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Dentifrices. Part 3: Dentifrice Recommendations

Abstract: This article, the third in a series about dentifrices, emphasizes the essential role of dentifrices in oral healthcare, highlighting their contributions beyond mechanical plaque removal to include plaque inhibition and delivery of therapeutic agents. Despite the sometimes-limited impact on mechanical plaque removal, the importance of fluoridated dentifrices, must not be underestimated. The article reviews the effectiveness and safety of dentifrices, including the challenges posed by subjective clinical indices and potential allergenic ingredients. It discusses the potential of innovative dentifrice formulations to improve compliance and oral health outcomes. Additionally, it emphasizes the critical role of dental care professionals in recommending dentifrices based on safety and effectiveness rather than cosmetic claims or cost. Through an analysis of the literature and clinical guidelines, this work aims to guide healthcare providers in making informed decisions about dentifrice recommendations for optimal oral health.

CPD/Clinical Relevance: Dentifrices are complex formulations that need to be proven effective in (clinical) trials and be appreciated by end users.

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Given that the use of dentifrice is an integral part of daily oral care, toothbrushing and dentifrice are inextricably linked. Brushing without dentifrice is experienced as unpleasant,[1,2] and people are less likely to brush their teeth if they cannot use a dentifrice.[3] The dentifrice must be perceived as acceptable and pleasurable.[3] Dental societies such as the ADA in the USA, and the FDI recommend brushing twice daily with a fluoridated dentifrice.[4,5]

Systematic reviews and evidence-based guidelines

A systematic review can be referred to as 'research of research' and is described as the highest level of evidence to guide clinical practice.[6,7] A systematic review summarizes the results from randomized clinical trials[8] in response to a research question.[7,9]

Healthcare providers, researchers, and policymakers need systematic reviews to efficiently integrate existing information and provide data for rational decision-making.[10] A synopsis or meta-review summarizes the findings of high-quality systematic reviews to provide even stronger information to support clinical action.[11]

Clinical indices for plaque and gingivitis

A problem in dental research is that plaque and gingivitis indices can only be considered surrogates for oral health. These indices are derived from subjective ratings, not from actual measurements.[12] Experiments indicate a relationship between the construct of plaque indices and gingival inflammation.[13] Plaque indices are often used in daily clinical practice to monitor oral hygiene practices and motivate patients to improve their oral hygiene. However, the construct validity of the dental plaque index scores is questionable because it is uncertain

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Frequency of dentifrice use

It is well established that particularly the frequency of dentifrice use has a major influence on effectiveness.[16,17,42,45] Self-reported infrequent brushers demonstrated higher incidence and increment of carious lesions than frequent brushers did.[45] Brushing twice per day or more has a greater preventive effect than once per day.[16,17,42,45]

Rinsing after toothbrushing

Rinsing behaviour after toothbrushing affects the amount of fluoride retained in the mouth[16, 17, 46] and has been reported to affect caries experience.[16] Brushing twice a day or more, or afterward rinsing less thoroughly, or not rinsing at all would confer greater caries reductions than brushing once a day or less, or rinsing with larger volumes of water after toothbrushing.[17,43,47–49] However, a more recent, prospective study did not show an effect of post-brushing rinsing regimen on caries incidence.[44,50] The rinsing behaviour after toothbrushing may also affect the safety of a product.[42,43,47–49]

Brushing time

The length of the brushing time determines how long the fluoride concentration in the dentifrice slurry stays in contact with the teeth and plaque, thus allowing fluoride uptake to take place.[16,44]

Shelf-life

Free ionic fluoride concentration in dentifrices varies with storage time and conditions.[51] In addition, there may be variations in the quality of the ingredients used in different manufacturing facilities globally, some of which may contain trace impurities that can affect fluoride ion concentration.[51]

Globalization has produced a complex market for dentifrice where familiar brands can be manufactured thousands of miles away from their traditional customer base.

Moreover, familiar packaging can hide different details in the formulation and possibly even efficacy.[51]

Box 1. Factors affecting the efficacy and impact of dentifrice use.

whether they actually measure the amount of plaque on a tooth surface.[13,14]

Factors affecting dentifrice effectiveness

A dentifrice does not significantly contribute to plaque removal during a brushing exercise but can support plaque inhibition.[15] In addition to the inherent properties of a fluoride dentifrice product, biological and behavioural factors can modify its anticaries effectiveness.[16] Behavioural factors include the frequency of dentifrice use, the time of day that dentifrice is applied, the amount of dentifrice applied to the brush, length of brushing, and the rinsing practices after brushing.[17] The most important factors affecting the efficacy and impact of dentifrice are summarized in Box 1.

Side effects of dentifrice

Although dentifrices should not have side effects or adverse effects, modern dentifrices can contain ingredients that carry a risk of sensitization, resulting in allergic phenomena. Based on the number of publicly available case reports, contact allergy to dentifrice seems to be infrequent, but not rare, in the general population.[18] It may be assumed that some allergic reactions to dentifrices go unrecognized for the users themselves and/or the dental care professional.[18] Many food additives in oral hygiene products are potential allergens that may cause allergic reactions.[19] Manufacturers do not have to mention all ingredients on product labelling if the concentration falls below the threshold stated in the EU Cosmetics Regulation, even if they are one of the 26 EC (European Commission) -known allergens. The thresholds for rinse-off products, such as dentifrice, is 0.01%. In contrast, this is much higher for leave-on products such as creams, at 0.001%.[20,21]

Allergic reactions usually manifest as cheilitis, with or without dermatitis around the lips, and less frequently cause oral mucosal symptoms such as glossitis, gingivitis, stomatitis, soreness, burning, burning mouth syndrome, aphthous or non-aphthous ulcers, or lichenoid reactions.[18] See Box 2 for an overview on side effects of dentifrice.

The future of dentifrice

Dentifrices are ideal vehicles for the delivery of therapeutic agents because they are ubiquitously used during routine toothbrushing. They can be formulated to support user compliance with recommended brushing instructions.[22,23] Dentifrices are certainly not finished products. Flavour balance, safety, stability efficacy, for example, are continuously evaluated, and adjustments are made as necessary to satisfy individual requirements.[24]

There is room for dentifrice products that will encourage motivation by the intended user.[24] A modern example is dentifrices containing plaque-disclosing agents and, therefore, allowing evaluation of toothbrushing efficacy by its user. This might stimulate the accomplishment of optimal toothbrushing.[25,26]

Several studies demonstrated that plaque-indicating dye-containing dentifrices, together with proper use and oral hygiene instructions, significantly increased the efficacy of plaque removal.[27–30] A barrier to its use is mainly the high consumer costs. This sophisticated product is about 40 times more costly than a white label dentifrice, and 10 times the price of a premium brand product.

Within the current knowledge, a dentifrice is not an agent that contributes to mechanical plaque-control,[15] but has more of a focus on plaque inhibition properties.[31,32] It effectively offers extended care beyond the actual brushing. In addition, it can also, for instance, help to freshen the breath. It appears that there is a future for the development of dentifrices as a carrier for effective ingredients to care for and maintain oral health. After a careful assessment of the evidence obtained, one can state that the choice of a dentifrice should not be based solely or primarily on price or taste. This would be an injustice to the dentifrice manufacturers that have, since the 1870s, made efforts of to improve their 'dentifrice cream' in order to achieve overall oral health. The formulation of the modern therapeutic fluoride dentifrices has evolved into a sophisticated art and science.[16]

Oral mucosal peeling

Oral mucosal peeling induced by oral hygiene products seems to be a relatively common finding in daily clinical practice.[52] This also is often unrecognized by the users themselves and/or the dental care professional. A recent SR on oral mucosal peeling concluded that there is a causal relationship with dentifrices but also mouthwashes. The degree of desquamation is linked to the concentration of SLS.[53] High concentrations of SLS, as well as other constituents of oral hygiene products, can also be held responsible, albeit, in much lower frequencies. Most cases are painless, leaving normal mucosa after desquamation.

Idiopathic asymptomatic desquamation has been observed with a dentifrice with a low water content formulation compared to other dentifrices.[54]

Recurrent aphthous ulcers

Recurrent aphthous ulcers are a painful recurring condition and the most common oral mucosal disease.[55] In patients suffering from recurrent aphthous ulcers, SLS appears to increase the incidence and duration of the lesions.[56] A recent systematic review suggests that patients may benefit from using SLS-free dentifrices for their daily oral care.[55] Some manufacturers have replaced SLS with other less irritant surfactants.[57–59] Owing to its dehydrating and irritating effects on mucous membranes, SLS may be contra-indicated for bedridden patients or for those with a dry mouth and sensitive mucosa.[56] Reformulating dentifrices towards compositions without SLS might be the first step towards low-allergen dentifrice formulations.

Crohn's disease

The use of dentifrice has been proposed to be associated with Crohn's disease.[60] The metal additives in dentifrice were presumed to be linked to the disease, which was further explored.[61,62] At present there is limited substantiating scientific evidence.[63] A direct relationship has not been observed, although the biological impact of aluminium and iron on the microbiota has been confirmed in several studies.[64–66]

Flavouring substances

While flavouring substances in dentifrice make brushing with a dentifrice more enjoyable, they may also be responsible for allergic contact cheilitis.[67–70]

Box 2. Side effects of dentifrice.

Based on the available literature, the following basic recommendations on dentifrice use can be given:

- Use a fluoride dentifrice for toothbrushing[42,71–74]
- Use a dentifrice to obtain a longer-lasting effect following toothbrushing[31]
- Consider a dentifrice with other active ingredients upon product indication or recommendation of the dental care professional[31,75]
- Consider a stannous fluoride dentifrice for an additional effect on gingival health[75]
- Consider a dentifrice that is specifically formulated for tooth whitening to reduce tooth surface discolouration[38]
- For manual toothbrushes, use at least 1 cm of dentifrice; and for power toothbrushes, use a dose of 0.5 cm twice [76]
- Brush your teeth twice per day[5,17,77]
- Brush your teeth for at least 2 minutes or longer[13,78,79]
- Rinse with no more than a handful of water after brushing[76]
- Do not ingest unnecessary amounts of dentifrice[16,40,80]

Box 3. Recommendations for patients from dental care professionals.

Dentifrice and daily dental practice

Members of the dental team are advocates for obtaining good oral health. An important pathway to better oral health is the use of therapeutic oral care products that supplement mechanical plaque-control measures to ultimately prevent dental caries and periodontal disease. Healthcare providers can take a leadership role in helping their patients filter through the excessive advertising and recommend only dental products proven to be safe and effective.[33] People value various factors, such as pleasant taste or perception of a clean feeling, in order to feel fresh and confident in social situations.[34] These patient-reported outcomes can be the focus of attention in the daily dental practice to promote appropriate oral hygiene behaviour.[35–37]

Dental care professionals generally presume that the effect of whitening dentifrices is mainly based on abrasivity. In a recent systematic review, it was found that it was not feasible to differentiate products based on their abrasive ingredients. It was synthesized that a combination of factors makes whitening dentifrices effective on extrinsic tooth discolouration.[38] Also, despite what is often suggested by dental care professionals, the same systematic review did not report any adverse events or side effects.[38] However, another recent systematic review concluded that when using whitening dentifrice, side effects, such as tooth sensitivity and the effects on soft tissues, were almost twice as likely as when using regular dentifrice.[39] It should be noted that in the two dentifrices compared, both also differed in their abrasive composition.

While the dental care professional must remain abreast of the ever-increasing development and marketing of dental cleaning products, it is not motivating and easy if these developments are purely cosmetic claims. In the past, dental care professionals had to rely on data obtained from clinical trials, some of which were of poor quality. The regulatory bodies have done much to improve the quality of trials and to review and approve manufacturer claims. Much of the improvement in the oral health of individuals, communities, and populations can be attributed to the widespread availability and use of safe and effective dentifrices.[40] Assessing claims, ingredients, and efficacy, as well as what is needed and what the patient wants are key considerations in recommending dentifrices.[41] Understanding the labelling and ingredients listed on the packaging

for dentifrices is an important step to know which dentifrice can best deliver the desired benefits, safely and effectively for a given patient. Moreover, knowledge regarding ingredients to which patients may have sensitivities is necessary. Many dentifrices offer multiple benefits in one, such as a whitening benefit, anti-plaque, and anti-gingivitis claims, anti-tartar claims and anti-sensitivity claims, plaque, and gingivitis reductions.[42] It is disappointing that dental care professionals seldom recommend a particular dentifrice for another specific ingredient or dental complaint/request.[43,44]

Conclusion

A dentifrice does not assist in the instant mechanical plaque removing effect of toothbrushing. The plaque removing effect is beyond the brushing moment itself, and is based on the chemical inhibition of plaque regrowth. Dentifrices containing stannous fluoride have significant effects in obtaining gingival health compared to standard fluoride dentifrices. Whitening dentifrices can reduce natural extrinsic tooth surface discolouration. Box 3 summarizes patient advice that dental care professionals can recommend.

Compliance with Ethical Standards

Conflict of Interest: The authors declare that they have no conflict of interest.

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