

Rural dentistry: Is it an imagination or obligation in community dental health education?

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ABSTRACT

During the past two decades, epidemiologic studies in less developed or developing countries have clearly reported that caries prevalence shows the distinctive patterns over the world, even though it is declining in many developed countries. Due to huge rural districts where arrival is problematic and ineffective dental and preventive care centers in most suburban districts, there has been significant difference between the different parts of the communities to provide dental care service, and unfortunately the sole preventive measure has been limited with the advising of using the tooth brush and paste. The problems are usually arisen not only from the inadequacy of trained personnel but also from the absence of an effective economic and pragmatic system which aims to effectively dispense the dental service to all over the country. For this reason, the basic aim of dental care should be to carry out the many dental services in a multidisciplinary manner within the first appointment and to serve the people at their own homes and/or districts. Clearly, the needed multidisciplinary dental care system can lead to a new educational doctrine for rural dental practice. This versatile and practical training program based on specific perceived needs of a specific population(s) could need a new educational program. So, various preventive and/or restorative procedures included by this new doctrine could be named as “rural dentistry.” In this review, with the examples from the many *in vivo* studies carried out under rural conditions over the world, the probable practices in this specific dental doctrine have generally been exemplified.

Key words: Chlorhexidine, fissure sealant, fluoride varnish, prevention, rural dentistry

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INTRODUCTION

The unsuitable geographical conditions such as mountainous districts, less economical and technical conditions and the inadequate dental health and preventive service, even in most city centers, unfortunately, create prominent variations in providing health service in various parts of the world.¹⁻⁴ Thus, the preventive dentistry does not go beyond “explanation of how to use toothbrush and toothpaste” in deprived communities. However, the main problem under these conditions is not only the insufficient number of trained personnel, but also the lack of a series of practical and economical methods targeting to provide the care all over the country, even in rural districts.^{5,6}

It is obvious for the less deprived communities that it is not possible to achieve an established oral health

system as in the Northern European countries, due to the difficulties of supplying service and materials because of high costs. On this basis, the main purpose is to take the health service away to the remote areas where people suffer from this service and to implement many activities at the same time in a multidisciplinary way within the first appointment. For example, a multipurpose approach consisting of caries recording, caries treatment, oral care information, and “preventive procedures” for future caries development seems to be inevitable for the districts where it is hard to reach geographically. This multidirectional approach, named as rural dentistry, needs a new concept and educational program through the health priorities of a community suffering from the dental service. In this review, the necessity of this dental doctrine and the dental procedures to be applied under limited technical conditions will be discussed from a general point of view.

THE LATEST CONCEPTS IN BASIC ORAL CARE

In recent years, various authors have been studying some concepts and programs in order to widen the basic oral care and oral health services in nonestablished marketing economy (EME) countries.^{5,7,8} Among these

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programs the Basic Oral Health Care is the most widely emphasized, recently.⁵ This program has been expressed as follows: (i) oral urgent treatment (OUT), (ii) affordable fluoridated toothpaste (AFT), (iii) oral health promotion (OHP), and (iv) atraumatic restorative treatment (ART). Key components of basic oral healthcare have also been summarized as follows:

- Emergency care by health or dental ancillaries
- Oral health promotion by health personnel as background support for oral and general health activities (hygiene)
- Tooth brushing programs with fluoridated toothpaste by health and/or educational personnel
- Tooth brushing with fluoridated toothpaste campaigns in the media, e.g., television, launched by governments, dental health profession, and toothpaste manufacturers
- ART by dental ancillaries

Nevertheless, the details of the basic oral healthcare and treatment services in these programs are not precisely defined and especially the limits of the preventive approaches that are to be applied easily under the field conditions are not clearly explained. Actually, from a scientific and pragmatic point of view, it seems inevitable to modify the oral care services explained by four parts mentioned above. For example in Turkey, encouraging the use of toothbrush and toothpaste, and increasing oral health education would be appropriate in suburban areas because it is easy to reach these districts periodically. On the other hand, in rural districts where it is more difficult to supply the toothpaste-toothbrush distribution, it is much more reasonable to think radically and to prefer professionally applied preventive programs based on individual caries risk.

Generally, in these series of multidisciplinary single-visit programs which can be defined as rural dentistry, the record of the oral disease (dental caries, gingival and periodontal problems, etc.), oral hygiene education, supplying a primitive treatment, the determination of the caries risks via simple vehicles, and individual preventive programs can be emphasized. In our review, for rural conditions the applicability of dental education, risk determination, primitive treatments, and preventive programs will be discussed via various field trials and clinical reports.

ORAL HYGIENE EDUCATION

“Caries is not a destiny; it could be modified by behavioral change.” The goal of the education is to improve the dental care of children and/or, if they are too small to learn, of parents by active rather than passive methods as well as to improve their habits about dental hygiene.

We did conclude from our field trials performed in rural districts that, in the village home garden, actively showing brushing action to a family with the aid of a

brush and toothpaste being used by a family member, preferably mother, is the best method for rural districts of southeastern Anatolia,⁹ because, as seen in many other studies, the mother’s education status is inversely related to early caries prevalence and incidence.^{10,11} However, there is weak scientific support for the assumption that gained knowledge is an efficient tool to change a nonhealthy dental behavior. Similarly, Kay and Locker¹² have reported that oral health education has a very low and temporary effect on plaque accumulation and no key effects on caries decrease. Moreover, the importance of the age factor in the establishment of hygiene behavior has insistently been emphasized. Zimmer *et al.*¹³ have accepted the age of 6 as the upper limit for brushing to establish habitually, and have reported that the possibility for this habit to establish after this age is 23%. Interestingly, Benitez *et al.*,¹⁴ in a study performed in the USA, have concluded in the children with active and extensive caries patterns such as ECC that in communities with high caries risk and low socioeconomical levels, it is more crucial to implement effective and active methods, rather than changing the patient’s behavior, at an early age for caries prevention. Schou and Wright¹⁵ have also concluded that oral care education is ineffective in children living in socially deprived communities.

The success of dental health education may depend on psychosocial factors, such as self-esteem, immigrant status, age, and social deprivation. As a conclusion, oral hygiene education appears to be a topic that must be given as part of rural dentistry, but not much time should be spent on it. In short, oral care education should definitely be given; however, it should not be regarded as the “primary target.”

RISK ESTIMATION

It is possible to provide long-term risk determinations for people, especially for the children, living in the same region, by following them the eruption of the first primary teeth. As a result, it would be possible to apply short-term, highly sensitive risk determinations rather than expensive and detailed bacteriological tests, and thus more economical approaches intended to determine for high-risk people can be chosen.¹⁶ For this reason, past caries experience, which is proven to be a highly sensitive in different studies, can be regarded as a suitable method.^{17,18}

Beginning with the eruption of the teeth, infant is facing the “caries disease” and his first exceptional experience is early lesions on both upper anterior and posterior deciduous teeth, named as ECC. This caries pattern, that has been reported to be affected by early and heavily MS colonization, inappropriate dietary habits, social factors, and great families as seen in rural areas, is a valuable tool to determine early caries risk.^{19,20} In a long-term study by Kaste *et al.*,²¹ it has been reported that the buccal-lingual caries of anterior teeth cannot be used as an indicator for

future caries; however, a DMFT score of 5 and above might indicate five or more caries in permanent dentition. They have also stated that children with high caries in primary dentition at the average age of 4.4 have 2.4 times more caries in permanent dentition at the age of 15.

Al-Shalan *et al.*,²² in their study in which they examined a new index (CERT index –caries, extracted, restored teeth), recording the total number of caries, extracted and restored teeth, found that children with EEC displayed four times higher CERT values compared to the children without EEC. Similar evidence was observed especially in the first molar caries experience, indicating pupils having EEC developed 2.5 times more caries compared to their counterparts without EEC.

Honkala *et al.*²³ concluded that it is rather difficult to develop criteria to judge caries-sensitive children; instead, to use the DMFT index is the most suitable approach. In harmony with this foresight, Gray *et al.*,²⁴ in their study with 565 children, concluded that three or more caries in deciduous molars of 5-year-old children are more indicative for the first permanent molar caries at the age of 7.

Accordingly, as a general conclusion, permanent first molars should be considered as the primary target in children who had lost their deciduous incisors as a result of caries or who had more than two caries in deciduous molars.

PREVENTIVE PROGRAMS

Fluoride application

Fluoride products are still used as indispensable agents in the preventive dentistry. They include a wide range of individual and public-base programs ranging from water fluoridation to fluoride gels. Among these methods, fluoride varnish application is routinely preferred in routine preventive programs due to their easy application and low cost. For this reason, varnish form of professional fluoride application should firstly be thought in the dental preventive project based on the rural dentistry concept.

The use of fluoride varnishes for caries prevention was reviewed by a WHO expert committee.²⁵ It was concluded that fluoride varnishes, which are usually applied with small brushes or syringes, have been demonstrated as efficacious in caries prevention. The same board stated that fluoride varnishes have comparable caries reduction benefits to other forms of topical fluorides and its extensive usage should be encouraged.

The general aim of topical fluoride application is to treat the hard tooth surfaces in such a way that caries progression is retarded, arrested or even reversed. Although the 3- to 6-month intervals are usually recommended particularly

for high-risk groups, the main problem for the rural and suburban areas is at what frequency the varnishes to be used?²⁶

In a study performed by the noninvasive method, Holm *et al.*²⁷ have observed a caries decline in pits and fissures of newly erupting first molars for more than 2 years after the application of fluoride varnish twice a year. From a pragmatic point of view, it seems possible that 6- to 8-year-old children living in rural and suburban districts, and also having caries, indicating more than two deciduous molar caries, can be taken in control by fluoride varnish application with respect to caries increment for a moderate time period. In harmony with this foresight, it has been found from a field trial that various fluoride varnish preparations applied in school environment provide low-to-moderate caries prevention varying from 17% to 21.9% after a period of 32 months.²⁸

In a metaanalytic overview, Helfenstein and Steiner²⁹ did conclude that twice application of fluoride varnish per year can provide 38% prevention. Nevertheless, Klimek *et al.*³⁰ stated that compared with moderate- to low-risk group children, this application mode was not sufficient in high-risk groups, and they also expressed that varnishes, if used with fissure sealants (fs), could not only be effective in pit and fissure caries, but also in proximal caries.

In Spain, Bravo *et al.*³¹ examined the caries increment in both fissured and nonfissured (smooth) surfaces of the children subjected to one of the two preventive measures which are fluoride varnish and fs. At the end of 24 months, the authors stated that fs provided a better prevention than that of the varnishes in fissured surfaces, but not in nonfissured surfaces. Although this difference between the sealant and varnish application was statistically significant for fissured surfaces, it was not true for nonfissured surfaces. Of course, the most remarkable result of this study was that there was a significant decrease in caries increment of the nonfissured (smooth) surfaces in the fs group, even though no direct application was carried out. The authors did explain this observation with giving a better oral care education to the fs-applied children. Consequently, they emphasized that using the combination of sealant and varnish could provide a good precaution in children.

Of the varnish studies implemented at distinctive time periods, one is, of course, the most interesting and the closest to the rural dentistry concept. In this 4-year follow-up study carried out by Zimmer *et al.*¹³ in Germany, it was shown that 37% caries decline was obtained with the varnish application twice a year in the children coming from socially deprived community. Moreover, the authors stated that repetition of fluoride varnish application more than two times in a year would be more effective for children with high caries risk and low social level.

Consequently, in preventive dentistry, fluoride varnish application appears to be a reliable method for moderate and/or low-risk children. In high-risk groups, the number of varnish application should be increased; however, as this would not be very cost-effective, an additional method such as fs would clearly be necessary. However, for suburban children who consume more sugar than that of the rural children and also for children who spend many times in the fields as agriculture workers, future studies are needed to clarify the relation between the frequency of application and the economical profits.

Fissure sealants

Current evidence has shown that of the methods used for caries prevention, including fluoride varnish, antibacterial varnish, and mouth washes and, of course, toothpastes, fissure sealants needing single application have been recognized as the most widely preferred method to combat occlusal caries, especially for early permanent dentition.³¹⁻³³

Actually, in oral environment showing dynamic nature, the efficacy and duration of a preventive measure depends highly on long contact time between the preventive agent and the tooth surface. Such a preventive method to be successful for a long time in occlusal surfaces is fissure sealants. Fissure sealants having the enhanced range of products with glass ionomers and hybrite ionomers could be used easily under low technical conditions in field applications nowadays. For example, in Thailand, Songpaisan *et al.*³⁴ have ambitiously examined the caries preventing effect of four different preventive methods in children of two distinctive age groups (7–8 and 12–13 years old). The most interesting point to be noted in this study, in which various treatments such as glass ionomer fs, chemically cured fs, and fluoride gel were examined, was that the elementary school teachers took part in the study as hygienists after a 3-day educational program. In this study, of the four different preventive methods investigated, chemically cured fs (Delton) showed a perfect prevention of 93% after 24 months. The results of this study carried out completely under field conditions have clearly shown a proper example indicating that an optimal prevention can be achieved in a vast majority of children at different age groups by means of primitive and cost-effective applications, and that better results can be obtained when preventive measures are implemented at younger ages.

Florio *et al.*,³⁵ in their 12-month study on 250 Brazilian children, reported that fs was the most effective procedure among the three preventive methods which are fs with a resin-modified glass ionomer (Vitremmer) (100%), fluoride varnish (Duraphat 83.3%), and weekly use of NaF mouthwash (72.7%) with brushing. They did also report that although not statistically significant, fs prevented the development of initial occlusal caries when compared to other methods used. Accordingly, Frencken *et al.*³⁶ have also shown a similar result in their 3-year field study in

Zimbabwe. In their study, glass ionomer fs, placed with a primitive technique named ART, has been investigated with respect to durability, and it was shown that when compared to unsealed counterparts, sealed surfaces with ART glass ionomers had four times higher caries resistance after 3 years. However, most surprising results have recently been shown in the Damascus study supported by WHO in Syria. In this 5-year study by Taifour *et al.*,³⁷ 101 ART fissure sealants were placed in 60 children aged 6–7 years, using a split-mouth design. At the end of 5 years, 49 children reached did demonstrate 2.1 times more dentin caries in their unsealed first molars compared to sealed counterparts. This study still remains to be the most important example to show the advantageous results of early and economical precautions in the socially deprived communities.

Chlorhexidine as an antibacterial agent

Chlorhexidine (CHX) is an antibacterial agent used successfully since 1970s especially in Northern European countries. CHX is still the sole antibacterial agent against MS, the primary caries inductive bacteria. Besides various antimicrobial agents and methods tested, the persistent reduction of mutans streptococci has been achieved by chlorhexidine varnishes, followed by gels and mouthwashes.³⁸ However, the main problem concerning CHX application is the frequency of the application period to obtain optimal profits under low technical and economical conditions.

The reduction of MS after CHX application is highly related to the bioavailability from the product, and after the cessation of either mouth wash or gel with toothbrush, a rapid increase of the MS level was observed.^{39,40} However, the best clinical effect resulting in a considerable caries reduction has been obtained when persons highly colonized with mutans streptococci were treated with gels.³⁸

The result of a series of studies by Zickert *et al.*⁴¹ revealed that the application of fluoride varnish with CHX gel in —3-month intervals was superior to that of varnish alone on children with high MS levels, and this effect continued for more than 2 years even after the cessation of CHX treatment. This “long-lasting effect,” even after 3 years, has provided a remarkable advantage to combat dental caries for developing countries. However, taking into consideration that a special condition for each community including sucrose consumption, oral hygiene level, and social stress is usually varied from others; the main question should be focused on the form and frequency of the application method to obtain economically optimal prevention.

Since mid-1980s, combined application of CHX with fluorides has usually been recommended in many field studies, due to the synergistic effect of these two agents. It has also highly emphasized in a metaanalytic overview that if CHX gel application was supported by fluoride

treatment, greater MS suppression could be attained compared to fluoride application alone.⁴² Moreover, CHX application combined with sucrose restriction has been shown to be more effective.⁴³ With this respects it could be possible to say that when compared to Northern European communities with high-sucrose consumption, better results could economically be obtained after single application of CHX fluoride products in deprived rural districts.

CHX–thymol mixing in varnish form is also recommended to be an effective antibacterial agent for widespread application in high-caries risk children and adolescents. Brathall *et al.*⁴⁴ have examined the efficiency of an antibacterial varnish containing 1% thymol and CHX on the fissure carries for 2 years in a child population whose age ranges were 7–8 and 12–13 years. After the applications performed at baseline, 3–4 and 8–9 months, a significantly reduced fissure caries development was observed for 2 years. In the same study, after the last varnish application, a certain reduction of mutans streptococci in plaque was seen in the test teeth; comparing the size of the lesions, more large cavities were found in the untreated teeth. It was concluded that varnishes should be considered as further options for prevention of fissure caries, possibly in more individualized programs or in combination with already established methods.

In another study by Araujo *et al.*⁴⁵ the effects of CHX–thymol varnish treatment applied at baseline 3–6 months on caries development and caries progression of partially erupted first molars were studied for 2 years. It was emphasized that there was no caries in all of the varnish-treated teeth whereas 6 of the 16 control molars showed initial caries. The authors reported that the antimicrobial varnish could reduce the plaque MS level of erupting permanent molars, and cause a statistically significant reduction in caries development.

Although these examples showed varied results for prevention, neither of CHX varnish, thymol varnish alone or in combination has been scientifically documented to be able to reduce caries in deprived communities in where less technical and economical conditions are prevailing. However, it is clear from many studies that caries prevention, even retardation, could be achieved to a large extent, by the combination of CHX and fluoride rather than by CHX or fluoride alone. On the other hand, future studies are needed to show the costs of CHX when used alone or combination with fissure sealants, fluoridated varnish, and other preventive agents for less technical and economical conditions.

PRIMITIVE RESTORATIVE TREATMENTS

The atraumatic restorative treatment (ART) approach evolved in response to the unavailability of restorative

care in the population groups with limited resources, and involves the removal of only soft, demineralized tooth tissue with hand instruments, followed by filling the cleaned cavity and associated pits and fissures with an adhesive restorative material. Actually, the ART approach to the management of dental caries has become available through the combination of a better understanding of the dental caries process that permits the employment of minimal cavity preparations and the development of reliable and effective adhesive restorative material.⁴⁶ Moreover, because only hand instruments in combination with an auto-cured glass ionomer are used, ART restorations and glass ionomer sealants can be placed everywhere, thus also at school premises.⁴⁷

With the studies firstly started in middle African communities, ART has been shown to be a successful operative and preventive method even under less technical conditions. Due to pragmatic nature, it could easily be applied by the short-term trained dental personnel.⁴⁸ Although the approach showed promising results, it had mainly been studied for one-surface restorations and in permanent teeth. Even though the first attempts using ART did show that one-surface ART restorations was as successful as amalgam counterparts, the rate of failure could have increased by the time, especially after 3 years.^{36,44} Moreover, in the two surface cavities ART has been thought as insufficient even after 6 months to 1 year.⁴⁹

Of the ART studies performed right now, one has, of course, most remarkable results. In this study, Mickenautsch *et al.*⁵⁰ used a mobile dental unit to perform ART fillings in both permanent and primary teeth, and also investigated the effect of ART on traditional dental services in the same area. Interestingly, after the introduction of ART approach in south Africa, the total number of amalgam restorations placed did decrease at about 16% for permanent and 1.4% for primary teeth, and the total number of extracted teeth did reduce at about 18% for permanent and 36% for primary dentition, and as a result of these observations, restorative component of all dental procedures applied did increase at 33% and 37% for permanent and primary teeth, respectively. Finally, the same authors concluded from these results that ART with its cost-effectiveness and applicability under all conditions could make restorative care more accessible for all population groups, and could affect dental health policies for a moderate-to-long time period.

From a great point of view, ART could have had additional benefits due to used glass ionomer material releasing fluoride ions. For example, according to Anderson *et al.*⁵¹ besides encouraging oral hygiene practices such as tooth brushing and flossing in the primary and young permanent dentition practitioners might be able to take advantage of remineralization techniques. The use of fluoride varnishes, liners and, of course, fluoride releasing glass ionomer

restoratives might be included in this. For this reason ART can provide a good alternative for the combined applications with any other preventive methods.

Target groups and objectives of rural dentistry

Ages 0–3

- a. Determination of early deciduous caries; initial projections for the future caries development especially in children with EEC; and education of the parents
- b. As a first-time precaution, application of preventive treatment with simple practical and cost-effective agents such as fluoridated gel or Sn-F in EEC patients.

Ages 4–6

- a. Education of the parents and child about the child's oral care habits, and introducing the tooth brushing procedure to the child
- b. Treatment of initial (occlusal) deciduous caries with ART and application of the F-gel, if necessary.

Ages 7–12

- a. Oral health education
- b. Application of ART sealants, fluoride, or CHX varnish on newly erupted first molars
- c. Treatment of initial and, if present, small dentinal caries lesions with ART.

Adolescents

- a. Oral health education
- b. Extraction of deciduous root remnants
- c. Simple scaling, if necessary
- d. Applications of primitive individualized preventive methods (fluoridated varnish, CHX varnish, etc.) together with ART fissure sealants for high caries risk children.
- e. Treatment of occlusal caries with ART.

Adults

- a. Reminding the people about oral health information
- b. Scaling
- c. Restoration of occlusal caries with ART fillings
- d. Simple tooth extractions.

Elders

- a. Scaling
- b. If present, restoration of root (surface) caries with the ART technique
- c. Simple root or tooth extractions.

Mothers, as a specific target group

- a. Pregnant mothers:
 - Explanation and demonstration of basic oral care habits.
 - Scaling to provide optimal gingival health and if necessary using CHX mouth wash.
 - Using primitive preventive methods (such as xylitol chewing gum) to reduce cariogenic bacteria for a moderate-to-long term.

- b. Mothers with new-born babies (less than 10 months old):

Explanation and demonstration of basic oral care habits.

Scaling to provide optimal gingival health and if necessary using CHX mouth wash.

Using primitive preventive methods (such as xylitol chewing gum, CHX, and/or fluoride mouthwash) to reduce cariogenic bacteria for a low-to-moderate period.

Giving the simple information to the mothers about how the dental caries form on the teeth, and how can be prevented in early dentition.

RECOMMENDATIONS AND CONCLUSIONS

In rural dentistry, the first procedure is to decide the priorities of the oral health service according to both financial conditions and the sociocultural structures of the country (community). Actually, the main problem at this stage is where should one primarily go in countries having huge rural districts, and less economical conditions. In Turkey, for example, should the villages in rural districts or schools in the suburban areas be taken as priority? On this basis, the regional boarding schools display a clear advantage for rural dental applications, because they shelter many children coming from various villages with hard geographical conditions. In short, the different demographic, geographic, and economic properties of the countries create various important opportunities with respect to rural dental approaches. However, regardless of the procedures to be applied in rural dentistry, the primary aim should focus on "providing the multidirectional dental service at the first visit as much as possible."

Although caries incidence has been declining in industrialized countries since 1980s, "the caries disease" still remains to be a public health problem affecting wide-range deprived communities. On the other hand, for these communities, the problem of how to implement basic preventive practices such as fluoride and CHX gel or varnish application, fissure sealant, etc. has not yet scientifically solved due to multifactorial nature of caries disease, causing varied results for the same method in different communities. For example, many of the school-based and/or field trials have been virtually performed in economically and socially developed communities living usually in North European countries; thus the results could not exactly be adopted to individuals in deprived communities, and their economical analysis has not yet been fulfilled. For example, it could be possible to perform the preventive methods less frequently in rural districts than in city centers due to less sugar consumption, leading to reduced caries risk.

As a result, apart from the first aid and basic oral care programs of WHO, especially in developing countries where

dental services are limited, it seems necessary to establish various multicentered study groups to implement different preventive methods by means of the orientation of dental schools supported by the governments (Ministry of Health).

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