

# Empirical Support for a Fissure Sealant Placement Timeframe Protocol for Black South Africans

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## ABSTRACT

**Objectives:** It is recommended that fissure sealants should be placed within four years after eruption. Due to considerable variations in the eruption times of molar teeth, this recommendation is of limited value from a public health perspective. This study, therefore, sought to provide empirical support for a public health fissure sealant placement timeframe protocol.

**Methods:** The first and second molar eruption patterns of black South African children aged five to seven and 11 to 16 years were analysed in relation to caries experience using the 1999/2002 National Children's Oral Health Survey.

**Results:** By seven years of age, 90% of first molars had erupted with a caries experience of 3%. By 14 years of age the erupted first molars caries experience was 20%. The 13- and 14-year-olds presented with 86% and 98% erupted second molars with a caries experience of 11% and 20%, respectively.

**Conclusions:** The study findings suggest that during school-based fissure sealant programmes involving black South African children, first molars should be targeted at age seven (Grade 1), or as soon as possible thereafter. However, caries protection may still be achieved until thirteen years of age (Grade 7). Furthermore, second molars should be sealed between the age of 11 and 13 years (grades 5-7).

## INTRODUCTION

There is strong scientific evidence that fissure sealants are effective in the prevention of dental caries<sup>1</sup>. The caries protective effect of fissure sealants is also illustrated in public health programmes in South Africa<sup>2</sup>. However, to ensure cost-effective utilisation, fissure sealants should be placed in individuals with a high risk for dental caries, and primarily on teeth that are prone to pit and fissure caries - the first and

second molars<sup>3</sup>. Although the placement of fissure sealants in older caries prone individuals is not precluded, the ideal time to place fissure sealants is within four years after eruption<sup>1</sup>. From a public health point of view, which is concerned with communities and not individuals, this recommendation is however of limited value, mainly because of the considerable variations in eruption patterns of molar teeth<sup>4, 5</sup>. Knowledge about eruption patterns of molar teeth in relation to dental caries prevalence will be much more useful in school-based programmes<sup>5</sup> because informed decisions can be made to target age cohorts where a large percentage of molars have erupted before dental caries starts to increase significantly.

In the absence of empirical evidence of eruption patterns of first and second molars in relation to dental caries experience in South Africa this study was conducted to determine the most appropriate age-cohorts to be targeted in black South Africans during school-based fissure sealant programmes.

## METHODS

The methods of the 1999/2002 National Children's Oral Health Survey (NCOHS) have been previously published<sup>6</sup>. Briefly, the NCOHS used a multi-stage probability sampling process. Although the main focus of the NCOHS was the four to six-, 12- and 15 year-old subjects, adequate numbers were sampled in the three-, seven-, 11-, 13-, 14- and 16 year-old age groups to warrant inclusion in the current study.

Eruption patterns of first and second molars of black South Africans were analysed in relation to the caries experience of erupted molars. The caries experience was measured using the DMFT index and the treatment needs per tooth was recorded according to the World Health Organisation (WHO) guidelines<sup>7</sup>. Gender differences in eruption patterns of molar teeth and the associated caries experience were also examined.

Since a large proportion of caries in children remains untreated in South Africa<sup>2</sup>, the treatment need for molars with caries experience was used to provide an indication of the ratio between one-surface restorations and multiple-surface restorations. Since the occlusal pit and fissures on molar teeth are much more

**Table 1: 1<sup>st</sup> Molar Eruption Patterns and Caries Experience for Black South Africans**

Age	n	% Erupted molars		% Molars with caries experience	
		mean	sd	mean	Sd
5	2630	42 <sup>a</sup>	45	1 <sup>a</sup>	7
6	3349	76 <sup>b</sup>	37	2 <sup>a</sup>	11
7	261	90 <sup>c</sup>	25	3 <sup>a</sup>	13
11	589	99 <sup>d</sup>	7	13 <sup>b</sup>	27
12	3231	99 <sup>d</sup>	8	15 <sup>b</sup>	28
13	188	99 <sup>d</sup>	8	17 <sup>b</sup>	31
14	647	99 <sup>d</sup>	9	20 <sup>c</sup>	32
15	3201	98	13	19 <sup>c</sup>	31

Bonferroni post hoc contrast analysis:  
P<0.05 (a, b, c and d indicate homogenous groups)

**Table 2: 2<sup>nd</sup> Molar Eruption Patterns and Caries Experience for Black South Africans**

Age	n	% Erupted molars		% Molars with caries experience	
		mean	sd	mean	Sd
11	589	73 <sup>a</sup>	40	6 <sup>a</sup>	20
12	3231	75 <sup>a</sup>	38	7 <sup>a</sup>	20
13	188	86 <sup>b</sup>	32	11 <sup>a</sup>	26
14	647	98 <sup>c</sup>	13	20 <sup>b</sup>	33
15	3201	97 <sup>c</sup>	16	19 <sup>b</sup>	31
16	145	98 <sup>c</sup>	10	20 <sup>b</sup>	32

Bonferroni post hoc contrast analysis:  
P<0.05 (a, b and c indicate homogenous groups)

**Table 3: Gender Differences in Eruption Patterns and Caries Experience of 2<sup>nd</sup> Molars For Black South Africans**

Age	Gender	n	% Erupted molars		% Molars with caries experience	
			mean	sd	mean	Sd
11	male	260	66 <sup>*</sup>	41	5	15
	female	328	79	36	7	23
12	male	1506	70 <sup>*</sup>	41	6	19
	female	1708	80	34	7	20
13	male	86	81	36	10	24
	female	102	90	27	11	28
14	male	267	97	13	17	30
	female	375	98	13	22	34
15	male	1370	96	17	17 <sup>*</sup>	29
	female	1787	97	15	21	32

\*Wilcoxon Rank Sum Test, P<0.05

susceptible to dental caries compared with the smooth surfaces<sup>8</sup>, it was considered that one-surface restorations were mainly intended for caries affected occlusal surfaces.

The sample used was weighted to adjust for response patterns to produce a representative sample of five to seven-, and 11- to 16-year-old children who participated in the NCOHS. The mean (sd) percentage of erupted first and second

molars per age category was determined and compared with the mean (sd) percentage of erupted molars with caries experience. Due to the non-parametric nature of the eruption patterns, Kruskal Wallis analyses of variance in combination with post-hoc contrast analysis (Bonferroni) were used to show differences between age cohorts in terms of eruption patterns and caries experience for first and second molars, respectively. The Wilcoxon Rank Sum Test was used to analyse gender differences in the different age cohorts.

## RESULTS

### Eruption and caries patterns: first molars

Ninety percent of first molars have erupted by seven years of age (Table 1). The post hoc contrast analysis however indicated no variance in eruption patterns from eleven years onward. The need for one-surface restorations on the first molars outnumbered multiple surface restorations by 3.5 to one (entire sample). The caries experience in erupted first molars was low (1 to 3%) and statistically the same in the five-, six- and seven year-old cohorts. The post hoc contrast analysis indicated that the caries experience of erupted first molars was the same for 11- and 12-year-olds but then significantly (P<0.05) increased until 14 years of age.

### Eruption and caries patterns: second molars

Eighty six percent of second molars had erupted by 13 years of age while 98% of second molars erupted by 14 years of age (Table 2). The need for one-surface restorations on the second molars as opposed to multiple-surface restorations was 4.7 to one for the 11- to 16-year-olds. The caries experience (6 to 11%) in erupted second molars did not vary significantly between the 11- and 12-year-old cohorts but increased significantly (P<0.05) to 20% for the 14-year-old cohort, and remained statistically the same at ages 15 and 16 years.

### Eruption and caries patterns: Male versus female

The eruption and caries patterns of first molars for males and females were not statistically different (data not displayed) and more or less reflected the overall profile for black South Africans (Table 1). The eruption and caries patterns of the second molars differed significantly for males and females (Table 3). In the 11- and 12-year-old cohorts, a significantly higher percentage of second molars had erupted in females compared with their male counterparts but the males caught up with the females by the age of 14. The 9% difference between second molar eruption percentages of the 13-year-old males and females is also important to note. This difference was not statistically significant – probably due to the relatively small sample size of this age cohort. Females presented with a higher percentage of erupted second molars with caries experience in the 15-year-old cohort.

## DISCUSSION

To maximise cost-effectiveness, the decision to seal or not to seal must firstly be based on a proper risk assessment for future pit and fissure caries<sup>1</sup>; and secondly, the timing of school-based programmes must take into consideration eruption patterns in relation to dental caries<sup>5</sup>. The results of this study indicate that first molars should be targeted at seven years

of age, or as soon as possible thereafter, which will ensure a 90% coverage and will maximize the caries preventive effect since the caries experience is still very low at this stage. Unfortunately, eight- to 10-year-old children were not sampled during the NCOHS that followed WHO protocol<sup>7</sup>, of examining mostly six, 12- and 15-year-olds. The gradient of the caries prevalence increase in erupted first molars is therefore unknown in the omitted age-cohorts. Nevertheless, very good deductions can be made without information from these cohorts since the results indicate that significant caries protection may be achieved until 13 years of age through the placement of fissure sealants on the first molars. However, more pit and fissure caries lesions will be prevented if fissure sealant placement takes place as soon as possible after eruption.

The findings that the percentage of erupted second molars with caries experience more than tripled from 11 to 14 years of age, and nearly doubled from 13 to 14 years, indicate that the best time for the placement of fissure sealants on the second molars should be prior to 14 years. If fissure sealant programmes target the second molars of 11- to 13-year-olds, nearly 80% coverage could be achieved with the best possible caries protective effect.

In the South African schooling system most children become seven years of age in Grade 1 and will turn 13 in Grade 7, just prior to the transition to secondary school. Grade 1 and 2 children should therefore be the main focus for the sealing of first molars and grades 5, 6 and 7 for the sealing of second molars, bearing in mind that a potential caries protective effect may be achieved until 13 years of age (Grade 7) in terms of the first molars. It is however, suggested that the late sealing of first molars should be performed in conjunction with the sealing of second molars and/or if indicated through risk assessment. Unfortunately the transition to secondary school will make the management of fissure sealant programmes aimed at the older cohorts (from 14 years and older) very difficult, or even impossible due to the break in continuity from primary school to secondary school. Furthermore, from a public health point of view, to start a fissure sealant project in Grade 8 in secondary school will probably only provide a minimal caries protective effect.

A summary of the literature indicates that eruption patterns of molar teeth may vary in terms of anatomical location (arch differences), gender (females often precede that of males) race and social class<sup>5</sup>. It is, however, doubtful if distinctions in terms of gender<sup>5</sup> and arch differences will have additional caries protection benefits from a public health perspective. Gender differences in terms of eruption and caries patterns are of academic interest. Empirical evidence in this regard may assist during interpretation of epidemiological studies. In this study the initially delayed (prior to 13 years of age) eruption pattern of second molars, in black African males, compared with black African females, may explain the lower caries profile in the 15-year-old male cohort.

Conversely, it has been suggested that race and social class may be used to prioritise fissure sealant programmes<sup>5</sup>. Since the black population comprises approximately 80% of the

South African population<sup>9</sup>, which is reflected in the NCOHS sampling, it means that the suggested time-frame protocol applies to the majority of children in South Africa. The largest part of the black population has a relatively low socio-economic status<sup>10</sup> and is therefore more often than not the responsibility of public health systems.

The main limitation of this study is the fact that important caries determinants such as fluoride and sugar consumption (not collected during the NCOHS) were not controlled during this study. Another limitation is the fact that only DMFT was recorded, opposed to DMFS that would have been more useful to make accurate recommendations in terms of fissure sealant programmes. However, the sizable need for one-surface restorations opposed to multi-surface restorations recorded in this study shows that there is no reason to believe that the caries profile in South Africa is drastically different from elsewhere, where it has been shown that the vast majority of caries in children occurs in the pits and fissures of the molar teeth<sup>8, 11</sup>. The results from this study, and an earlier fissure sealant programme evaluation study in South Africa, which confirmed significant caries protection using the DMFT as measurement tool<sup>2</sup>, illustrates that the DMFT index is sensitive enough to be used as gauge of pit and fissure caries experience. The strength of the study is the large sample size used.

## CONCLUSION

To ensure maximal coverage and caries prevention, public health fissure sealant programmes should attempt to seal the first molars of black South Africans at the age of seven years (Grade 1), or as soon as possible thereafter. Significant caries protection on the first molars may conversely be achieved up to the age of 13 (Grade 7). Second molars should be targeted from 11 (Grade 5) to 13 years of age (Grade 7). Therefore, it is generally indicated that primary schools should be targeted for fissure sealant programmes of the molars. The decision to seal should, however, always be based on an assessment of the individual's risk to develop pit and fissure caries in the future.

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