson et al., 1995; Pattanporn and Navia , 1998]. In addition, higher frequency of calculus accumulation was found also in children with amelogenesis imperfecta [Stewart et al., 1982] and asthma [McDerra et al., 1998]. In contrast, no correlation was found between accumulation of calculus and certain parameters of saliva, such as flow rate, buffer capacity and acidity [Pattanporn and Navia, 1998].

Another well known clinical situation that may contribute to calculus accumulation is non-functioning teeth as a result of severe dental pain in children (disused teeth). Nevertheless no reference for this statement could be found in the English literature or in paediatric, periodontic or orthodontic text books [Wei and Lang, 1982; Proffit and Fields, 1986; Pinkham et al., 1988; McDonald et al., 2000; Mariotti, 2008]. The aim of the present study was to evaluate the occurrence of supra-gingival calculus in children aged 6-10 years with disuse conditions such as: presence of dental pain, open-bite or erupting teeth.

## Methods

Children aged 6-9 years (mean age 7.64±2.12, 45% girls) in one elementary school participated in the present study. Clinical examinations of the participants were performed by one dentist (RM). Plaque index was evaluated according to the simplified plaque index (PI), modified from Greene and Vermilion [Wei and Lang, 1982] immediately after dyeing the teeth with disclosing solution (RED-COTE, John D. Butler Company, Chicago, IL, USA). Briefly, PI was scored as following: no plaque = 0; islands of plaque = 1; continuous line of plaque < 1 mm = 2; continuous line of plaque ≥ 1 mm = 3.

Gingival health was evaluated according to the modified gingival index (GI) of Lobene et al. [1986] and Fischman [1988]. Briefly, GI was scored according to absence of inflammation = 0; mild inflammation - slight change in colour, little change in texture of any portion of marginal or papillary gingival unit = 1; mild inflammation - criteria as above but involving the entire marginal or papillary gingival unit = 2; moderate

inflammation - glazing, redness, oedema and/or hypertrophy of marginal or papillary gingival unit = 3; and severe inflammation - marked redness, oedema and/or hypertrophy of marginal or papillary gingival unit, spontaneous bleeding, congestion, or ulceration = 4.

The presence of dental calculus was evaluated dichotomically (present or absent) in the buccal, palatinal/lingual or occlusal surfaces. The examination was carried out in a lighted room, using a disposable mirrolite (Kudos, Yuen Long, Hong Kong) and dental explorer. In addition, local factors that may also contribute to calculus accumulation were evaluated. These included: presence of open-bite (anterior or posterior), the magnitude of overjet (OJ), presence of erupting teeth and self-reported presence of dental pain. Children with evidence of dental calculus were invited to scaling in a private dental clinic free of charge.

The Ethics Committee of Tel Aviv University and the Israel Ministry of Education approved the study, and written informed consent was obtained from the parents.

**Statistical analysis** The sample size of the study group was determined on the basis of previous published data regarding the frequency of supra-gingival calculus accumulation in children aged 5-11 years; A power calculation for sample size was performed as follows: when the power of the sample research was set at 80%; and the significance at 95% a sample size of 262 was required. We added 20% and used a sample of 327 participants. A relation between presence of calculus and the explanatory variables was analysed using Chi-square test. The level of significance was set at 5%.

## Results

The present study included 327 children aged 7.64±2.12 (range: 6-9) years of age (45% girls); of those, 113 (34.6%) were aged 6-7 years, 109 (33.3%) were aged 7-8 years and 105 (32.1%) were at the age of 8-9 years.

Supra-gingival calculus was found in 15.9% of the children, and those age 6-7 years had a higher prevalence of calculus as compared with children aged 7-8 years (23% vs. 13.5%, p=0.057) or 8-9 years (23% vs. 12.4%, p=0.078), respectively (Table 1). Among the children with calculus, 30 children (57.7%) had calculus accumulation on the lingual aspects of the mandibular incisors, 17 children (32.7%) on the lingual and buccal aspects of the mandibular incisors and 3 children (5.8%) only on the buccal aspect of the mandibular incisors.

Of the children studied, 174 (53.2%) had a PI score 0-1; 115 (35.2%) had a PI score of 1-2; and 38 (11.6%) presented a PI score of >2. The prevalence of calculus in these groups was 14.9%, 18.3% and 14.3%, respectively. No statistical relation was found between PI and calculus (p=0.666) (Table 1).

GI score of 0-1 was found in 32 (9.8%) of the children; 213 (65.1%) had GI score between 1-2; and 82 (25.1%) presented GI score of >2. The prevalence of calculus in these groups was 9.4%, 18.8% and 11.0%, respectively. No statistical relation was found between GI and calculus (p=0.148) (Table 1).

*Table 1. Summary of variables evaluated for association with accumulation of supra-gingival calculus.*

| Variables | | Number of patients (%) | Prevalence of calculus | p Value |
|---|---|---|---|---|
| Age | 6-7 years [a] | 113 (34.6) | 23.0% | a>b, p=0.057; a>c, p=0.078 |
| | 7-8 years [b] | 109 (33.3) | 13.5% | |
| | 8-9 years [c] | 105 (32.1) | 12.4% | |
| PI Score | 0-1 | 174 (53.2) | 14.9%, | p=0.666 |
| | 1-2 | 115 (35.2) | 18.3% | |
| | >2 | 38 (11.6) | 14.3% | |
| GI Score | 0-1 | 32 (9.8) | 9.4% | p=0.148 |
| | 1-2 | 213 (65.1) | 18.8% | |
| | >2 | 82 (25.1) | 11.0% | |
| Open-bite | Yes | 92 (28.1) | 29.4% | p=0.0006 |
| | No | 235 (71.9) | 10.7% | |
| Erupting teeth | Yes | 260 (79.5) | 17.7% | p=0.119 |
| | No | 67 (20.5) | 9.0% | |
| Dental pain | Yes | 13 (4%) | 15.4% | p=0.738 |
| | No | 314 (96) | 15.9% | |

*PI=Periodontal Index; GI=Gingival Index*

Open-bite was evidenced in 92 (28.1%) of the participants. The prevalence of calculus among children with open-bite was significantly higher than that of children without open-bite (29.4% vs. 10.7%, p=0.0006) with an odds ratio of 3.489 (Table 1, Figure 1). The magnitude of open bite (<1 mm vs. >1mm) did not affect the prevalence of calculus.

Over jet above 2 mm was present in 14 children. No statistical correlation was found between presence of increased OJ and calculus.

*Figure 1. Clinical photograph showing anterior open-bite associated with accumulation of calculus on the mandibular incisors.*



Erupting teeth without occlusal contact were found in 260 children. The prevalence of calculus among children with erupting teeth was higher than that of children without erupting teeth (17.7% vs. 9%, respectively, p=0.119) (Table 1).

Among the study population 13 children reported having dental pain, but none of them reported severe dental pain. No statistical correlation was found between presence of dental pain and calculus (15.4% vs. 15.9%; p=0.738) (Table 1).

## Discussion

Several studies have shown that calculus is a risk factor for development of periodontal disease in children as well as in adults [Sjödin and Matsson, 1994; Sjödin et al., 1995; Albandar et al., 1997; Albander et al., 1998]. Sjödin and Mattson [1994] have shown that presence of calculus in children of 9 years of age was associated with development of periodontitis. Until now, no study has evaluated the occurrence of supra-gingival calculus in relation to non-functional teeth. In the present study it was found that open-bite was statistically correlated with accumulation of calculus in children, and children with erupting teeth, without occlusal contact, had a higher occurrence of calculus but this was not significant. The reason for this finding might be related to the fact that tooth percussion during mastication and swallowing breaks out the initial calculus calcification on teeth surfaces and prevents its further accumulation. Thus, in patients with an open-bite who lack this percussion, the accumulation of calculus is more likely. This interpretation might also explain the well known phenomena among the paediatric clinicians (although no reference was found) that there is accumulation of calculus in reduced function teeth as a result of experiencing prolong severe pain [Delima et al., 2001].

Interestingly, in the present study it was found that the prevalence of calculus decreased from the age of 6-7 years to the age of 7-9 years. This finding may result from the fact that with age the anterior teeth reach occlusal contacts and this might decrease the accumulation of calculus as mentioned above, contradicting the finding of Hugson et al. [1981] that calculus increases with age. The discrepancy may be because that Hugson et al. examined different age groups (5, 10, 15 and 20 years).

According to the present results, children with an open-bite or with erupting teeth should be followed frequently for accumulation of calculus and should be treated accordingly to prevent periodontal disease. Further studies should be conducted to follow children with open-bites and calculus after restoring the occlusion. That open-bite is related to calculus accumulation, might contribute also to the calculus accumulation in children with amelogenesis imperfecta who present with open-bite [Stewart et al., 1982]. Increased calculus accumulation in these patients may also result from the rough surfaces of the teeth and their higher sensitivity and as consequence, difficulty in performing effective tooth brushing.

## Conclusion

Accumulation of calculus in children aged 6-10 years was found mainly in the mandibular incisors, decreased with age and was correlated with open-bite.

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