Strategies for managing carious lesions in patients with disabilities - a systematic review

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Abstract

Caries may constitute an additional problem to people with disabilities. Individuals’ physical and intellectual impairments as well as insufficient availability of appropriate services are addressed as barriers to oral health care in this population. The present study aimed to determine the current strategies applied for the prevention and treatment of dental caries in people with special needs by means of a systematic review of dental literature. Three databases were searched from January 1991 up to 1 February 2011. Randomised clinical trials, case-control, cohort studies and systematic reviews on preventive or restorative programmes related to dental caries in people with disabilities, published in English, Spanish, Portuguese, French and German languages were included for analysis. Only eight papers met the inclusion criteria; five referring to caries preventive, and three to restorative care programmes. Owing to the heterogeneity, quality, number, types and outcomes of the studies included in this review, it was not possible to extract a common strategy for the prevention and treatment of dental caries in people with disabilities. In light of the urgent need for such strategies for this population, it is suggested that international associations dealing with the production of scientific evidence, and those related to disability and oral health, must promote the development of quality research in order to propose guidelines for the prevention and treatment of dental caries in people with disabilities.

Key words: People with disabilities, dental care for people with disabilities, systematic review, caries prevention, restorative care

Introduction

Oral health among people with disabilities requires serious attention from the dental profession. Pathologies of the hard and soft tissues, as well as those related to functional aspects such as speech, swallowing, chewing, breathing and facial expression are frequently observed in this population (Faulks and Hennequin, 2006). In particular, lack of access to dental treatment of dental caries and its sequelae is a cause of great distress and suffering for many physically and/or mentally disabled people and their families (Tesini and Fenton, 1994; Nunn et al., 2008). Although the aetiological factors of dental caries are the same for people with and without disabilities, specific medical conditions and the use of certain medications may increase the probability of amplified caries activity in those with disabilities (Stabholz et al., 1991; Tesini and Fenton, 1994). Physical impairment, often associated with mental retardation, may further compromise the ability of people with disabilities to maintain good oral care practices and to cooperate successfully during maintenance procedures (Wyatt and MacEntee, 1997).

A number of oral epidemiological surveys covering people with disabilities have been published. A recent systematic review revealed that adults with intellectual disabilities (ID) had an equal to lower prevalence of dental caries but a higher prevalence of periodontal disease than experienced by the general public (Anders and Davis, 2010). The major differences between the two groups were the lack of oral care, the increased number of untreated tooth cavities and the low utilisation of preventive strategies in the ID group.

Management of oral health for people with disabilities is diverse. Barriers to the provision of oral care may, therefore, vary from behaviour management to physical and emotional contention. Maintenance of good oral health is very frequently reliant upon the availability of caretakers, their knowledge of how to prevent preventable oral diseases and their motivation to consider oral health important for the well-being of the disabled person (Ersin and Öncag, 2006).

The most common problem in treating cavitated carious lesions restoratively is related to people’s inability to cooperate during ordinary dental care procedures, es-
especially when they are too lengthy or somewhat painful (Molina and Kultje, 2003). Dental anxiety is increased if procedures are associated with needles and/or the use of rotary instruments, making it even more difficult to treat them during subsequent visits (Manford and Roberts, 1980). Drooling and the resultant unintentional loss of saliva from the mouth can considerably affect the setting of moisture-sensitive restorative materials (Hussein et al., 1998).

The prevention and restorative treatment of carious lesions in people with disabilities could be improved if dental professionals were supported by clinical guidelines. A first step in developing such guidelines is to carry out a systematic review of the available literature addressing these topics.

The aim of the investigation was to carry out a systematic review into preventive and restorative treatment programmes used for managing dental caries in disabled people of different ages.

Materials and methods

Three electronic databases, PubMed, Medline and LILACS (Latin American and Caribbean Health Science Literature) were searched and all publications listed in the databases from 1 January 1991 to 1 February 2011 were included. Before starting the search, different combinations of MeSH terms, limits and Boolean operators were tested, in order to define those that could include the highest number of relevant publications. The final strategy used is presented in Table 1. Contacts with experts were made in an attempt to retrieve additional relevant publications. References of included publications were hand-searched in order to identify studies that had not been retrieved from the electronic databases search.

The inclusion criteria were divided into three sections:

Type of studies
These concerned randomised, controlled (clinical) trials, cohort studies, case control studies and systematic reviews on preventive and restorative intervention programmes published in English, Portuguese, Spanish, French and German languages. If only a relevant title without a listed abstract was available, a full copy of the article was obtained and assessed.

Type of participants
People of any age and gender, presenting any type of disability. The intention was to include only publications having a control group (non-disabled people). As only a few publications with this condition were found, this inclusion criterion was dropped.

Type of interventions
Preventive and/or restorative intervention programmes for managing dental caries. Studies were independently assessed for type of disability, study methodology, baseline caries experience scores, preventive and restorative intervention programmes and study outcomes by two reviewers (GFM, SCL) and double-checked (JEF). Disagreements among the examiners were resolved through discussion until agreement was reached.

The level of evidence of the retrieved publications was assessed, using the criteria described in Table 2.

Table 1. List of MeSH words and limits used in the final literature search

Table 2. Criteria for assessing the level of evidence of included publications.

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Systematic review of level II studies</td>
</tr>
<tr>
<td>II</td>
<td>Randomised controlled trial (RCT)</td>
</tr>
<tr>
<td>III-1</td>
<td>A pseudo-RCT (alternate allocation of some other method)</td>
</tr>
<tr>
<td>III-2</td>
<td>A comparative study with concurrent controls; non-randomized experimental trial; cohort study, case-control study; interrupted time series with a control group</td>
</tr>
<tr>
<td>III-3</td>
<td>A comparative study without concurrent controls; historical control study; two or more single arm studies</td>
</tr>
<tr>
<td>IV</td>
<td>Case series with either pre-test / post-test outcomes</td>
</tr>
</tbody>
</table>

Results

A flow diagram of the systematic search is presented in Figure 1. A total of 75 publications were retrieved of which eight were suitable for final analyses; five related to caries-preventive programmes and three to restorative treatment programmes.

Caries-preventive programmes

Table 3 provides a summary of key information obtained from the included studies on caries preventive programmes. The quality of the included studies was rated between level II and level III-3. Only one randomised controlled trial was identified. The sample size of two studies (Shapira and Stabholz, 1996; Johnson and Almqvist, 2003) was very low, whilst the duration of all five studies was limited; 30 months being the longest. Except for one study (Shapira and Stabholz, 1996), drop-out rates were substantial considering the short study durations. Subjects studied were mentally/intellectually disabled people (Shapira and Stabholz, 1996; Ersin and Öncag, 2006), physically disabled people (Johnson and Almqvist, 2003; Honkala et al., 2003) and a combination of the two groups of disabled people (Mojon et al., 1998). Elderly people with disabilities were the subject of investigation in two studies (Mojon et al., 1998; Johnson and Almqvist, 2003; Honkala et al., 2003) and a combination of the two groups of disabled people (Mojon et al., 1998). Elderly people with disabilities were the subject of investigation in two studies (Mojon et al., 1998; Johnson and Almqvist, 2003; Honkala et al., 2003) and a combination of the two groups of disabled people (Mojon et al., 1998). Elderly people with disabilities were the subject of investigation in two studies (Mojon et al., 1998; Johnson and Almqvist, 2003; Honkala et al., 2003; Ersin and Öncag, 2006).

The caries-preventive programmes all differed. Homogeneity was not observed. Two studies investigated the effect of chlorhexidine varnish, fluoride gel and fluoride varnish on caries incidence rates (Johnson and Almqvist, 2003; Ersin and Öncag, 2006). No difference was observed between the preventive agents in both studies and a caries-reducing effect was observed in only one study (Johnson and Almqvist, 2003). One programme dealt with plaque control measures (Mojon et al., 1998), one assessed the effect of xylitol- containing candies (Honkala et al., 2003) and one investigated the effect of comprehensive preventive treatment, including the application of sealants (Shapira and Stabholz, 1996). All three programmes showed some caries-reducing effect but the magnitude was low.

Restorative treatment programme

Table 4 provides a summary of key information obtained from the included studies on restorative treatment programmes. The quality of the included studies was rated between level II and level III-2. Only one randomised controlled trial was identified. The sample size in two studies was very low (Molina and Kultje, 2003; Guaré et al., 2008) and drop-out rates had not always been provided. Intellectually disabled people and people with special needs (undefined) were the subject of investigation. The majority of studies were carried out amongst the younger part of the population (Carrillo et al., 2008; Guaré et al., 2008). One study investigated the survival of restorations (Molina and Kultje, 2003), whereas the other two assessed the effect of restorative care on behavioural reactions of the people studied (Carrillo et al., 2008; Guaré et al., 2008). In all included studies, tooth cavities were restored with either high-viscosity conventional, or resin-modified, glass-ionomer and they all tested a chemomechanical caries removal gel, which was accepted by the study participants but prolonged the treatment time. In one study, the ART approach was used (Molina and Kultje, 2003). Homogeneity of restorative treatment programmes was lacking.
Figure 1. Flow chart of included studies
<table>
<thead>
<tr>
<th>Authors</th>
<th>Type of study</th>
<th>Study methodology</th>
<th>Preventive programme</th>
<th>Initial DMFS</th>
<th>Final DMFS</th>
<th>Outcome</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnson and Arnozist, 2003</td>
<td>Quasi RCT / Pilot study</td>
<td>Physically dependant people: sample; 15 individuals, 45 to 89 yrs: dependent variable; active primary root carious lesions (yes/no): drop-out of 25% at 12 months</td>
<td>Group 1: professional tooth cleaning and application of tap water flavoured with eucalyptus oil. Group 2: professional tooth cleaning and application of Cavitene (chlorhexidine varnish). Group 3: professional tooth cleaning and application of Cavitene and Fluor Protector (fluoride varnish). Every three months for 18 months, each subject received the treatment twice within a 10-day interval. One oral hygienist.</td>
<td>n/a</td>
<td>n/a</td>
<td>All interventions were able to arrest caries progression. No significant difference between groups</td>
<td>III-1</td>
</tr>
<tr>
<td>Erenin and Oncag, 2006</td>
<td>RCT</td>
<td>Intellectually disabled people: sample; 90 individuals, 12 to 15 yrs: dependent variable; caries increment (DMFS): drop-out of 42% at 12 months</td>
<td>Subjects received full mouth rehabilitation under GA before starting the programme and then were randomly allocated to three groups: 1) Application of Cavitene (chlorhexidine varnish), re-applied every three months; 2) Semi-annual application of fluoride gel (NaF 2%) during 4 minutes; 3) Semi-annual application of Bifluoride 12 (fluoride varnish). Follow up at 1 year. Mothers of participants from all groups brushed teeth twice a day using a fluoride containing toothpaste (1500ppm).</td>
<td>Mean DMFS</td>
<td>Mean DMFS</td>
<td>No significant difference between the three groups</td>
<td>II</td>
</tr>
<tr>
<td>Mojon et al, 1996</td>
<td>Quasi RCT / Parallel group</td>
<td>Mentally/physically impaired people: sample; 116 individuals, mean age 64 yrs: dependent variable; caries increment in crown and roots (cavitation): drop-out; 31% (exp) and 33% (cont) at 18 months</td>
<td>Two groups from the same institution: 1) Experimental group: Care givers are instructed regarding oral health care, participants are provided with a oral hygiene set containing toothbrushes and fluoride toothpastes, recalls are established according to participants needs but not longer than every 6 months, dental treatment under requirement. Hygienist did scaling. 2) Control group: Dental appointments on request.</td>
<td>n/a</td>
<td>n/a</td>
<td>No changes in plaque. Reduction of caries progression in experimental group</td>
<td>III-1</td>
</tr>
<tr>
<td>Honkaia et al, 2006</td>
<td>Clinical trial</td>
<td>Physically disabled people: sample; 145 individuals, 10-27 yrs: dependent variable; caries increment (cavitation): drop-out 17% (exp) and 20% (cont) at 16 months</td>
<td>Two groups: 1) Study group received xylitol candies three times a day, after breakfast and lunch and before leaving the school, from Mondays to Fridays, during 18 months. No further recommendations were given. 2) Control group, those students who did not return a positive informed consent, were examined as a part of a regular national screening. School nurse</td>
<td>Mean DMFS: Experiment 8.2 Control: 9.8</td>
<td>Mean DMFS: Experiment 7.1 Control: 13.2</td>
<td>Decrease in mean DMFS experiment and increase in control group, although reduction in DMFS is unlikely</td>
<td>III-2</td>
</tr>
<tr>
<td>Shapira and Stabholz, 1996</td>
<td>Cohort, without control</td>
<td>People with Down's syndrome: sample; 20 individuals, 8 to 13 yrs: dependent variable; caries increment (cavitation) and plaque reduction: drop-out, 0% at 30 months</td>
<td>20 participants followed up during 30 months. Intervention: a) oral health care education and oral hygiene instructions for caregivers, parents and participants, b) periodontal maintenance treatment by dental hygienists every 4 months, c) dental maintenance by dentists, sealing new erupted molars, re-sealing those that had been lost and treating new caries lesions.</td>
<td>Mean DMFS: 1.4</td>
<td>Mean DMFS: 1.1</td>
<td>Decrease in DMFS and in plaque index, although reduction in DMFS is unlikely.</td>
<td>III-3</td>
</tr>
</tbody>
</table>

Table 3. A summary of key information obtained from the included studies on caries preventive programmes.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Type of study</th>
<th>Study methodology</th>
<th>Restorative treatment programme</th>
<th>Behaviour management</th>
<th>Dependent variable</th>
<th>Outcome</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molina and Kulte, 2003</td>
<td>RCT / quasi</td>
<td>Intellectually disabled people: sample; 25 people, 4 to 65 yrs (mean 16 yrs)</td>
<td>ART with and without a chemomechanical caries removal gel, restored with GIC: 28 cavities (ART without); 47 cavities (ART with) without local anaesthesia; one dentist</td>
<td>Conventional management</td>
<td>Survival of restorations after 1 year</td>
<td>95.7% survival of ART with chemo-mechanical and 78.6% survival for ART without (statistical significant difference). All patients accepted the treatment without the need of other behaviour management techniques.</td>
<td>III-1</td>
</tr>
<tr>
<td>Guaré et al., 2008</td>
<td>RCT / block randomisation</td>
<td>People with Down’s syndrome: sample 10 people, 5-12 yrs</td>
<td>Caries removal conventional with burs (n=5) and with a chemomechanical caries removal gel (N=5), restored with GIC under local anaesthesia; one dentist</td>
<td>Conventional management</td>
<td>Behaviour and physiological changes during treatment</td>
<td>Heart rate and treatment time higher for chemo-mechanical treatment. Other parameters (blood pressure, oxygen saturation, anxiety) no significant difference between treatments.</td>
<td>II</td>
</tr>
<tr>
<td>Carrillo CM et al., 2008</td>
<td>Comparative study with concurrent controls</td>
<td>People with special needs: sample; 51 people, 3-10 yrs</td>
<td>Chemical caries removal with Papacárie gel used in people with (group 1) and without motor disability (group 2); N=138 teeth; no local anaesthesia; glass-ionomer</td>
<td>Conventional management</td>
<td>Time for complete caries removal; acceptance of treatment</td>
<td>Completed caries removal with Papacárie gel took on average 8 minutes per tooth (7 and 10 min for group 1 and 2, respectively). Its application was well accepted by the patients in all phases and in the first and subsequent visits.</td>
<td>III-2</td>
</tr>
</tbody>
</table>
Discussion

The systematic search of publications related to programmes geared to prevention and treatment of caries lesions in people with disabilities resulted in only a few suitable publications, which were very diverse in implementation. Most of the excluded publications referred to case reports, which shared valuable information for guiding dentists in situations of rare medical diagnosis and subsequent treatment. Such publications cover experiences that may or may not apply in other similar cases. However, when recommendations that should be applicable to a larger group of disabled people are required, evidence of success of caries prevention and care programmes in comparative / analytical studies needs to be sought.

Different factors might explain the lack of well-designed randomised clinical trials regarding both preventive and restorative approaches appropriate for use in patients with disabilities. It is known that this type of study design is the most appropriate for approval of clinical treatments and the introduction of new or modified dental materials prior to marketing (Mjör, 2008). When the evidence provided by clinical trials carried out in dentistry in general was analysed, it was observed that the number, the design and the power of studies developed to address a clinical question are often inadequate (Bader and Ismail, 2004). In addition most of the trials selected in the present systematic review grouped individuals (Mojon et al., 1998; Johnson and Almqvist, 2003; Molina and Kultje, 2003; Ersin and Öncag, 2006) with different disabilities, which made comparisons between them difficult. This strategy was probably used to increase the sample size, as the type of disability itself can be an additional barrier to setting up longitudinal studies with sequential follow-up visits.

Considering that randomised clinical trials are ideal for comparing different therapeutic interventions, it is a matter of great concern that just two studies which were truly randomised (Ersin and Öncag, 2006; Guaré et al., 2008) were included in the present systematic review. The control of bias and the equal distribution of known confounding factors between groups are among many advantages that this kind of study presents. However, some of its big disadvantages are related to the fact that it might take a long time to obtain outcomes and possibly a long time to enrol patients (Jacob and Carr, 2000). For those reasons and because it can be quite difficult to set up a clinical study comprising all these aspects for patients with physical and/or motor impairment, we decided to broaden the inclusion criteria and to accept other types of studies, such as non-randomised clinical trials. Nevertheless, this strategy did not significantly increase the number of eligible papers, showing that there is an urgent need to increase the number of well-designed publications carried out in this field. Besides the number and the level of evidence of the publications retrieved as a result of a literature search that are shown in Table 3, their quality should also be assessed in the process of establishing the evidence that a systematic review can provide. This means that each study must be assessed according to the likelihood that bias, confounding and/or chance might have influenced its outcomes (NHMRC, 2009). Attention should be given to methodological aspects such as, subject’s selection and allocation, follow-up, measurement and analysis in order to minimise the introduction of bias at any stage of the study.

In the present systematic review, although half of the publications (Mojon et al., 1998; Johnson and Almqvist, 2003; Molina and Kultje, 2003; Ersin and Öncag, 2006) stated that patients were randomly allocated into experimental and/or control groups, none provided information about how the randomisation process was performed. In one paper (Guaré et al., 2008), although the abstract section defines the study as being a prospective controlled randomised trial, no information in support of this claim was provided in the text.

Another aspect that calls for attention is the reduced number of people enrolled in the publications and their inability to be accounted for, at the follow-up visits. Small, underpowered but sound studies can be considered in the evidence base if their findings are generally equivalent; nevertheless, it is very important that, at least some larger studies that test size effect can be included in a systematic review (NHMRC, 2009).

The quality of a publication is improved if the description of the training of operators/examiners, their calibration and the blindness of people (patients and staff) involved in the research, are correctly presented. It was observed that authors of the publications included in this systematic review had described these aspects better than those related to randomisation and concealment allocation. In summary, the lack of information about how studies were conducted and how data had been analysed had a negative impact on their internal validity, showing that methodological aspects still need to be addressed by the scientific community in this field of oral care.

A recently published systematic review regarding oral health of patients with intellectual disabilities (ID) stressed the need to develop strategies for increasing patient acceptance of routine dental care and to introduce more effective preventive strategies for minimising the need for restorative care (Anders and Davis, 2010). The present systematic review attempted to elicit information, not only about caries preventive programmes but also about restorative treatment programmes. The present review showed that no uniform preventive nor restorative treatment programme could be retrieved, while preventive methods based on a combination of plaque control, fluoride gel and varnish application, chlorhexidine varnish and sealants were acceptable for people with disabilities but the caries reducing / arrestment effect was modest. The restorative
treatment programmes had in common the use of a high-viscosity glass-ionomer and resin-modified glass-ionomer, in addition to the use of a chemomechanical caries-removal gel. The review findings show that caries management in people with disabilities seems to be unstructured and that evidence of a specific preventive and/or care programme is not yet available. Clinical guidance can, therefore, not be produced.

There is a high prevalence of people with some type of disabling condition (Barbotte et al., 2001), regardless of the many different indicators taken into account to define this specific group. Furthermore, availability and access to preventive and therapeutic dental care has been found to be inadequate (Lawthers et al., 2003; Nunn et al., 2008), as has the education of graduate students with regard to the provision of treatment to patients with special needs (Waldman et al., 2005; Nunn et al., 2008). Those facts call for action. International organisations such as the International Association for Disability and Oral Health (IADH), the Special Care in Dentistry Association (SCDA), International Association for Dental Research (IADR), World Dental Federation (FDI) and World Health Organisation (WHO), should give greater priority to the oral health of people with disabilities. Guidance should be provided regarding the development of an international agenda of relevant research topics. Research methodology should be included or made mandatory in specialisation courses for special needs dentists. At least the need for guidelines for treating people with different disabilities should be placed on the agenda of the forthcoming congresses of the IADH or SCDA.

Recommendations for further research

Randomised clinical trials (RCTs) provide the highest level of evidence for testing intervention effectiveness. Why were so few RCTs observed among the included publications? Is this because professionals that treat people with disabilities have insufficient interest in carrying out studies that comply to the high levels of science or is it difficult to adhere to all the requirements for conducting a RCT in a study group that consists of people with disabilities? This question is difficult to answer, as there may be no truth in either posed reason. Based on reading the retrieved publications it would seem advisable that those that wishing to start a study in this special group of people, should concentrate on studying one type of disability. A number of included studies had grouped people with different types of disabilities. It was noticed that the sample in many studies contained only a few individuals. This may be due to the relatively few people with a specific disability that consult a health centre or dental practice in a given time span. If that is the case it is advisable to contact additional centres and practices that treat such people in the vicinity before starting a study. This would increase the sample size and subsequently, this would increase the reliability of the outcomes. Multi-centre studies have an increased external validity, which adds to the quality of the study outcomes. The lack of quality research papers should be a concern of the professional associations, both locally and internationally.

Conclusions

It is concluded that the present systematic review did not lead to the discovery of strategies for caries preventive and restorative care in people with disabilities. More, and high quality research is required. International oral health organisations should spearhead the promotion of oral health, based on scientific evidence, for people with disabilities.

Acknowledgments

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