

The effect of an Atraumatic Restorative Treatment (ART) training course on the restorative treatment pattern in a provincial public oral health care system in South Africa

Mickenautsch, S¹, Frencken, JE², Van't Hof, MA³

¹ Division of Public Oral Health, University of the Witwatersrand, Johannesburg, South Africa, ² WHO Collaborating Centre for Oral Health Care Planning and Future Scenarios, Radboud University Medical Centre, Nijmegen, The Netherlands, ³ Department of Preventive and Restorative Dentistry, Radboud University Medical Centre, Nijmegen, The Netherlands.

ABSTRACT

Objective: To evaluate the effect of one ART training course on the restorative treatment pattern of dental operators.

Methods: The test group (N = 21) was trained in ART. The control group consisted of 20 operators. Data about the number of restored and extracted teeth and restoration type per dentition were collected 4 months before and 12 months after the ART training. The difference in restorations-extractions (REX) ratio between both groups after and before training was compared.

Results: In primary dentition the mean increase in the REX ratio was 0.07 (SD = 0.17) (test group) and 0.07 (SD = 0.34) (control group). In permanent dentition the mean increase was 0.02 (SD=0.16) (test group) and 0.02 (SD = 0.09) (control group). The percentages of ART restorations of the total number of restorations placed in primary and permanent teeth were 67% and 11%, respectively. An increase in the total number of restorations relative to number of extractions was observed in operators who placed ART restorations frequently.

Conclusions: One 3-day ART training course did not change the overall restorative treatment pattern of dental operators but led, for some operators, to a shift in caries treatment in primary teeth; from predominantly traditional, to ART restoration.

Key words: Atraumatic restorative treatment, public oral health service, South Africa, treatment pattern, restoration/extraction ratio

INTRODUCTION

The percentage of unmet restorative care needs amongst South Africans is very high: 96% for 6-year olds and 89% for 12-year-old children. In the 35-44-year-old age group, it was found to be 73%¹. Untreated carious lesions result in a reduced quality of life expressed through discomfort, pain and disfigurement, as well as acute and chronic infections². It has been shown that 70% of schoolchildren aged 8-10, in the Western Cape Province of South Africa, not only suffered daily toothache but also missed school education as a result³. National figures show that 38% of 35 - 44-year olds have dental pain, 81% of which is attributed to untreated carious lesions⁴.

In South Africa 80% of the population relies on public oral health services⁵. In 1996, free dental care in state hospitals and clinics was introduced, which resulted in an increase of attendees, predominantly requesting pain and sepsis treatment, but rarely restorative care⁶.

The Department of Health has developed a number of strategic oral health objectives. One concerns reduction of the incidence of premature tooth loss, particularly amongst South Africans who cannot afford private dental care⁷. A way to achieve this objective was through adopting and implementing the Atraumatic Restorative Treatment (ART) approach within the provincial oral health services^{8,9}. ART uses only hand instruments for managing cavitated caries lesions and seals caries-prone pits and fissures using glass ionomers¹³. It was selected because an increase in restorative care in both types of dentition had been reported one year after the ART approach was introduced into an oral health community outreach programme in peri-urban Johannesburg¹¹. The increase was ascribed to the less threatening nature of ART because, in contrast to conventional treatment, the need for administration of local anaesthesia is reduced and drilling teeth and suctioning saliva is unnecessary¹²⁻¹⁴. In the meantime, research after 3 years has shown that the survival of single-surface

Correspondence: S. Mickenautsch,
Department of Community Dentistry,
Faculty of Health Sciences,
University Of The Witwatersrand,
7 York Rd,
Parktown/ Johannesburg.
2193, South Africa.
Tel: 0027-11-717 2594
Fax: 0027-11-717 2625
Email: neem@global.co.za

ART restorations is comparable with that of amalgam restorations in permanent teeth¹⁵. However, results of longer-term survival studies are conflicting. Whilst Mandari et al.¹⁶ observed no significant difference between ART and amalgam restorations in single-surfaces in permanent teeth after 6 years, Frencken et al.¹⁷ reported statistically significant higher survival results for single-surface ART restorations than for comparable amalgam restorations in permanent teeth after 6.3 years. Not only is ART patient-friendly it also provides quality restorations.

Since 1997, dental schools in South Africa have gradually introduced it into undergraduate training but have not offered post-graduate courses in ART¹⁸. If premature tooth loss is to be reduced through ART, the public service dental workforce has to be trained in its use. Interventions such as participative workshops, follow-ups and feedback audits are known to be effective¹⁹. However, owing to limited resources and organisational constraints, a single participative workshop appeared to be the most practical option for introducing ART into the South African public oral health service. The present study was aimed at evaluating after 12 months the effect of a single ART training course on the treatment pattern of dental operators in a regional public oral health service.

MATERIAL AND METHODS

Study design

Permission to carry out the present study was obtained 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. In 2002 the public oral health services employed 68 dentists and 22 dental therapists. While regional health authorities of all the 5 administrative regions of the province were invited to participate in the study, 2 did not respond.

The test group consisted of all 18 dentists and 3 dental therapists employed in the public oral health service of the Ekurhuleni region, situated east of Johannesburg. Fifteen operators were South Africans, while the remaining 6 came from Chile, DR Congo, UK, Nigeria and Rumania. The control group consisted of all 8 dentists and 4 dental therapists employed in the public oral health service from the nearby Sedibeng region (n=12), south of Johannesburg, and 8 dentists from the Central Witwatersrand region. The latter were selected for logistical reasons based on the close proximity of their clinics to the location of the investigator. Of the control group operators, 15 originated from South Africa; the other 5, from India, Nigeria and Rumania. These operators neither received ART training nor

applied ART in the clinics.

Intervention

Operators in the test group were trained in ART according to recommended course standards²⁰ by a staff member (SM) of the Department of Community Dentistry, University of the Witwatersrand, Johannesburg, in August 2001. The training was conducted during a 3-day workshop. Lectures at the Dental School on the first day were followed, on days 2 and 3, by clinical training on selected patients at a primary health care clinic in an informal settlement south of Johannesburg. Lectures contained information on (dis)-advantages of ART, its clinical indication, successes and failures of ART restorations and sealants, selection of materials and instruments, hand-mixing of glass ionomer, clinical procedure and management of failed restorations. Operators received copies of the lectures and the ART manual²². Contrary to recommendation, no pre-clinical training in the use of ART was given on extracted teeth. Clinical training consisted of demonstration of the use of ART by the trainer, followed by supervised ART treatment by operators, of carious lesions. A workshop was attended by 4-6 participants operating in pairs: one carried out the treatment while the other provided chair-side assistance. The functions were alternated for the treatment of successive patients. Each operator restored between 3 and 10 cavities in the 6-15-year-old children selected.

Evaluation

Information concerning the number of restored and extracted teeth and type of restoration per dentition was collected from dental clinic records over the 4 months preceding the ART training (April to July 2001) and over 12 months after completion of the training (August 2001 to July 2002). The same type of information regarding the control group was collected during two similar periods: May to August 2002 and September 2002 to August 2003. The dental operators did the recording. The dental records formed the basis for calculating the ratio of number of restorations to number of extractions (REX score). The magnitude of the REX score expresses the effect of the ART workshop on the treatment pattern in both groups over a period of 12 months. In addition, the proportion of ART restorations to the total number of restorations placed in the test group was calculated separately for primary and permanent dentitions.

Statistical analysis

In this retrospective cohort study, with the operator as the unit of investigation, the difference in REX scores between the test and control group before and after ART training was calculated, using the Mann-Whitney U test. The dependent variable was the

difference in restoration/extraction ratio (\square REX score) pre- and post-ART raining. An oral biostatistician (MvtH) did the statistical analysis using SPSS-12. Statistical significance was set at $p=0.05$.

RESULTS

The gender ratio (M/F) in the test group was 9/12, and 14/6 in the control group. The mean age of operators in the test group was 38.2 ± 8.9 years, and 36.3 ± 10.0 years in the control group. In the test group, operators had graduated on average 11.5 ± 8.1 years previously and worked in their current position for, on average, 4.3 ± 4.4 years. In the control group, operators had graduated, on average, 10.68 ± 10.1 years before from dental school and worked in their current position for an average of 5.9 ± 8.8 years. The main type of treatment provided in both study groups was tooth extraction (Table 1). The mean REX scores before and after ART training, by type of dentition and by group, are shown in Figure 1. The differences in mean REX scores between the test and control group, for both dentitions, were not statistically significant. In primary dentition, the mean increase in the REX score in the control group was 0.07 (SD = 0.34); in the test group, 0.07 (SD = 0.17). In permanent dentition,

the mean increase in the REX score in the control group was 0.02 (SD = 0.09); in the test group, 0.02 (SD=0.16).

The ratios of restorations done over a 4 month period before, and a 12- month period after ART training, in primary and permanent teeth in both the test and the control group were not statistically significant different ($p>0.05$). The percentages of ART restorations, of the total number of restorations done in primary and permanent teeth, were 67% and 11% respectively, over the 12-month period post-ART training (Table 1). A positive \square REX score in primary and permanent dentitions was observed for 17/21 and 10/21 operators, respectively. The two highest \square REX scores (0.70 and 0.22) in the primary dentition were observed by operators who did predominantly ART restorations and who did many (more than 100) ART restorations during the 12-month observation period, whereas the highest \square REX score (0.63) in the permanent dentition was observed by the operator who did predominantly traditional restoration during the 12-month observation period (Table 2). Neither country of origin, gender nor type of operator affected the number of ART restorations done.

Table 1. Number of extracted and restored primary and permanent teeth by test and control group over a 4-month period 'before' and a 12-month period 'after' ART training. N=number of operators

		Test group (N=20)	Control group (N=20)
Primary teeth			
Extracted	Before	4 530	2 489
	After	10 098	6 459
Restored (total)	Before	270	344
	After	1 178	1 115
ART restorations (% of total restorations)	After	785 (67%)	–
Permanent teeth			
Extracted	Before	18 844	13 379
	After	43 707	39 012
Restored (total)	Before	1 546	832
	After	4 875	2 595
ART restorations (% of total restorations)	After	547 (11%)	–

Table 2. Percentage of ART restorations of total number of restoration and Δ REX score for the test group by type of dentition between a 4 month period 'before' and a 12-month period 'after' ART training.

Dental operator	Primary dentition		Permanent Dentition		Combined Dentitions	
	ART restorations (%) of total restorations	Δ REX score	ART restorations (%) of total restorations	Δ REX score	ART restorations (%) of total restorations	Δ REX score
> 100 ART restorations placed post training period						
1	97%	+0.70	49%	-0.02	83%	+0.29
2	88%	+0.22	2%	-0.05	35%	0
3	84%	+0.04	74%	+0.09	75%	+0.08
50-99 ART restorations placed post training period						
4	98%	+0.09	23%	-0.01	50%	+0.01
5	81%	+0.04	24%	0	46%	+0.01
6	77%	+0.02	8%	-0.01	16%	0
7	63%	+0.07	4%	+0.01	21%	+0.02
8	20%	-0.08	4%	+0.63	5%	+0.50
25-49 ART restorations placed post training period						
9	96%	+0.06	21%	+0.01	48%	+0.02
10	94%	+0.04	60%	+0.01	70%	+0.01
11	62%	+0.04	4%	+0.02	11%	+0.03
12	44%	-0.2	0%	-0.08	7%	-0.10
13	37%	+0.06	27%	+0.04	30%	+0.04
14	27%	-0.06	2%	-0.11	9%	-0.09
10-24 ART restorations placed post training period						
15	100%	+0.01	6%	+0.07	8%	+0.06
16	94%	+0.01	4%	+0.03	14%	+0.02
17	85%	0	34%	0	49%	0
18	67%	+0.04	23%	0	42%	+0.01
<10 ART restorations placed post training period						
19	83%	+0.01	3%	+0.04	7%	+0.03
20	38%	+0.08	0%	0	3%	0
21	17%	+0.16	0%	-0.29	2%	-0.19

Δ REX score = difference in restoration-extraction ratio pre- and post-ART training

A positive/negative Δ REX score indicates an increase/decrease in the number of restorations over the number of extractions in the 12-month post-ART training period.

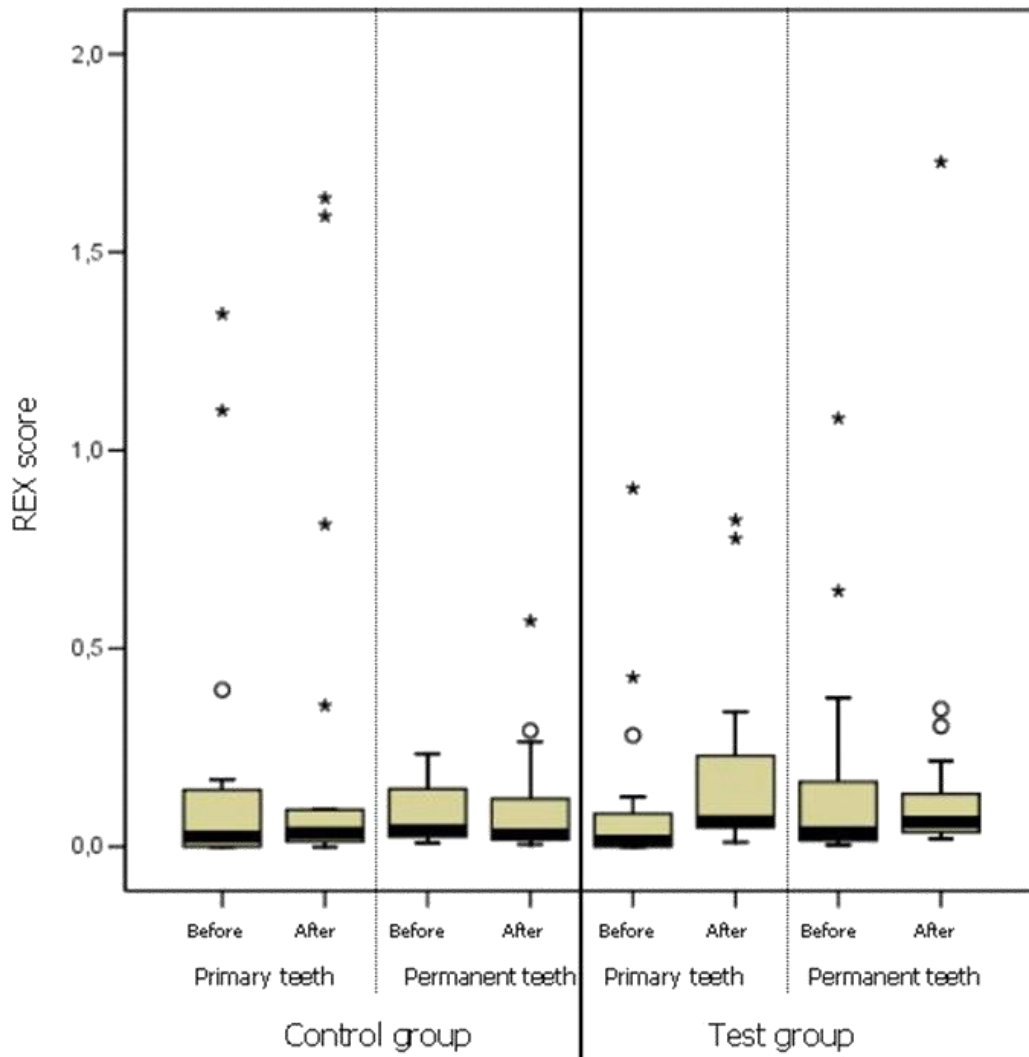


Figure 1. Box-Whisker plots for the REX score by treatment group (test and control) and type of dentition (primary and permanent) over a 4 month period 'before' and a 12 month period 'after' ART training. The box includes the quartiles, the bold horizontal line indicates the mean and the whiskers mainly include outliers in positive direction REX= restoration / extraction ratio

DISCUSSION

The present study followed, in essence, the principles of a retrospective cohort design without randomisation. Randomisation of operators within a clinic was impossible for organisational reasons. Such an observational study would have included the danger of confounding and biased information. Information bias may be related to the included clinics, as treatment data were sometimes recorded by staff at the end of the day and not immediately after completion of the treatment. Such reliance on memory potentially creates a recall bias. Evaluator blinding was also impossible. It would have required the employment of an outside evaluator totally ignorant about the ART training, for a considerable length of time. At the time of the study no such evaluator was available. Confounder bias could have been caused by operator characteristics (e.g. clinical experience), clinic characteristics (e.g. location) and patient characteristics (e.g. gender). It was assumed that such influences would be reflected in the pre-ART training REX scores. Therefore, confounder correction was carried out by testing the change in REX scores pre- and post-ART training. The period during which the records were collected for the test and control groups differed by month and by year. The difference in months was small but a one-year difference in year of collection between test and control group was caused by organisational and financial factors. It is known that summer patient clinic attendance patterns may differ from winter ones⁶. However, since data collection in the present study remained within the same season for the test and control groups, it is unlikely that the attendance pattern in the clinics differed over the years (community dentistry specialist South Africa - personal communication).

No difference was found in mean REX scores between test and control groups after 12 months. Therefore, operator knowledge and clinical skills in ART, obtained during a three-day training course, did not increase the overall restoration - extraction ratio in the public oral health services. The predominant treatment provided remained tooth extraction. However, secondary analyses showed that in primary teeth over the 12-month period, the ART training course had led to a shift in restorations; from the predominantly traditional to ART. That operators who applied ART more frequently did more restorations relative to tooth extractions than they had done before the ART training period, particularly in relation to primary teeth, is noteworthy. The dentist with the highest \square REX score in primary teeth had started applying ART because the dental unit was out of order, whereas the dentist with the second highest \square REX score in primary teeth applied ART because of its

child-friendly nature. Apparently the ART training course had stimulated a number of operators to apply this new treatment approach, which resulted in more restorations than extractions done in primary dentitions. The finding in the present study, that more restorations than extractions had been done, is in line with the results of a one-year pilot study that investigated the introduction of ART in a mobile dental clinic setting serving a disadvantaged, peri-urban community of Johannesburg¹¹. However, in that study the mean \square REX scores for primary (1.84) and permanent (0.65) dentitions were higher than found in the present one. In the pilot study no traditional treatment was offered during the post-ART training period because the operators preferred the child-friendly nature of ART that does not require a drill and hardly needs the administration of an injection^{12,13}.

It has been reported that single educational interventions cannot overcome potential barriers in the process of changing clinical practice¹⁴. Such barriers may include factors related to operator perception, patients' perceptions and beliefs and factors related to the practice environment¹⁹. The acceptability of technological innovation, such as the ART approach in the present study, may not necessarily depend on operators' previous practice experience, but more on their perception about the clinical advantage of the new method in relation to the current treatment procedures²². Freeman²³ suggests that operators tend to discount patient worries and concentrate too much on clinical features. The absence of an overall effect in the restoration - extraction pattern after the introduction of ART in the present study may have been influenced by the lack of follow-up seminars and of pathways for communication about the experiences obtained with the use of ART compared to traditional treatment, among the operators of the test group. A further barrier that may not be neglected in the South African context is the practice environment, characterised by malfunctioning equipment, insufficient human resources and a general lack of essential materials.

This study showed that one single ART training course had not changed the overall restoration-extraction pattern of dental operators in a regional public service after 12 months but it had led to a shift in the restoration pattern in primary teeth, from predominantly traditional to ART. Operators who did many ART restorations and chose ART more frequently than traditional restorative treatment also did more restorations relative to extractions than they had done before receiving ART training.

