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## Prevalence of Caries and Lesions Treatable through the ART Approach in High Caries Risk Schoolchildren in Damascus, Syria

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### Key Words

Dental caries · Atraumatic restorative treatment · Syria

### Abstract

**Objective:** To determine the prevalence of dentinal lesions treatable through the atraumatic restorative treatment (ART) approach for high caries risk schoolchildren.

**Subjects and Methods:** A convenience sample was taken of 1,542 grade 1 and 931 grade 2 children from 21 primary schools in a low socio-economic area in Damascus. Dentinal lesions in which the smallest excavator (diameter of 0.9 mm) could enter the cavitated lesion were considered treatable using the ART approach. Mann-Whitney U and ANOVA tests were used to analyse the data.

**Results:** The mean dmfs and dmft scores of the 6- to 7-year-olds (grade 1) were 9.0 and 4.4, respectively. The mean DMFS and DMFT scores of the 7- to 8-year-olds (grade 2) were 1.6 and 1.4, respectively. At least 89.9 and 54.9% of the dentinal lesions in the deciduous and permanent dentition that were in need of a restoration, respectively, were diagnosed as treatable using ART.

**Conclusion:** A high proportion of dentinal lesions in need of restorations in both deciduous and permanent dentitions in this high caries risk group of 6- to 8-year-olds were diagnosed as being treatable using the ART approach.

### Introduction

Syria is a developing country inhabited by 17 million people situated in the Eastern Mediterranean Region. Its capital, Damascus, has a population of 3 million. The proportion of the population under 15 years of age is 40%.

A large part of the younger population in Syria is seriously affected by dental caries. The prevalence of dental caries among 6- to 12-year-old schoolchildren in Damascus was reported to be 65% in 1991 [1] in a study that revealed that more than 90% of the dentinal lesions were found untreated. The report further revealed that the mean dmft score of 6-year-olds was 4.7 whereas the mean DMFT score of 12-year-olds was 2.4. These oral health statistics are considered high but they are not as high as those reported for children in some neighbouring countries. For example, the mean dmft scores of 6-year-olds in Kuwait [2] and in Saudi Arabia [3] were 6.2 and 6.4, respectively. The mean DMFT score for 6-year-olds in Lebanon was 2.0 [4] and the mean DMFT score of 12-year-olds in Kuwait was 2.6 [2].

In Syria, oral health educational and preventive programmes have been instituted in primary schools as part of the formal curriculum [5]. Oral health services are delivered mainly to schools near a dental clinic in urban areas only. Despite the effort to instill good oral health behaviour at an early age, many children suffer from the

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adverse effects of dental caries. The public oral health system is inadequately equipped to deal with this immediate problem. Although the country graduates a sufficiently high number (900) of dentists per year, other resources such as dental clinics, equipment and maintenance are insufficient and funds for upgrading the services are not likely to become available in the near future. The country has a surplus of dentists compared to the number of health centres and it is, therefore, not uncommon to find several dentists posted to a health centre that has only one dental unit.

Conventional restorative care relies heavily on electrical equipment. In the absence of sufficient means to purchase and maintain electrically driven dental equipment, alternative restorative treatment options appropriate for use in Syria must be considered. Changing the conventional manner (drill and fill) of treating dental caries was considered as one of the options. Such an option, however, was thought only feasible in conjunction with oral health care programmes that were based on effective and acceptable preventive measures. It would allow the government to provide oral health services to the public in a more effective and affordable manner.

Recently, a new approach for managing caries termed atraumatic restorative treatment (ART) was introduced [6]. ART relies only on hand instruments for removing decayed enamel and dentine and uses adhesive filling material for restoring the cleaned cavity. Glass-ionomers have been used as the filling material in most of the studies reporting on the use of ART to date [7], but (poly-acid modified) resin-based composite material is also used [8]. ART in combination with glass-ionomers has the advantage that it does not rely on availability of electricity and can therefore be used anywhere. The benefits of the introduction of ART into the care delivery system for children has been shown in South Africa. A year after the introduction of ART, the number of extractions was reduced by 17% for permanent teeth and by 36% for primary posterior teeth compared to the year prior to the introduction of ART [9]. Conversely, restorative care increased by 33% in permanent teeth and by 37% in primary posterior teeth. This positive change, involving increased acceptance of restorative care by children, was ascribed by the authors to the patient-friendly nature of ART that had reduced fear, mainly because of the absence of injections [9].

One of the advantages that ART can offer the oral health services in Syria concerns the utilization of government-employed dentists. Adoption of ART would mean that dentists need not practise only in health centres but also in schools. Government dentists could thus be

utilised more effectively, serving a larger part of the population.

In order to assess the viability and acceptability of the employment of ART in Syria, it was first decided to study ART among schoolchildren. A study was set up in which the effectiveness of the ART approach using glass-ionomers would be compared to the conventional restorative approach using amalgam. The present paper reports the prevalence of caries and, for the first time, the prevalence of dentinal lesions potentially treatable through the ART approach amongst schoolchildren in Syria.

## Subjects and Methods

### *Sampling Procedure*

The present study was carried out at the Regional WHO Demonstration, Training and Research Centre for Oral Health in Damascus. A power calculation determined the sample size required for the study of the effectiveness of the two treatment procedures. In order to obtain those samples, some 1,500 grade 1 and 1,000 grade 2 children needed to be examined. The number of primary schools in Greater Damascus is 312. A convenience sample of 21 schools around the Regional WHO Centre was taken. This sample allowed for easy transport between the schools and the dental clinic at the Regional WHO Centre. The sample area was inhabited predominantly by families with a low socio-economic background.

### *Examination*

The dental examinations took place on the school premises. All grade 1 and 2 children present on the day of the examination were examined. Each child was seated on a chair facing the window to allow for sufficient natural daylight to illuminate the oral cavity. The examiners used plain mouth mirrors, No. 5 dental probes and 0.9-mm excavators. No X-rays were used. The probe was mainly used to remove plaque and food debris from the tooth surfaces and not for probing pits and fissures. The diameter of the smallest excavator was used to determine the opening of the carious lesions. If the tip could enter a lesion, it was assumed that ART could be applied with certainty. Caries was diagnosed by 3 calibrated dentists employed by the Centre according to the criteria described in table 1. A score of 3 or C was used in the present study to determine the proportion of dentinal lesions diagnosed as treatable by ART. The anterior upper and lower deciduous teeth were excluded from the examination. Trained dental assistants acted as recorders.

### *Reliability*

As part of the preparation for the study, dental examiners were calibrated in three sessions. A total of 10 children were examined each day. Differences in observations were discussed amongst the examiners with the children present for reassessment. Inter-examiner evaluation in the present study was performed on 21 children. The Kruskal-Wallis test did not show a statistically significant difference between the examiners for the mean dmfs scores ( $p = 0.17$ ). However, a statistically significant difference was observed for the mean dmft scores ( $p = 0.02$ ). One of the examiners scored lower than the other 2. The difference, however, was small (4.6 versus 4.1 mean

Table 1. Caries diagnostic classifications used in the present study

Score	Lesion description	
	permanent	deciduous
0	A	sound surface
1		early enamel lesion; white/opaque or brownish/dark lesion in enamel only, including loss of tooth surface; considered being active or inactive
2	B	carious lesion involving the dentine slightly; lesion cannot be penetrated with smallest excavator
3	C	dentinal lesion; lesion can be penetrated with smallest excavator
4	E	dentinal lesion; pulp possible or definitely exposed
5	R	restoration
6	K	restoration with primary or secondary caries
7	M	missing tooth due to caries
8		unerupted permanent tooth
9	U	unable to make diagnosis
S		sealant

dmft counts). The reliability of diagnosing dentinal lesions that would be treatable using ART was calculated using kappa statistics. The inter-examiner consistency and standard error (SE) was 0.77 and 0.02, respectively. The intra-examiner consistency was 0.90 (kappa) and 0.01 (SE).

#### Statistical Analyses

Data were analysed using SPSS [10]. A non-parametric test (Mann-Whitney U) was used to test for differences between skewed distributed variables. The ANOVA test was applied after square root transformation of the data for normality. The proportion of dentinal lesions treatable with certainty through ART was calculated by dividing the number of lesions diagnosed by caries score 3 or C through the total number of lesions diagnosed by caries scores 2, 3 and 6 or B, C and K.

## Results

### Dental Caries

*Grade 1 Students.* The 6- and 7-year-olds totaled 502 and 1,040, respectively. 53.4% of the children were boys and 46.6% were girls. The proportion of boys and girls was evenly distributed over the two ages ( $p = 0.71$ ). The prevalence of dental caries (excluding enamel caries) in the deciduous dentition was 85%. The mean dmfs and dmft scores were 9.0 and 4.4, respectively. The d component constituted the predominant part of both indices (table 2). The Mann-Whitney U test did not show a statistically significant difference in mean dmfs and dmft scores

between the boys and girls ( $p = 0.15$  and  $p = 0.27$ , respectively). However, application of the ANOVA test with the mean dmfs score as dependent, and age and gender as independent variables showed an age effect ( $p = 0.01$ ). The 7-year-old children had on average a greater number of carious surfaces than the 6-year-olds. This effect was not observed for the mean dmft score.

*Grade 2 Students.* Of the 931 children examined, 24.6% were 7-year-olds and 75.4% were 8-year-olds. The group consisted of 51.3% boys and of 48.7% girls. The prevalence of dental caries (excluding enamel caries) in the permanent dentition was 57.6%. The mean DMFS and DMFT scores were 1.6 and 1.4, respectively. There were no permanent teeth found missing due to caries and the number of teeth filled was very low (table 3). By far the largest part (>93%) of both indices was the D component. The carious lesions were found predominantly in occlusal surfaces (85%) followed by smooth surfaces (13%) and approximal surfaces (2%). The children had on average 9.6 permanent teeth present. A DMFT score of 3 or more was found in 24.2% of these 7- to 8-year-olds.

Two ANOVA tests, one for the mean DMFS score and the other for the mean DMFT score as the dependent variable, and age and gender as independent variables showed an age and gender effect ( $p = 0.001$ ). Girls had on average more teeth (1.6) and surfaces (1.7) affected with caries than boys (1.2 and 1.4, respectively). The 8-year-olds had on average higher mean DMFS and DMFT scores than 7-year-olds ( $p = 0.001$ ).

### Dentinal Lesions Suitable for ART Treatment

*Grade 1.* The proportion of children with a dentinal lesion in the deciduous dentition that was penetrable with the excavator was 75.5%. The proportion of children with 1–4, and 5 or more dentinal lesions that were penetrable with the excavator was 43.7 and 31.8%, respectively. Table 4 shows the distribution of the various criteria for determining carious tooth surfaces in both deciduous and permanent dentitions. It shows that 49.8% of the total number of dentinal lesions in deciduous teeth were assessed as being treatable through ART. However, 44.6% of the carious surfaces were expected to have pulpal involvement. Of the total number of dentinal lesions in the deciduous dentition that were in need of a restoration, 89.9% were assessed as being treatable through ART among these 6- to 7-year-olds. The percentage of these primary dentinal lesions in which the smallest excavator could not penetrate (score B) was 4.2%.

*Grade 2.* The proportion of children with a dentinal lesion in the permanent dentition that was potentially

Table 2. Mean dmfs and dmft scores and the components among grade 1 children

	dmfs	ds	ms	fs	dmft	dt	mt	ft
Mean	9.0	7.0	1.1	0.9	4.4	3.7	0.2	0.4
SD	7.6	6.4	2.9	2.4	3.1	2.9	0.6	1.1
%	100	77.7	12.2	10	100	84.1	4.5	9.1

SD = Standard deviation; n = 1,542.

Table 3. Mean DMFS and DMFT scores and the components among grade 2 children

	DMFS	DS	MS	FS	DMFT	DT	MT	FT
Mean	1.6	1.5	0	0.1	1.4	1.3	0	0.1
SD	1.9	1.7	0	0.7	1.5	1.5	0	0.4
%	100	93	0	6	100	93	0	7

SD = Standard deviation; n = 931.

Table 4. Distribution (%) of carious lesions according to criteria by age group

Criteria score	Lesion description		6- to 7-year olds, % (deciduous dentition)	7- to 8-year olds, % (permanent dentition)
	permanent	deciduous		
1		early enamel lesion	-	34.6
2	B	small dentinal lesion	4.2	26.2
3	C	dentinal lesion	49.8	32.6
4	E	(expected) pulp involvement	44.6	6.0
6	K	restoration and caries	1.4	0.6

Criteria scores and lesion description refer to table 1.

treatable through ART was 25.7%. Two or more dentinal lesions with an opening in which the excavator could enter were observed in 12.3% of the children examined. The proportion of the total number of surfaces assessed as being carious and treatable by ART was 32.6% (table 4). The percentage of dentinal lesions expected to have pulpal involvement was 6%. It was calculated that ART can be applied with certainty in 54.9% of dentinal lesions in permanent teeth that were assessed as requiring a restoration among these 7- to 8-year-olds. The percentage of dentinal lesions in which the smallest excavator could not penetrate (score 2) was 26.2%.

## Discussion

This epidemiological investigation was carried out in support of a study assessing the effectiveness of the conventional treatment approach in comparison to the ART approach. Hence, a convenient sample was chosen from schools in the vicinity of the WHO Regional Centre where the treatments were to be performed. Although the schools were situated in a predominantly low socio-economic area, the results of the epidemiological investigation do not necessarily represent the caries situation amongst all low socio-economic groups in Damascus.

The study shows a high prevalence and severity of dental caries in both deciduous and permanent dentitions of these young children. Because X-rays were not used, the reported prevalence and severity of dental caries is even underestimated. The result of the present study in the deciduous dentition seems to be in agreement with the results of a study from Damascus reported earlier [1]. The high level of untreated decay indicates the absence of curative care, as seen in many developing countries [11]. It also shows that the preventive and educational school oral health programme instituted by the Government was much needed. This programme started only a few years prior to the present investigation and may not have had an impact on the oral conditions of the children examined.

A large proportion of dentinal lesions in deciduous dentition had pulpal involvement. Excluding these lesions, the study shows that 89.9% of the dentinal lesions diagnosed as requiring a restoration had an opening, which allowed the smallest excavator to enter. The excavator could not enter a dentinal lesion in only 5.6% of the total number of dentinal lesions in the deciduous dentition assessed to be in need of a restoration. Whether these lesions represent the so-called 'hidden' caries or small lesions is difficult to determine as no additional recording of these lesions was undertaken. However, such an opening can be carefully enlarged using a dental hatchet or gingival margin trimmer, particularly in enamel of deciduous teeth [6]. Thus, it may be possible that a certain proportion of these small dentinal lesions could also be treated by ART. This increases the percentage of dentinal lesions that can be treated through the ART approach to over 89.9%. These include single and multiple surface cavities.

The proportion of dentinal lesions treatable through ART with certainty in the permanent dentition was 54.9%. Considering that a number of dentinal lesions with score 2 can be opened using hand instruments, the percentage of dentinal lesions that can be treated using ART would be higher than the calculated 54.9% for these 7- to 8-year-olds. One other study that investigated the applicability of ART in the permanent dentition [12] was carried out in a population of (on average) 14-year-olds with low caries prevalence. The study showed that 84% of the dentinal lesions diagnosed could be treated using ART. The difference in the results between that study and the present investigation is probably due to the increased period for caries progression in the older children.

In conclusion, the prevalence of dental caries in the deciduous and the permanent dentitions of 6- to 8-year-old children in this sample was high. The percentage of dentinal lesions in the deciduous dentition that were diagnosed as treatable using ART was also very high (89.9%). The proportion of dentinal lesions in the permanent dentition that was diagnosed as treatable using ART was high (54.9%). It is suggested that the school oral health programme should be completed with an appropriate restorative component.

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