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Caries Experience of Egyptian Adolescents: Does the Atraumatic Restorative Treatment Approach Offer a Solution?

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Key Words

Atraumatic restorative treatment · Dental caries · Epidemiology · Oral health · Egypt

Abstract

Objectives: To assess the prevalence and severity of dental caries amongst Egyptian adolescents and the prevalence of carious lesions treatable through the atraumatic restorative treatment (ART) approach. **Subjects and Methods:** Using a convenient sample procedure, two secondary schools with a dental clinic were selected (967 students, average age: 13.7 ± 0.8 years, range: 12–15). Dental caries was diagnosed using the ART caries criteria, and plaque and calculus were assessed using the Green and Vermillion criteria amongst students grades 1–3 in the dental clinic by 3 calibrated examiners. The effect of the independent variables gender, age, tooth surface, jaw side (left or right) and type of jaw (mandible/maxilla) on dependent caries experience variables and D₂ and D₃ variables were tested using ANOVA. **Results:** The prevalence of dental caries including enamel lesion (D₂MFT) amongst the 967 students was 51.4% and that of dental caries excluding enamel lesions (D₃MFT) was 38.1%. The mean D₂MFT and D₃MFT scores were 1.5 and 0.8, respectively. The percentage of teeth filled and extracted was low. Female students had statistically significantly higher mean D₃MFT/S and D₂MFT/S scores than males ($p < 0.0001$). The prevalence

of cavitated carious lesions (D₃) treatable through ART was 48% for score 2 and 28% for score 3. **Conclusions:** Most of the cavitated lesions were found untreated despite the presence of a dental clinic and a dentist on the school premises. The majority of cavitated lesions without pulp involvement could be treated using the preventive and restorative components of the ART approach. Copyright © 2011 S. Karger AG, Basel

Introduction

The World Health Organization (WHO) has reported that caries experience in 12-year-olds is decreasing in developed and increasing in developing countries [1]. However, the report does not include data from Egypt as, in general, published caries epidemiological data among Egyptians are very few and old [2–6]. Based on the available data on caries experience amongst adolescents, the prevalence of dental caries is low and is skewly distributed with the large majority of dentinal carious lesions being present in a small percentage of children [3].

Most Egyptians live in rural or suburban areas with limited access to public oral health care services. Those providing the services usually are employed in clinics that have insufficient dental materials or instruments whereas most of the available equipment is inoperable for reasons

such as lack of electricity and/or running water or spare parts. This situation reflects the low priority of oral health within the Egyptian national health care system [6]. Extraction of badly decayed teeth is the predominant treatment used to cure toothache [6]. This situation is characteristic of many developing countries [1]. Therefore, to improve the oral health service in Egypt, the current restorative treatment approach needs to be changed and appropriate treatment concepts that emphasize disease prevention and conservation of tooth structures should be adopted [7]. One such concept is called atraumatic restorative treatment (ART). The ART approach is based on the principle of appropriate technology, prevention and cure and is in line with WHO's primary health care concept [8]. It represents a practically and scientifically sound treatment method for managing dental caries that makes preventive and restorative treatment available to many population groups previously left without dental care [9].

Although young age is considered the best time to start caries prevention, it can be argued that, in communities with limited resources, this age group may be given less priority in favor of preserving the permanent dentition of older individuals. As adolescents have a full set of permanent teeth it is important that these young people are supported in keeping these teeth healthy through exposure to preventive, promotional and curative care.

The successful use of ART in adolescents in Egypt is shown by the high 5-year survival rate of 85% for single-surface ART restorations [10] and the high level of its acceptance among adolescents [11]. However, the ART study was neither accompanied by an investigation into the prevalence of dental caries among this age group, nor has the prevalence of carious lesions treatable through the ART approach been investigated. Therefore, in order to properly plan appropriate caries management programs for adolescents in Egypt, information regarding the above-mentioned situation is needed.

The purpose of this study was to assess the prevalence and severity of dental caries amongst Egyptian adolescents as well as the prevalence of carious lesions treatable through the ART approach.

Subjects and Methods

Sampling Method

Egypt is a developing country with a population of 74 million people. Greater Cairo is administratively divided into three districts: Cairo, Giza and Shobra. The population of Cairo is about 7 million. In Egypt, the preuniversity education system is composed of three stages, namely primary, preparatory and second-

Table 1. Caries diagnostic classification used in the present study

Code	Description
0	Sound surface
1	Early enamel lesion; white/opaque or brownish
2	Cariou lesion involving the dentine slightly; lesion cannot be penetrated with smallest excavator
3	Dentinal lesion; lesion can be penetrated with smallest excavator
4	Dentinal lesion; possible or definite pulp exposure
5	Restoration
7	Missing due to caries
9	Unable to diagnose

D₂ consists of caries codes 1–4; D₃ consists of caries codes 2–4.

ary. Public and private schools offer educational services according to their socioeconomic structures. By far the largest group of schools are free public schools [12]. Some of the secondary schools have been provided with a dental clinic. From a list of public preparatory schools in Giza, provided by the Health Insurance Organization, two schools in one district, one for boys and the other for girls, with a dental clinic were conveniently chosen. This epidemiological investigation was part of a clinical study of the survival of restorations using different materials. The present study was approved by the Ministry of Health's Ethics Committee.

Oral Examination

A total of 967 students, 493 girls and 474 boys, from grades 1–3 who were present on the day of the examination were orally examined at the school's dental clinic using good operating light and air and water spray by 3 calibrated examiners (E.H.M., M.M.S., A.H.R.), from the Restorative Department of Cairo Dental School. Plaque and calculus on the six index teeth (16; 11; 26; 26; 31; 46) were recorded by trained dental assistants using the OHI index [13]. Cariou lesions were diagnosed using the criteria described in table 1. The examiners used plain mouth mirrors, explorers and 0.9-mm discoid excavators. The explorer was used to remove plaque and remaining food debris from the tooth surfaces rather than digging it into pits and fissures. The excavator was used to assess a small dentinal lesion that needed a sealant (code 2) or those that needed to be restored (code 3). Cotton rolls were used for saliva control and cotton pellets were used to dry teeth and to remove plaque that hindered proper diagnosis. No radiographs were taken.

Quality of Data

At the beginning of the study, examiners were trained and calibrated in 3 sessions over 3 days during which a total of 10 students were examined every day. Differences in observations were discussed amongst the examiners with the students present for reassessment and for reaching consensus. Intra- and interexaminer consistency tests were performed on 20 students examined 1 week apart by all 3 examiners who were blinded to this examination. The kappa coefficient was used to calculate inter- and intraexaminer consistency.

Table 2. Mean D₂MFT/S and D₃MFT/S scores, standard deviations (SD) and their components

Caries indices	Mean	SD
D ₂ MFT	1.5	2.0
D ₂ MFS	2.2	3.5
D ₃ MFT	0.8	1.4
D ₃ MFS	1.5	3.0
D ₂ T	1.3	1.9
D ₂ S	1.6	2.7
D ₃ T	0.6	1.2
D ₃ S	1.0	2.1
MT	0.1	0.3
FT	0.1	0.5

Statistical Analysis

The independent variables analyzed were age, gender, tooth surface, type of jaw and jaw side while the dependent variables were caries experience (mean D₃MFT/S score and mean D₂MFT/S score), level of oral hygiene (mean plaque and mean calculus score). The D₂ component of the D₂MFT/S score constituted caries codes 1, 2, 3 and 4, whereas the D₃ component of the D₃MFT/S score constituted only caries codes 2, 3 and 4.

The effect of the independent variables on all caries variables was tested with ANOVA models without interaction effects. Effects of tooth surface, jaw side (left/right) and type of jaw (mandible/maxilla) on D₂ and D₃ variables were tested with a three-way ANOVA model without interaction. Differences between categorical variables were tested using a χ^2 test. Statistical significance was set at $\alpha = 5\%$.

Results

Disposition of Subjects

The kappa values for inter- and intraexaminer consistency for all codes were 0.99 and 0.99, respectively. Among the 12- to 14-year-olds and also for gender, there was no statistically significant difference ($p = 0.13$). However, the number of 15-year-old boys was statistically significantly lower than that of girls ($p < 0.01$).

Caries Experience

The prevalence of dental caries including enamel lesions (D₂MFT) was 51.4% and that of dental caries excluding enamel lesions (D₃MFT) was 38.1%. The mean D₂MFT/S and D₃MFT/S with standard deviations and index components are presented in table 2. Female students had statistically significantly higher mean D₃MFT (1.18 vs. 0.89), D₃MFS (1.90 vs. 1.57), D₂MFT (1.98 vs. 1.68) and

D₂MFS (2.83 vs. 2.40) scores than males ($p < 0.0001$). There was an age effect for the mean D₂MFT score observed ($p < 0.006$). Twelve-year-olds had statistically significantly lower mean D₂MFT scores than 13- to 15-year-olds ($p < 0.003$).

The D component predominated the D₂MFT and D₃MFT indices. The D₂ component accounted for 87%, the M component for 5% and the F component for 8% of the D₂MFT index. The distribution of components within the D₃MFT index was: D₃ component 78%, M component 9% and F component 13%.

There was no statistically significant difference observed in the D₂ component between the right and left side of the maxilla and the mandible ($p = 0.69$). There was a type of jaw and tooth type effect observed. The D₂ component was higher in the mandible than in the maxilla ($p < 0.001$). The D₂ component was mainly present in first and second molars. The prevalence of adolescents belonging to the high caries risk group (D₂MFT score ≥ 4) was 16%.

Cariou Lesions Treatable with the ART Approach

The frequency distribution of caries criteria scores within the D₂ component was: code 1: 49%; code 2: 25%; code 3: 15% and code 4: 12%. Regarding the cavitated carious lesions (D₃), the distribution was: code 2: 48%; code 3: 28% and code 4: 23%. In the maxilla, caries codes 2 and 3 showing lesions that were treatable through either ART sealants (code 2) or ART restorations (codes 2 and 3) were predominantly found in occlusal surfaces (66%), followed by palatal (12%) and mesial surfaces (12%), whereas the predominant surface with carious lesions treatable by the ART approach (codes 2 and 3) in the mandible was found in occlusal surfaces (64%), followed by buccal (26%) and mesial (6%) surfaces.

Oral Hygiene Experience

The prevalence of adolescents with plaque was 74.7% and that of adolescents with abundance of plaque (DI ≥ 1.5) was 2.1%. The prevalence of adolescents with calculus was 71.3% and that of adolescents with medium levels of calculus (CI = 1) was 3.4%. None of the adolescents had teeth covered with abundance of calculus.

Discussion

In order to organize effective community oral health promotion and care programs at preparatory schools, a situation analysis of oral health amongst its students was

needed. The present study was carried out to estimate the caries prevalence and experience among a group of adolescents that had access to organized oral care at the school compound. The sample was chosen in a convenient way. Therefore, the results of the present study are not representative of the oral health situation of adolescents in Greater Cairo. However, considering the absence of caries epidemiological studies on Egyptians in general for many decades, the present study provides useful information on the oral health situation of adolescents that have access to oral care at their school premises.

A few aspects of the methodology used need to be discussed. As the possibility for taking X-rays was not available at the schools, it is well possible that the condition called 'hidden caries' was not detected, which may alter the reported ratio of enamel to dentinal carious lesions in the D₂MFT/S count. Furthermore, the correction factor for the M component was set at 3. However, as no longitudinal caries epidemiological surveys have been reported in Egypt, the factor 3 may be an under- or overestimation of the contribution of the M component to the DMFS count. Considering both methodological aspects it is very unlikely that they have a great impact on the caries estimates presented.

Compared to the goal set for 12-year-olds by WHO for the year 2000, the present study showed a low level of dental caries in this adolescent population. This finding of the present study is in agreement with results reported from Egypt in the 50–70s [3, 14, 15]. They contradict the situation expressed in the literature that dental caries is increasing in developing countries at a critical rate [16].

Although it is difficult to strictly compare the results of the present study with those of other Middle East countries, because of the different sampling methods employed, deviation in ages studied and employment of different examiners, it is worthwhile to place the caries situation in Egypt in a wider context. The mean DMFT score of 1.5 of on average 13.7-year-olds in the present study is in line with the mean DMFT score of 1.3–2.0 for 12- and 15-year-olds in Tunisia in 1994 [17], but it appears to be lower than that of 12- and 15-year-olds from Syria (2.3 and 3.6) in 1998 [18] and even lower than that of their Jordanian age mates (4.5) during 1993–1997 [19]. It appears that the caries experience found in adolescents in the present study is relatively low compared to age mates in neighboring countries.

The D component predominated the DMFT index similar to other developing countries [20]. More than 75% of the cavitated carious lesions had not been treated.

Having the present study performed in schools that are equipped with a dental clinic poses some pertinent questions about the effectiveness of the current school oral health program. It has not been investigated, in the present study, why the delivered care at schools was mainly devoted to extraction and restorative care, and not to caries prevention and promotion. But we suggest that the current school oral health program needs to be evaluated.

The present study has shown that 15% of the cavitated carious lesions could be restored using ART with certainty. From the 25% of teeth with caries code 2, those with a cavity opening that can be widened using hand instruments could also be restored using ART. Those cavities with caries code 2, with a cavity opening that cannot be widened using hand instruments, could be sealed with ART. In a systematic review, Griffin et al. [21] demonstrated that sealing over small dentinal lesions is an accepted and effective manner of managing such small dentinal carious lesions, despite the fact that microorganisms are sealed in the process. Moreover, a review of the evidence showed that these microorganisms are reduced tremendously and that practitioners should, therefore, not be concerned about inadvertently sealing over remaining carious lesions [22]. This shows that the introduction of ART in schools and other communities in Egypt would contribute to improvement of oral health.

The largest percentage of carious lesions was recorded for teeth with caries code 1. These lesions require preventive care, either through vigorous plaque control or through placing an ART sealant. The effectiveness of ART sealants has been shown in a 5-year study from Syria. ART sealants, using high-viscosity glass ionomers, were significantly better than resin composite in preventing dentinal lesion development in pits and fissures of 7- to 8-year-olds [23]. The remaining caries code 4 usually requires extraction in the public services in Egypt. In summary, the suggested treatment options for the different caries codes are in line with WHO's Basic Package of Oral Care [24]. This package is based on pain relief through extraction and ART restoration, preventive care through tooth brushing with a fluoride-containing toothpaste and through ART sealants, and restoring tooth cavities using ART.

However, for the Basic Package of Oral Care to be introduced in schools, its elements need to be taught in under- and postgraduate education institutions and through specially conducted ART training courses. In this way the high surplus of general dental practitioners, who are now distributed over the governmental health care units, of which many are nonfunctional, could be made to real use for improving the oral health of the pop-

ulation of Egypt. In this process, the educational model for teaching ART to undergraduate students, proposed for use in Brazil's dental institutions, may be helpful [25]. Training dental personnel in ART is a necessity if one wants to provide quality preventive and restorative care. Also the type of dental personnel may be a factor in the success of ART restorations with dentists performing better than nondentists [26]. ART is considered one of the treatments that constitute modern caries management within the concept of Minimal Intervention Dentistry [7], but it should not be looked at lightly. All procedural steps should be carried out according to standard.

The finding that dentinal lesions in the present study were predominantly found in lower molars and in occlusal surfaces is in agreement with results from other studies [3, 18, 27]. Producing restorations through ART in easily visible tooth surfaces will increase its quality.

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Conclusion

The caries experience in this adolescent population was relatively low. Most of the cavitated lesions were found to be untreated despite the presence of a dental clinic and a dentist on the school premises. The largest majority of cavitated lesions without pulpal involvement could be treated using the preventive and restorative components constituting the ART approach. We recommend that the Basic Package of Oral Care be introduced in the public oral health services of Egypt.

Acknowledgments

The authors are very appreciative of the assistance provided by Dr. Samar Morris and Dr. Amal Kamal, supervisors of the dental and oral health care unit at Gamal Abdel Nasser preparatory school, while conducting the study.