Atraumatic Restorative Treatment and Dental Anxiety in Outpatients Attending Public Oral Health Clinics in South Africa

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Abstract

Objectives: *This study was undertaken to test the hypotheses that using the atraumatic restorative treatment (ART) approach results in lower patient anxiety and that lower anxiety leads to higher restoration/extraction ratios.* ***Methods:*** *The test group of dental operators (*n *= 9) was trained in ART. The control group (*n *= 11) was not, and did not apply ART. The Short Form of the Dental Subscale of the Children's Fear Survey Schedule (CFSS-SF) and Corah's Dental Anxiety Scale (DAS) were used to assess patient anxiety after ART (test group) and after traditional restorations (control group). The restoration/extraction ratio calculated for primary (children) and permanent dentitions (adults) per operator was based on 12-month treatment statistics. Dental anxiety assessments were analysed using ANOVA. Differences were compared using the* t*-test and corrected for confounding factors (ANCOVA). The Pearson correlation coefficient was used to measure the correlation between dental anxiety levels and restoration/extraction ratios.* ***Results:*** *The mean CFSS-SF score for test-group children was statistically significantly lower than for the control-group children. The mean DAS score for test-group adults was statistically significant lower than the control. No significant correlation was observed between dental anxiety level and restoration/extraction ratio per operator for both dentitions in both groups.* ***Conclusion:*** *The first hypothesis was accepted; the second, rejected. Although dental anxiety scores were lower both in child and in adult patients treated by ART than in those who received traditional restorative treatments, this positive effect had not resulted in higher restoration/extraction ratios.*

Key Words: atraumatic restorative treatment, dental anxiety, South Africa, public oral health services, restoration/extraction ratio

Introduction

Public oral health services in developing countries have only limited resources and manpower with which to address their populations' oral health care needs and demands. In South Africa, approximately 600 dental operators (dentists, dental therapists, oral hygienists) in public service serve 60 to 80 percent of a population of 44.8 million people (1-3). Under such circumstances, the focus of treatment is directed to the relief of pain and sepsis through extraction, leaving little time for restoring decayed tooth surfaces and preventing the progression of caries and periodontal disease.

According to the results of the National Oral Health Survey in South Africa 1988/89, treatment needs for restorable carious lesions were twice as high as those for tooth extraction (3). There is a disparity between this result and the high ratio of nine tooth extractions to one restoration rendered in the South African public service 10 years later (2). Therefore, it seems very unlikely that the continuing use of the current restorative treatment regime will lead to the attainment of the South African National Department of Health's goal of reducing premature tooth loss within the population in the foreseeable future (3).

An appropriate alternative to the traditional restorative treatment approach is the atraumatic restorative treatment (ART). This approach relies on hand instruments for removing infected carious tooth tissues and uses adhesive restorative materials to fill the cavity and adjacent pits and fissures (4). Mickenautsch et al. (5) introduced ART in a dental outreach service in South Africa and reported a significant increase in the number of restorations relative to the number of extractions, 1 year after the introduction of ART. The changes were ascribed to the absence of the need to administer local anesthesia, drill teeth, and suction saliva during ART (5). These characteristics of ART were thought to have been instrumental in reducing dental anxiety and increasing patients' compliance, which, in turn, increased the operators' willingness to treat more painful teeth restoratively, instead of extracting them in accordance with the common practice (6). If the application of ART would improve the current national low restoration-to-extraction (REX) ratio of 0.11 and simultaneously reduce the level of

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dental anxiety among patients, the goal of reducing premature tooth loss in South Africa's public oral health services might be met.

Because of promising results from the pilot study (5), health authorities in one region of the Gauteng Province in South Africa expressed the desire to introduce ART into the provincial oral health service system. The subsequent introduction of ART through a training program was accompanied by a 1-year monitoring program (6). One aim of the monitoring process was to test the hypotheses that the ART approach causes lower dental anxiety levels in child and adult patients and that its use would produce higher restoration to extraction scores in a public oral health service setting than are achieved through using a traditional restorative treatment approach, after 12 months.

Methods

Study Design. With permission from the Ethics Committee for Research on Human Subjects (Medical) of the University of the Witwatersrand, Johannesburg, South Africa (under protocol number M00/07/13), the study was carried out in Gauteng Province, South Africa. Gauteng is the smallest province in the country (17,010 km^2), with equal levels of population density and urbanization in all of its five administrative regions (Central-Witwatersrand, Ekurhuleni, Sedibeng, Pretoria, and West Rand). It consists predominantly of large peri-urban areas and covers almost entirely the three metropolitan areas of Johannesburg (Central-Witwatersrand, Ekurhuleni, West Rand regions), Pretoria (Pretoria region), and Vereeniging (Sedibeng region) (1). Small stone houses supplied with electricity and piped water, a high unemployment rate, and a large informal economic sector characterize the communities in peri-urban areas.

All regions of Gauteng were invited to participate in the study, but the health authorities in Pretoria and West Rand did not respond. All dentists and dental therapists employed full-time from the Ekurhuleni region (n = 21), whose health authorities wanted ART to be introduced into the oral health services, were trained in ART in 2001. The training followed a standard course of 3 days (7). The test group consisted of nine of the original 21 dental operators trained in ART, whereas the control group comprised dental operators from the nearby Sedibeng region, south of Johannesburg (n = 11). The dental operators of the control group had not received any ART training, nor had they applied ART in their daily practice.

Assessment of Dental Anxiety. The inclusion criteria for the test group were patients who had received an ART restoration. Patients who had been treated restoratively with the traditional approach on the day when the fieldworker visited the clinic of the dental operator constituted the control group. The fieldworker asked the patients to complete questionnaires outside the clinic immediately after they had been treated. Those unable to read and understand the questionnaire were interviewed by the fieldworker. Each dental operator was visited once a month over the 12-month evaluation period.

The CFSS-SF questionnaire was used for children up to the age of 15 years. This is a shortened form of the Children's Fear Survey Schedule – Dental Subscale (CFSS-DF). The CFSS-DF contains 15 items, on a scale of 1 to 5, that are related to: a) invasive dental procedures; b) less invasive dental procedures; and c) general medical aspects of treatment (8). The CFSS-SF is restricted to only the eight items related to invasive dental procedures. Each has a possible score rating of 1 (no fear) to 5 (very frightened). The total minimum score is 8; the total maximum score is 40 (9).

The Corah's Dental Anxiety Scale (DAS), consisting of four items and developed for assessing dental fear and anxiety in adult patients, was used for patients 16 years and older (10). As in the CFSS-SF, each DAS item ranged from a score of 1 to 5, with a total minimum score of 5 and a total maximum score of 20. Both scales were applied to patients having received ART restorations in the test group and to those having received traditional restorations in the control group.

Evaluation. In the test group, information concerning the backgrounds of the dental operators, the number of restored and extracted teeth, and the type of restoration per dentition was collected from dental clinic records over a 12-month period following the completion of the ART training (August 2001 to July 2002). Information on the same variables was collected in the control group during the 12-month period of September 2002 to August 2003. Recording was done by the dental operators and collected by the fieldworker.

Statistical Analysis. The quality of the data was checked by calculating the Cronbach's alpha for both dental anxiety scales. Cronbach's alpha for the CFSS-SF and DAS scales was 0.94 and 0.88, respectively, indicating a high reliability level in the data obtained.

The dependent variables were the mean CFSS-SF and DAS scores. The independent variables used were test and control group, gender, age, and number of teeth restored. Data were analyzed using ANOVA and ANCOVA, and the t-test was used in testing differences in results. A difference was statistically significant at $\alpha = 0.05$. Based on clinic record statistics, the REX ratio over the 12-month period, in primary dentitions and in permanent dentitions of patients 16 years and older, was calculated. Children who had received a restoration in the permanent dentition were excluded from the analyses. The Pearson correlation coefficient was used for measuring the correlations between mean CFSS-SF scores, mean DAS scores, and mean REX scores for primary and permanent dentitions by operators. An oral biostatistician (MvtH)

performed the analysis using SPSS-12 (SPSS, Inc., Chicago, IL).

Results

Disposition of Subjects and Operators. The test and control groups consisted of nine and 11 dental operators, respectively. Background information about these dental operators over the 12-month observation period is presented in Table 1.

Background information about the patients interviewed in the test and control groups over the same period is presented in Tables 2 and 3. Children interviewed in the test group were younger than those in the control group ($P < 0.01$). Adult patients were interviewed in five of the nine dental operators in the test group. Consequently, more treated patients in the control (218) than the test (38) group were interviewed. All operators in the test group had placed ART restorations in children and all operators in the control group had placed traditional restorations in adults and adolescents.

REX Score. The mean REX score of dental operators, in child patients, was 0.10 [standard deviation (SD) = 0.11] in the test group, and 0.04 (SD = 0.03) in the control group ($P = 0.15$). The mean REX score of dental operators, in adult patients, was 0.04 (SD = 0.03) and 0.04 (SD = 0.04) in the test and control groups, respectively.

Dental Anxiety Levels. The mean CFSS-SF10 score for the test-group children was lower (14.8, SE = 1.7) than that for the control-group children (24.4, SE = 1.2). The difference was statistically significant ($P = 0.001$). The treatment effect on dental anxiety in children was estimated to be 9.8 anxiety points (95 percent CI = 5.0 to 14.6) after correction for the child variables (ANCOVA with age, gender, and number of restored teeth). The mean DAS score for adults from the test group (6.7, SE = 0.4) was statistically significant ($P = 0.001$); lower than that for adults from the control group (9.3, SE = 0.2). No confounders were observed in the analyses of the DAS data (ANOVA). The treatment effect on dental anxiety for adults was estimated to be 2.6 anxiety points (95 percent CI = 2.0 to 3.0).

No significant correlations were observed between mean CFSS-SF scores and mean REX scores of the operators, regarding primary teeth of child patients ($r = -0.65$, $P = 0.06$), or between mean DAS scores and mean REX scores of the operators treating adult patients ($r = 0.03$, $P = 0.97$) in the test group. The results were similar for child patients ($r = 0.08$, $P = 0.81$) and adult patients ($r = -0.24$, $P = 0.49$) in the control group (Figures 1 and 2). Children treated by the two operators who had placed many ART restorations in primary teeth had lower mean CFSS-SF scores than those treated by operators who had performed few ART restorations (Figure 1).

Table 1
Background Information of Dental Operators per Treatment Group

	Test group		Control group	
	Mean	SD	Mean	SD
Age (in years)	41.0	8.7	36.3	7.1
Number of patients treated per day	24.2	8.5	26.2	8.5
Years since graduation	14.6	7.6	11.3	8.2
Years in current post	5.8	3.7	4.1	2.4

SD, standard deviation.

Table 2
Background Information about Dental Operators and Patients Treated and Interviewed over a 12-Month Period, according to Treatment and Age Group

		Test group		Control group	
		Children	Adults	Children	Adults
Number of patients treated and interviewed		59	38	84	218
Gender ratio of patients (M/F)		27/32	10/28	36/48	94/124
Age of patients (years)	Mean	8.9	27.3	10.3	31.1
	SD	3.0	8.2	3.0	8.9
Number of restorations placed per patient	Mean	1.5	1.5	1.5	1.4
	SD	0.6	0.7	0.7	0.6

SD, standard deviation.

Table 3
Mean Number and Standard Deviation (SD) of Children and Adults That Have Been Interviewed per Operator by Treatment Group

	Test group		Control group	
	Mean	SD	Mean	SD
Children	7.0	4.4	6.4	2.3
Adults	4.8	4.9	17.7	7.6

Discussion

This is the first study in which the effects of the introduction of the ART approach through special ART training of dentists and dental therapists has been measured in a public oral health service system. A field study of this nature has the advantage that the test is carried out under real-life conditions. A disadvantage is that standard scientific requirements cannot always be fulfilled.

The calculation of the REX score relied on data collected in time

Figure 1
Relationship between mean dental anxiety [Short Form of the Dental Subscale of the Children's Fear Survey Schedule (CFSS-SF)] and restoration/extraction (REX) score for child patients in primary teeth per operator for test (atraumatic restorative treatment) and control (traditional) group

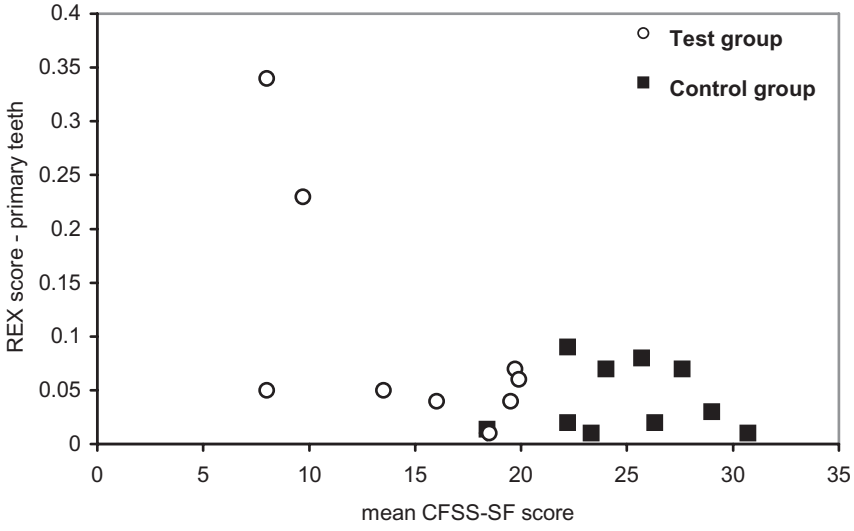
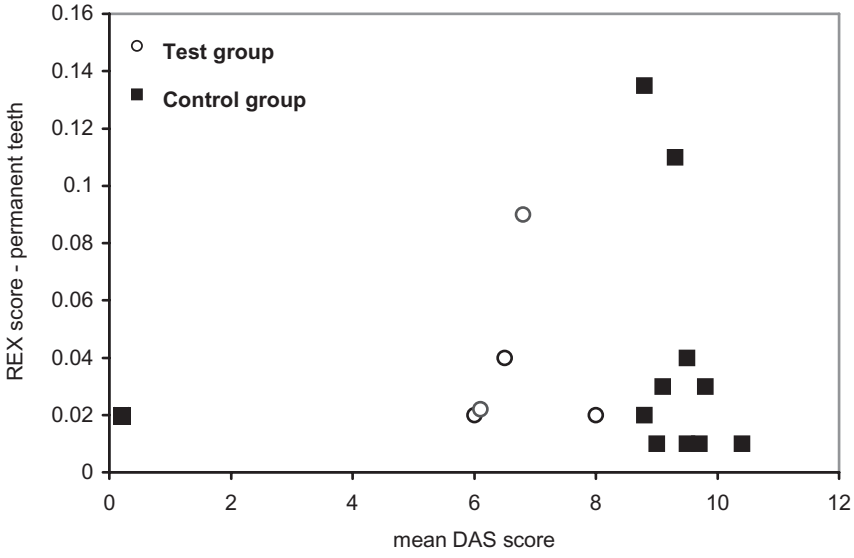


Figure 2
Relationship between mean dental anxiety [Dental Anxiety Scale (DAS)] score and restoration/extraction (REX) score for adult patients per operator from test (atraumatic restorative treatment) and control (traditional) group



periods, which differed for the test and control groups by month and by year. This difference was caused by organizational and financial factors. However, as data collection remained within the same season for both groups, there is no reason to believe that the attendance pattern has differed (South African community dentistry specialist, personal communication).

The selection of dental operators in the test group was done to allow the fieldworker, who relied mainly on public transport, to visit one dental clinic per day. However, some dental clinics in the test group were situated so far from her base that she could not reach them in a day. That necessitated the exclusion of operators working in clinics too distant from the present study. As there were no major differences between the clinics constituting the test group, in terms of provision of treatment, availability of equipment, and costing of services, the selection was not considered to have caused an unacceptable bias in the study design. Initially, Sedibeng and Central-Witwatersrand were selected to constitute the control group. For the same logistic reasons that determined the collection of data in the test group, only dentists in the Sedibeng region could be visited as the fieldworker lived in the region.

The number of patients interviewed over the 12-month period was low. This observation reflected the present restorative treatment pattern in clinics in the public oral health service in the study areas and elsewhere in South Africa (6). The availability of only one fieldworker, who could only visit a clinic once a month, may have further limited the number of patients interviewed. Usually, the fieldworker had to spend a whole day waiting to interview only a few patients who had received restorative care. Occasionally, absolutely no restorative treatment was rendered on her visiting day. The latter explains why adult patients of only five of the nine operators in the test group were interviewed. This indicates that care should be taken when extrapolating the results of this study.

The assessment of dental anxiety by a single questionnaire could only measure the patients' perceptions about the treatment provided on a single occasion. Because the results on the patients' anxiety are cross-sectional, only correlations with the different treatment approaches can be shown, but no causation can be established (11).

Corah's DAS was adopted for this study because it has frequently been

used to assess dental anxiety of adults and has shown good reliability (12). As the DAS scale is useful only for children with the cognitive ability to understand its questions (13), because it omits questions about treatment procedures such as "cleaning the teeth" that may cause distress for children but not for adults (13), and as there is insufficient evidence for its reliability in relation to children (10), in this study the DAS scale was not used for children under 16 years of age.

The CFSS-DF has been demonstrated to be highly reliable (Cronbach's alpha, 0.62 to 0.92) for measuring dental anxiety in children, particularly in relation to invasive dental procedures (8-10). Traditional restorative treatment included invasive procedures such as the administration of local anaesthesia and drilling of teeth. Hence, the CFSS-DF appears to be an ideal measurement instrument for assessing differences in dental anxiety about both treatment types. However, the CFSS-SF scale, being a modification to the CFSS-DF scale, was chosen as the measurement instrument for dental anxiety in children because it was shorter and had high reported reliability (9,14). It has been shown that shorter rating questionnaires are generally more acceptable to children (15) and that the CFSS-SF can successfully be applied, particularly in the African situation (9).

The application of both DAS and CFSS-SF scales after treatment is in line with earlier recommendations (9,13). It has been reported that patients' anxiety levels are conditioned by their past experiences of dental treatment (13,14). These may cause anticipatory anxiety, which can be unspecific to the type of treatment provided (16). To avoid any confounder effect resulting from such anticipatory anxiety, the questionnaires were applied after treatment.

The results of this study showed that both child and adult patients treated with the ART approach were less dental-anxious than those whose treatment used the traditional approach. The first hypothesis was accepted. This result is in accord with the findings of other studies comparing patient anxiety and discomfort levels in children undergoing ART with those experiencing traditional approaches (17,18). There appears to be no other comparative study on dental anxiety in adults treated through the ART and traditional restorative treatments.

Uncooperative behavior and negative patient attitudes toward dentists are generated by patients' fear of experiencing pain or discomfort during dental treatment (19-26). It can be assumed that reduced patient anxiety and discomfort may therefore lead to more positive behavior which, in turn, may reduce operator stress during interaction with patients (27-30). Such a positive effect could motivate operators to choose ART above traditional restorative treatment options and resort to providing restorative care more frequently than at present. Although the mean CFSS-SF score for children in the test group was statistically significantly higher than for children in the control group, this study was unable to establish a significant correlation between reduced dental anxiety in children and increased REX scores of dental operators in child patients. The same outcome was obtained for both variables in permanent adult dentition. Therefore, the second hypothesis was rejected. Among the reasons for the rejection may be the influence of factors such as patient load, supply of materials, clinic environment, and lack of chairside assistance, which may have hindered the full implementation of the ART approach. With respect to adult patients, dental operators may have taken the standpoint that ART is appropriate for use in primary teeth but not in permanent teeth. These factors may also have contributed to the fact that the REX score for adult patients after ART introduction (0.04) was below the national average of 0.11 (without ART). These factors constitute the barriers to successful ART implementation and need to be investigated. It is also possible that the 12-month evaluation period was too short to show a possible effect. After all, the correlation between low dental anxiety scores and high REX scores of operators for child patients in the test group was almost significant ($P = 0.06$) and the two dental operators with the lowest dental anxiety scores had the highest REX scores. Attempts are being made to undertake a long-term evaluation in the near future.

In conclusion, although dental anxiety scores were lower in patients treated by ART than in those treated by traditional restorative means, after 12 months they had not led to an increase in the restoration to extraction ratio in primary dentitions of children and permanent dentitions of adults, in provincial public oral health clinics in South Africa.

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