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Title; Knowledge transfer on the use of Atraumatic Restorative Treatment: a mixed-methods study

Short title: Knowledge transfer on the use of ART

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Key words: Atraumatic Restorative Treatment, Minimally Invasive Dentistry, caries removal, knowledge transfer

Title: Knowledge transfer on the use of Atraumatic Restorative Treatment: a mixed-methods study

Objectives: to investigate the knowledge and attitudes of Irish dentists on the use of ART and possible barriers to its effective implementation. **Methods:** This was a mixed- methods, comprising two phases. In Phase I, 25 dentists participated in 3 focus groups, moderated by a trained methodologist in qualitative research. In Phase II, a questionnaire was posted to 300 dentists in order to assess their knowledge and perceptions regarding the use of ART. **Results:** 126 dentists in total participated in the study, 58 males (46%) and 68 females (54%), with a mean age of 44 (SD=10.7). 25% of participants had been qualified for more than 20 years, whereas the majority (58%) were between 10 and 20 years since qualification. The survey showed that ART was considered inferior to conventional treatment by 45% of dentists. Moreover, 66.3% of participants stated they do not feel they can charge the same for ART as they do for conventional restorations (66.3%). Both qualitative and quantitative phases showed that dentists still see ART as being a temporary measure. Focus groups discussions, showed that although dentists appeared to have some knowledge of ART, they are still not sure of its benefits and still consider it a substandard treatment for low resource settings. They also seem to be uncomfortable with the concept of partially removing carious dentine. **Conclusions:** Irish dentists are still concerned about using ART routinely. Barriers to its use include fear of restoration failure and lack of support from clinical managers.

Clinical significance: ART is an effective minimally invasive approach to treat carious lesions, but despite all the available evidence to support its use, many barriers still exist to its full implementation in practice. Training of dentists and dental practice managers and change in remuneration systems could help minimise these barriers.

extraction due to caries under general anaesthesia, with a cost of €819.97 per child [14], ART could be a way to avoid such procedures and associated costs.

Therefore, the aim of this study was to investigate the knowledge and attitudes of Irish dentists on the use of ART and possible barriers to its effective implementation.

The null hypothesis of this study is that Irish dentists are familiar with the ART approach and use it to restore carious lesions routinely.

Materials and Methods

This was a mixed-methods study comprising of two phases: Phase I or qualitative, and Phase II or quantitative.

In Phase I, a purposive sample of dentists who were attending a Gerodontology training day in the XXX was recruited. Three focus groups were moderated by a trained methodologist in qualitative research who is not a dentist. Interview topics were discussed in advance, and a discussion guide was created. Questions were open ended, giving the participants the chance to expand on each topic. The moderator remained neutral, intervening when statements were vague or unclear. All focus group discussions were tape-recorded.

In Phase 2, a list of registered dentists was obtained from the Irish Dental Council (3,000 registered dentists) and 300 dentists were randomly selected. A questionnaire was designed based on previous studies [15] and piloted with a sample of 20 dentists in the XXX, prior to being posted to all selected dentists. The aim of the questionnaire was to assess their knowledge and perceptions regarding the use of Atraumatic Restorative Treatment. Socio-demographic data of dentists were also collected, including age, year of graduation, training institution, and type of practice (public/private/mixed). Questions included their definition of Atraumatic Restorative Treatment, and what patients would be suitable to receive ART restorations. Dentists were asked to indicate whether they “strongly agreed”, “agreed”, “undecided”, “disagreed” or “strongly disagreed” with 19 statements, such as: “ I consider ART an inferior treatment option as compared with other restorations”, “ When doing restorations, I prefer to use the drill, because I find it easier “and “ART restorations take longer to do than amalgam or composite restorations” (Appendix 1).

Introduction

The Atraumatic Restorative Treatment (ART), which is a minimally invasive approach to treat carious teeth, was first used more than 30 years ago in Tanzania [1]. The approach entails using hand instruments only, for accessing carious lesions and removing decomposed dentine, followed by sealing of the cavity with a glass-ionomer cement. As ART does not require the use of the drill or local anaesthesia, no clinical setting is required. This made it a very suitable approach to treat underserved populations, with little or no access to oral healthcare [2]. As we gained more knowledge about the caries process and new dental materials emerged, ART can now be considered a useful tool to manage carious lesions among several population groups, in clinical or non-clinical settings including those in developed countries. There is evidence that ART is now being used in many countries in the world in both public and private practice, and it has been endorsed by the WHO (1994) and the FDI World Dental Federation (2002) [3].

A large body of evidence has been generated since the technique's early days, reporting on its high survival rates, particularly in single-surface restorations in permanent teeth [4-7], its cost-effectiveness [7] and its patient-acceptability [8]. The use of hand instruments only and no use of anaesthesia make ART ideal to be used with children or fearful individuals. Additionally, this minimally invasive approach can benefit vulnerable populations such as the elderly living in nursing homes. Its effectiveness and acceptability among elderly patients has been demonstrated previously [9].

Despite the robust literature supporting the use of ART, some studies have shown that barriers still exist to its full implementation in public and private dental services in many countries [10-12]. These barriers include remuneration models and dentists' lack of knowledge to apply the concept. Many dentists consider ART as a temporary measure and still feel more accomplished when they use rotary instruments to remove carious dentine [10, 13].

In Ireland, it is not known to what extent GDPs (General Dental Practitioners) are familiar with the concept of ART and if they use it routinely. Anecdotal evidence suggests that the technique is not widely used and dentists are still reluctant to consider it as a definitive treatment measure. In a country where a considerable amount of children still require dental

Ethical approval was obtained from the XXX Ethics Committee. All participants were asked to sign a consent form and all the information collected was kept confidential.

Transcription and Data analysis

Qualitative data from the recorded discussions were transcribed verbatim, and thematic analysis was conducted with the use of NVivo (NVivo qualitative data analysis software; QSR International Pty Ltd. Version 8, 2008). NVivo is a qualitative data analysis computer program that facilitates the coding and hence the analysis of the qualitative data generated. The transcripts were analysed and coded on a line by line basis, independently by two researchers. The remaining data were entered in IBM® SPSS Statistics (Version 27) and analysed using descriptive statistics.

Results

One hundred and one dentists replied to the questionnaire sent by post and 24 participated in the focus groups. The sample comprised of 46% males and 54% females, ranging from 26 to 74 years of age, with a mean age of 44 (SD=10.7). 25% of participants had been qualified for more than 20 years, whereas the majority (58%) were between 10 and 20 years since qualification.

Quantitative phase

Most of participants (85%) had heard of ART before, but only 42.9% of them were able to describe the technique accurately. When asked about patients' suitability to receive ART restorations, 44.6% of dentists believe any patient can benefit from it, whereas 44.4% consider it a suitable approach for paediatric, special needs, and older individuals only.

The majority of respondents (76%) agree or strongly agree that patients feel "grateful and satisfied" when no drilling is used during treatment, and 51.9% of them stated their patients "feel grateful and satisfied" when the ART approach is used. However, ART was considered inferior to conventional treatment by 45% of dentists. Moreover, GDPs don't feel they can charge the same for ART as they do for conventional restorations (66.3%). Drilling is still preferred by dentists, and considered easier and quicker than other methods of caries

removal (Table 1). Responses regarding training on the ART approach and managers' support and understanding of the technique are illustrated in Table 1.

Qualitative phase

The thematic analysis of focus groups discussions identified 5 themes. Themes and sub-themes are presented in Table 2.

Although dentists appeared to have some knowledge of ART, they are still not sure of its benefits and still consider it a substandard treatment for low resource settings.

(Hearing about it) " I'd say at a conference about 10 years ago ya I don't think they used that phrase when we were studying".

"It was mentioned in my training but it was kind of seen as like if you are really stuck, if you are in a disadvantaged area or in the middle of a jungle somewhere".

Numerous instances were described in which participants would be unwilling or unhappy to use ART throughout the focus groups.

"I couldn't hand on my heart put in one of those and say to the mother you won't be back with that tooth again before it falls out".

"ART isn't going to be long-term".

"in general in an adult tooth I do want to remove all or as much of the bacteria as I possibly can just to try and preserve the pulp rather than the idea of leaving caries behind...I would rather do a pulp exposure than leave the bacteria there in an adult tooth".

"I would be quite happy to do this now in a deciduous tooth that I know is going to fall out anyway but I don't think I would be confident to do it in a molar tooth a permanent tooth, I would still probably if it is a small filling amalgam."

However, they were notably more agreeable to using ART among certain groups such as children, older people, nervous and special needs patients. The fears associated with using ART appeared to weigh strongly against its potential benefits. Fear of restoration failing, potential legal issues, and judgment by other dentists were some of these.

"I have actually used ART in practice because with children it is just a nice way to introduce it and I am speaking about children here"

"are you opening yourself up medico-legally to a complaint you know what I mean if there isn't that proper communication there that you have explained to the patient what you are actually trying to achieve so I'd say you have to be quite clear that I am purposely leaving this brown area here but it's fine".

"Ya because patients go to different practices, so you could do one thing and you have explained your reason and then they go take an x-ray somewhere else and the other dentist will be like "why was that done" and sure they don't have access to our notes or our way of thinking so it's kind of, it's grey then do you know, they don't know if we have just been negligent or whether we actually we removed all that was necessary".

Some other barriers to the use of technique include practice policy, habit, and remuneration systems (medical card system).

"I don't know, I think it is just what I have learned more so as opposed to just my preference, it is just kind of easier to go with, probably faster to pick up a handpiece and get it done so I don't know."

"Well, you wouldn't be allowed under medical card to do ART ..."

"Well if there was another box on the medical card form that was an ART restoration and they were allocated more allowance you could give more of them for a patient and then still have their two restorations a year counted as amalgam or composite... then maybe it might be possible to treat more patients more cost-effectively for the HSE and yet give everyone what they need without more cost".

Dentists also mentioned that the dental practice they were working in could influence whether or not they would use ART. For example, if the principal dentist supplied GIC and used ART it would influence the other dentists in the practice to follow suit.

"and as well you might not be the principal dentist doing all the ordering so you know it is a bit awkward that way as well so generally like I use what my principal dentist

orders you know so if I want something she will get it but like I don't interfere too much that is not practical either so..."

Additionally, participants felt there is a lack of clear guidelines regarding the implementation of the ART approach from a professional body.

"I mean if there is guidelines published that people could be like if it came down to a medical legal thing it's like well this guideline says this is acceptable or the best practice for this condition am I am not aware of many guidelines on it."

Discussion

The results of both quantitative and qualitative phases showed that although most dentists have heard of ART, there is still a lot of scepticism in relation to its use in Ireland. Therefore, the null hypothesis was rejected.

Dentists consider ART a technique that is suitable for certain populations only, and consider it inferior to other restorative treatments. ART was introduced more than 30 years ago in Tanzania, as an alternative to treat carious lesions in underserved communities [1]. The approach has become a well established minimally invasive technique to manage carious lesions in any setting, given the tooth concerned has no history of spontaneous pain, no draining sinus and the carious lesion is accessible by hand instruments [16]. However, the perception of it being suitable only when no other option is available still persists among Irish dentists.

The ART technique follows the most current evidence in relation to caries removal in which selective dentine removal is performed in small to medium cavities, and selective removal to soft dentine in deep cavities [17]. However, dentists in this study didn't seem comfortable with the idea of not removing all carious tissue. Additionally, they still feel the technique is more suitable for use in deciduous teeth and just certain groups of patients. Several studies have shown the successful use of ART in one surface-restorations in permanent teeth [18] and the benefits of using it with paediatric, elderly and special needs patients, in clinical settings [4, 9, 19]. It is clear then that a gap exists in the translation of all this evidence among Irish dentists.

Innes et al. have recently discussed the barriers to moving knowledge to action in the management of carious lesions. According to them, one cannot assume that new evidence will immediately result in changes to practice, and the reasons for this are many and complex. Some authors have summarised the problems with translational research into 3 categories: “don’t know”, “can’t do” or “won’t change”. It is suggested that changing behaviour is possible, but several factors might play a role in this process. The authors suggest that an essential starting point of managing the problem of “don’t know” is the availability of high-quality, evidence based guidance on best clinical practice [20].

In the quantitative phase of this study, dentists stated their preference for using the drill, as they consider it to be a faster (54.4%) and better (48.9) way of removing carious tissue. Studies have shown that drilling, although faster, is the most invasive technique to remove carious dentine, and in most of the case results in over preparation of the cavity [21, 22]. Although different methods for carious tissue removal are generally taught in dental schools, the use of burs to remove infected dentine still seems to be the norm [23]. In undergraduate dental courses, interventionist approaches seem to be incentivised, and in many dental schools students’ performance is assessed through the number of restorations placed or procedures performed [24]. Broader aspects of patients’ treatment such as caries risk assessment or a decision not to intervene might not be valued equally [25].

The dentists in the study expressed a clear uneasiness with using ART as they believed there was a higher risk of treatment failure and if that did occur it could damage dentist-patient relationships which dentists described as somewhat strained already. Dentists feared receiving complaints and potential legal issues arising from using ART. The fears associated with using ART appeared to weigh strongly against the potential benefits of using it. This fear could be a result of a lack of training on and consequently knowledge of the most current ART evidence. Several studies have shown the operator is one of the main factors associated with ART failure [26, 27]. Although the majority of dentists (54%) considered the training they received was sufficient to make them confident using the approach, 70% would welcome more ART training. Considering that ART has been introduced in the Irish Dental Schools’ curricula somewhat recently, including ART in Continuous Professional Development courses could potentially increase dentists’ ability to successfully undertake ART restorations. Besides training, the benefits of using ART should be more widely promoted, ideally by the Irish Dental

Association or the HSE. Quotes taken from focus groups showed that dentists feel this endorsement would likely alleviate their fear to use it more routinely in practice.

Remuneration systems and support from practice management were also cited as important barriers to the use of ART by participants in both qualitative and quantitative phases. In Ireland dentists operate under a medical card scheme, through which patients are entitled to specific dental treatments including extractions and fillings. ART is not recognised as a restorative option under this scheme. Furthermore, the majority of participants (66.3%) do not feel they can charge the same for an ART restoration as they would charge when using amalgam or resin composite.

In this study, only 38.5% of participants stated that their clinical manager fully supports the use of ART and the majority of dentists (53%) are not sure if or firmly believes their manager does not understand the concept. Support and acceptance of the technique by managers and clinic owners appear to weigh strongly in dentists' decision to use or not the ART approach. Farag et al. have shown that participation of managers and decision makers in ART training courses may have a positive effect in reducing some of the barriers mentioned by dentists. They have recommended that the best approach in the implementation of ART in public and private sectors is to start at management level and then introduce it in government and routine dental practice. [15].

One of the study limitations is the sample size. Three hundred dentists were included in the quantitative phase, but only 101 (33%) of them returned the completed questionnaires. Despite the sample size, both quantitative and qualitative phases unveiled very similar barriers to the use of ART as found in previous studies from different countries [10, 12, 15, 28]. Future studies should try and understand what ART training dentists currently receive and the impact of training courses on dentists' perception of and willingness to use ART.

Conclusions: Although there is a large body of evidence to support the use of ART, dentists knowledge in regards to the technique seems limited and dentists still see ART as a temporary measure to be used only with certain patients. Promoting more training on the ART approach, together with validation from the Dental registration body may be effective ways of increasing its acceptance and use as a treatment modality in both public and private sectors.

Changing the remuneration system to include ART could also encourage its use among Irish dentists.

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Table 1- Questionnaire responses concerning charging for ART restorations, the use of the drill, ART training, and manager's support

	Strongly agree or agree % (N) 100%= 101*	Undecided % (N)	Strongly disagree or disagree % (N)
I don't feel I can charge the same for an ART restoration as I charge for other types of restorations, such as composite.	66.3%(61)	10.9%(10)	18.5%(17)
I prefer to use the drill because it is much QUICKER	54.4% (50)	15.2% (14)	30.4% (28)
I prefer to use the drill because it is BETTER	48.9% (45)	18.5% (17)	32.6% (30)
When doing restorations, I prefer to use the drill, because I find it EASIER.	53.8% (50)	19.4% (18)	26.9% (25)
I have had adequate training, in order for me to feel confident when rendering ART.	54% (49)	23.1% (21)	23.1% (21)
I would like to receive more training on the ART technique.	70%(63)	23.3%(21)	6.7%(6)
My clinic manager fully understands the concept of ART	40% (34)	25.3%(21)	27.7% (23)
My clinic manager fully supports ART in our clinic	38.5% (32)	40.7% (33)	13.5% (11)

*N might not equal 101 for all categories due to missing responses

Table 2 -Main themes and sub-categories

Main themes	Sub-categories
1-Familiarity with ART	<ul style="list-style-type: none"> • Knowledge of ART • Minimally Invasive Dentistry • Perception of ART
2-Fear of potential consequences	<ul style="list-style-type: none"> • ART not considered gold-standard • Dentist/Patients relationships • Legal concerns
3-Use of ART	<ul style="list-style-type: none"> • Habit behaviour • Routine use of ART
4-Target populations	<ul style="list-style-type: none"> • Ideal groups • Suitable cases
5-Financial Barriers to access	<ul style="list-style-type: none"> • Public reimbursement system • Time consuming technique