

The efficacy of mouth rinses with essential oils



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Contents

3 Foreword

Professor Helen Whelton writes about the effectiveness of mouth rinses as gum disease is on the rise.

4 Oral health in context

In 2015, Araujo and colleagues presented a unique meta-analysis on the efficacy of an essential oil-containing antimicrobial mouth rinse to help prevent and reduce plaque. Armed with the authors' findings, this article explores the realities of oral health and considers the potential for dental healthcare professionals to review their practices to help patients tackle plaque accumulation effectively.

6 Summary of meta-analysis on efficacy of mouth rinses with essential oils

We present a summary of Araujo and colleagues' seminal 2015 meta-analysis, including why it was conducted, the methods used, the results, points of discussion and conclusions reached.

Alongside all of this is a concise roundup of the scientific evidence supporting the efficacy of an essential oil-containing antimicrobial mouth rinse as part of a daily oral hygiene routine.

10 Does anyone need mouth rinse? - An expert view

Focusing on the clinical implications in terms of plaque reduction and the associated potential outcomes such as reduced caries and gingivitis, Professor Anthony Roberts expands on the significance, importance and relevance of the data to consider its potential for change within everyday dental practice.

12 Effecting change

In conclusion, we present an overview of the evidence available to support dental care professionals considering whether to update recommendations to patients to influence positive change over their everyday oral health habits.



Dental plaque, coloured scanning electron micrograph (SEM). Plaque consists of a film of bacteria (pink) embedded in a glycoprotein matrix. One of the bacteria in this sample is *Fusobacterium nucleatum*. The matrix is formed from bacterial secretions and saliva. Plaque is the main cause of tooth decay. The bacteria feed on sugars in food, producing acid as a waste product. This acid corrodes the teeth's enamel coating, resulting in dental caries. A build-up of dental plaque can also lead to inflamed and infected gums. Severe gum disease can lead to teeth falling out.



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Foreword By Professor Helen Whelton

Address gum issues

Professor Helen Whelton says there must be more information communicated about the effectiveness of mouth rinses as gum disease is set to rise.

In this supplement, Prof. Anthony Roberts outlines the rationale for the use of mouth rinses and provides an overview of recent reviews of their effectiveness. Why is this important? Well, there is an unwarranted sense of complacency about oral inflammation. If the quantum of inflammation of generalised gingivitis was transferred to a visible part of the body, we would be shocked and concerned and would rightly treat it until it disappeared. Why not the mouth then? As professionals, we are the champions of oral health and it is up to us to endeavour to address this complacency amongst the population.

The need to address the periodontal diseases has become more pressing because we have an increasingly dentate ageing population. Between 2011 and 2016, the population of Ireland age 65 years and over increased by 19.1% (CSO). The disruptive effect of fluoride on caries is now manifesting in our dentate older population as reported in the last National Survey of Adult Oral Health, and this is good news. In Ireland, the percentage of edentulous 35-44 year olds fell from 12% in 1979 to 4% in 1989 to 1% in 2000.

Although 41% of those age 65+ years were edentulous in 2000, simple extrapolation of the trends presented in the survey¹ suggests that total tooth loss may fall to less than 5% by 2025. Whilst this dramatic improvement in tooth retention is set to improve older adults' ability to eat, smile, converse in comfort and generally enjoy life, it is not without a down side. The most recent national data¹ show that 50% of dentate adults aged over 65 years had periodontal pocketing (38% shallow and 12% deep). Such pockets are a substantial source of inflammation with potentially detrimental effects on general health.

Health impacts

The general health impacts of periodontal inflammation include a two-way relationship with diabetes. Extensive periodontal inflammation is more common among people with diabetes and if not addressed has an adverse impact on diabetic control. Other commonly reported associations with periodontal inflammation include metabolic syndrome,² cardiovascular, cerebrovascular and respiratory diseases, and rheumatoid arthritis.^{3,4} Just a few decades ago, tooth loss was significantly more prevalent amongst older adults and as a consequence it is reasonable to suggest that the inflammatory burden then was less than it is now. The oral health of older adults is also threatened by xerogenic medications used to combat those ailments that are prevalent among an ageing



population. The resulting dry mouth leads to reduced natural cleansing, increased plaque accumulation and greater difficulty in maintaining oral health. This may be accompanied by the challenge of impaired dexterity with age rendering those affected less able to carry out effective oral hygiene.

Prevention is the best cure

One obvious solution to this increased inflammatory burden is to prevent its occurrence. As Professor Roberts points out in his article, patients who develop periodontitis would have previously had gingivitis and on a similar note, gingivitis does not occur without plaque. Effective home care is essential for plaque control and it is important to capture incremental improvements, for example, through supporting improved brushing, for a longer duration, with a more effective brush, and an anti-plaque toothpaste or mouth rinse that delivers additional anti-plaque or anti-gingivitis effects. Such approaches are synergistic and deliver incrementally better plaque removal. Less is more with plaque and all efforts to enhance plaque control are to be encouraged. We have got to redouble our efforts to tackle the serious problem of inflammatory periodontal diseases. We must act now to keep healthy young mouths healthy for life and for living.

I welcome this supplement which presents evidence for approaches to improve plaque control through better home care, supported by effective oral healthcare products, which could lead to enhanced population oral health, general health and quality of life.

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Oral health in context

Araujo and colleagues have published a meta-analysis on the efficacy of an essential oil-containing antimicrobial mouth rinse to help prevent and reduce plaque.¹ In light of this, we explore the realities of oral health globally and consider the potential for dental professionals to review their practices to help patients tackle plaque accumulation, which can help prevent tooth decay and gingivitis.*

In 2015, Araujo and colleagues presented: "the first meta-analysis to demonstrate the clinically significant, site-specific benefit of adjunctive EO [essential oil] treatment in people within a six-month period (that is, between dental visits)".¹ The meta-analysis consisted of 29 clinical studies comprising 5,106 subjects;¹ for further details see **Figure 1**.

A global view

In 2010, it was calculated that worldwide, 3.9 billion people are affected by oral conditions.² It was further found that untreated caries in permanent teeth had a global prevalence of 35% for all ages combined, and 9% of the global population suffered untreated caries in deciduous teeth.² Within the Global Burden of Disease (GBD) 2010 study these oral conditions were rated first and tenth respectively, in a list of 291 diseases and injuries.²

Closer to home, the UK Adult Dental Health Survey 2009 reported that almost one-third of the population surveyed showed signs of decay, equating to millions of people.³

However, as we know, oral health should not be considered in isolation.⁴

As stated by Sheiham (2005): "The compartmentalisation involved in viewing the mouth separately from the rest of the body must cease, because oral health affects general health by causing considerable pain

and suffering and by changing what people eat, their speech and their quality of life and well-being".⁴

In addition, in terms of cost, according to Listl and colleagues (2015): "findings suggest that the global economic impact of dental diseases amounted to US\$442 billion in 2010.

"Improvements in population oral health may imply substantial economic benefits not only in terms of reduced treatment costs, but also because of fewer productivity losses in the labour market".⁵

"There is a universal recommendation to brush twice daily for at least two minutes with a fluoridated dentifrice. For periodontitis patients two minute is likely to be insufficient. Daily inter-dental cleaning is strongly recommended to reduce plaque and gingival inflammation".

Prevention is key

In light of the prevalence and financial burden of dental diseases globally, it is worth noting the World Health Organisation's perspective on a preventive regimen: "Clinical and public health research has shown that a number of individual, professional and community preventive measures are effective in preventing most oral diseases".⁶ It continues: "Most of the evidence relates to dental caries and control of periodontal diseases. Gingivitis can be prevented by good personal oral hygiene practices, including brushing and flossing, which are important also to the control of advanced periodontal lesions".⁶ However, it is also known that although brushing and interdental cleaning are pivotal to oral hygiene, bacteria from other areas of the mouth can recolonise on teeth quickly.⁷

In 2015, Working Group 2 of the 11th European Workshop in Periodontology on the primary prevention of periodontitis, reported that there is value in adjunctive chemotherapeutic intervention, reaching a consensus that: "There is a universal recommendation to brush twice daily for at least two minutes with a fluoridated dentifrice. For periodontitis patients two minutes is likely to be insufficient. Daily inter-dental cleaning is strongly recommended to reduce plaque and gingival inflammation".⁸

The group also concluded that for some patients, there are advantages to adjunctive use of chemical agents for plaque control.⁸ Clearly, this is where a third home care step in the form of a mouth rinse may well come into its own. This is further supported by Araujo and colleagues' meta-analysis, which will be further explored in the pages that follow.

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* In the UK, mouth rinse containing essential oils is classified as a cosmetic product. Because of this, the focus of this Journal of the American Dental Association review will centre on the plaque reduction data. However, Araujo et al. (2015), in their meta-analysis, also reviewed the impact on gingival health from adjunctive use of essential oil-containing mouthwash. Read the full article here: http://jada.ada.org/article/S0002-8177(15)00336-0/pdf.



FIGURE 1: Selection of randomised controlled six-month trials of mouth rinse for the Araujo et al. (2015) meta-analysis.¹

Summary of meta-analysis on mouth rinse efficacy

We present a summary of Araujo and colleagues' seminal 2015 meta-analysis to consider the scientific evidence supporting the efficacy of an essential oil-containing antimicrobial mouth rinse as part of a daily oral hygiene routine.¹



In 2015, Araujo and colleagues published the first meta-analysis to show the clinically-relevant benefits of an essential oil-containing mouth rinse in site-specific areas of the mouth, when used as an adjunct to mechanical cleaning over a six-month period.¹

They related: "Oral health is integral to the general health and well-being of patients. Although largely preventable, oral disease is recognised to significantly burden the economic, psychological, and social development of communities across the globe. Gingivitis and other periodontal diseases continue to exist as serious challenges on a global scale".¹

Placing this in context, the authors went on to report on the global burden of oral conditions. Marcenes and colleagues (2013) revealed that 3.9bn people worldwide are affected by oral conditions collectively, such as untreated caries and periodontal disease.²

In Ireland, the Oral Health of Irish Adults survey (2000) suggested a high level of periodontal inflammation and disease in the population, with non-medical card holders tending to have more healthy sextants than medical card holders.³

Unmet need

It would seem that there is an unmet need here, but why might that be? Barnett (2006) suggested that although it is possible to maintain an adequate level of oral hygiene in theory, when "using mechanical methods alone, data indicate that the vast majority of people are unable to accomplish this on an ongoing basis".⁴

He continued that this provides "a clear rationale for incorporating effective antimicrobial measures, such as use of an antimicrobial mouth rinse, into daily oral hygiene regimens".⁴

Looking at the issue from both individual health and general public health perspectives, Barnett (2006) stated that using an antimicrobial mouth rinse on a daily basis has a significant effect on plaque control, making it a cost-effective and significant adjunct to mechanical cleaning.⁴ Barnett (2006) further wrote that the reasoning behind using an antimicrobial mouth rinse comprises two elements:

- Since mechanical methods performed by the majority of people are inadequate, an adjunctive antimicrobial mouth rinse may help to reduce plaque levels.⁴
- It offers a way to deliver antimicrobial agents to mucosal sites throughout the mouth that are unaffected by mechanical methods and would otherwise serve as 'reservoirs' for plaque bacteria.⁴

All of this information and its potential effect on oral health outcomes can now be supplemented in light of the findings reached in Araujo and colleagues' 2015 meta-analysis.¹

Initial steps

In the earliest stages of creating Araujo and colleagues' 2015 meta-analysis, the researchers had access to 32 published and unpublished randomised, long-term clinical trials involving over 5,000 healthy subjects who nonetheless were suffering from the early stages of periodontal disease.¹ These participants had been given an essential oil-containing mouth rinse for a number of reasons, ranging from obtaining views on the taste of the formulation to its efficacy as an adjunct to mechanical cleaning.¹ All 32 studies had been designed to meet the requirements of the American Dental Association and the US Food and Drug Administration.¹ The primary aim of the meta-analysis was "to compare the efficacy of

combined mechanical oral hygiene and use of essential oils-containing mouth rinses with that of mechanical oral hygiene [alone]", using the percentage of sites identified as maintaining gingival health at six months as a basis.¹ A secondary purpose was "to examine treatment effects using other summary measures based on the plaque index (PI)". Finally, Araujo and colleagues (2015) assessed and then described a number of possible causes of diverse treatment outcomes among study findings.¹

Methods used

Of the original 32 studies considered by Araujo and colleagues (2015) which were "six months or longer duration, observer-masked, parallel, randomised, placebo-controlled, sponsored by Johnson & Johnson Consumer Companies and its predecessors that assessed the effect of marketed mouth rinses containing the fixed combination of four essential oils (menthol, eucalyptol, thymol, and methyl salicylate) on plaque", 29 met the criteria of the meta-analysis.¹

The three that were deemed unsuitable for the meta-analysis were considered so for a variety of reasons, including that they had not been ADA approved, did not use consistent measurement scales, did not incorporate a placebo group, and/or had no "site-level data available for external researchers to use".¹

Within the accepted 29 studies, only results relating to groups using mechanical methods with essential oil-containing mouth rinse (MMEO) were analysed. Each met the criteria of using the same mechanical methods and 20ml of a mouth rinse containing essential oils twice a day for 30 seconds each time.¹ **Table 1** presents a summary of the protocol characteristics for the 29 suitable studies.

Outcomes "were chosen based on the clinical relevance, which could help clinicians to better choose a preventive approach".¹ These included, but were not limited to:

- "plaque-free site (yes/no): a site was defined as plaque-free (yes) if Pl scores were 0 or 1 a site was not defined as plaque-free (no) if Pl [Quigley-Hein Plaque Index] scores were 2, 3, 4, or 5"; and,
- "percentage change in a participant's whole-mouth mean plaque score (PI 2 or 6 surfaces) from baseline at six months".¹

Data analysis

With regard to data analysis: "For the analysis of healthy sites and plaque-free sites, by-study treatment effect and standard error (SE) estimates were obtained using a generalised linear model approach, using a logit link based on the odds of healthy or non-healthy sites (or plaque-free or plaque sites). A model was fit by study, including terms for treatment and for baseline percentage of healthy (or plaque-free) sites as a co-variate. This model was used to estimate the odds ratio (OR) and associated SE within each study".¹

DerSimonian and Laird's method was then used to reach an overall estimate of the OR "based on a random effects assumption, using the estimates for the within-study ORs and associated SEs. The corresponding estimate based on the fixed effects assumption was obtained similarly by combining the within-study estimates, using as weights the inverse of the squared within-study SEs. Forest plots were generated for healthy sites and plaque-free sites, with a confidence interval (CI) for each study, and an overall summary OR, and percentage change".¹

When considering "percentage change from baseline in whole mouth

mean ... plaque scores, analyses were based on a model with percentage change at the participant level as the response and baseline mean score as a co-variate", the DerSimonian and Laird method was used once again.¹ This was utilised to create an estimation of the difference between treatment based on the random effects assumption.¹

The Cochrane Handbook for Systemic Reviews of Interventions principles were then applied to evaluate the risk of bias in each of the studies included in the meta-analyis.¹

Results

In total, data for the meta-analysis came from 5,106 randomised subjects, 2,544 of whom received MMEO treatment and the remainder received MM treatment only. The demographic of the subjects is detailed in **Table 2**.

Reflecting upon efficacy, Araujo and colleagues (2015) reported: "Efficacy analyses were performed on the intention-to-treat populations across 29 clinical studies that fit the criteria for the meta-analysis, including 4,827 participants with post-baseline data (2,425 in the MM treatment group and 2,402 in the MMEO group)".¹ Among its findings, the meta-analysis revealed:

"the summary OR of a plaque-free site for participants in the MMEO group compared with participants in the MM group, was 7.8 (95% CI, 5.4-11.2) from the random effects model"¹; and,

"for the variable percentage reduction from baseline in Pl at six months, the summary percent reductions (95% Cl) was 27.7 (22.4-32.9)".¹

See **Figure 1** for the responder analysis of percentage reduction of whole-mouth plaque index and **Figure 2** for the responder analysis of percentage of plaque-free sites intention-to-treat population.

Discussion

Alongside presenting the percentage reduction in plaque indexes, the meta-analysis offered new data on the adjunctive use of essential oil-containing mouth rinses, as well as mechanical methods alone, in helping to maintain gingival health.¹

In addition, the authors of the meta-analysis emphasised that the 29 studies that had been included were all of a high standard, having been designed to meet regulatory and ADA Seal of Acceptance requirements.¹ Revisiting the motives behind this meta-analysis, Araujo and colleagues (2015) wrote that there are dual reasons for using an antimicrobial mouth rinse. Firstly, it works as an adjunct to mechanical methods to help control and inhibit plaque accumulation, which can assist in the prevention of gingivitis and dental decay. Secondly, it offers an efficacious way of delivering antimicrobial agents to mucosal sites, facilitating the elimination of plaque bacteria otherwise capable of resettling on tooth surfaces above and below the gum line.¹

Other work

To provide a framework within which to reflect upon the results of their meta-analysis further, Araujo and colleagues (2015) then considered the outcomes achieved by a number of their contemporaries.

For example, in 2006 Gunsolley conducted a meta-analysis – in part – to evaluate the efficacy of anti-plaque products in six-month trials.⁵ He found "strong evidence that antiplaque ... agents are efficacious. Coupled with reports showing that the relative efficacy of these agents is similar to that of

Table 1: Summary of study characteristics.

Study	Year study initiated	Country	Dental prophylaxis	Supervised rinsing	Flossing	Plaque index no. surface	Negative control rinse B/F•	Mean plaque inclusion criteria
Menaker and Ross, 1981 (DOF [†])	1980	United States	Y‡	Y	N§	2	V¶	2.00
Lamster and colleagues, 1983	1981	United States	Ν	Y	Ν	6	V/SW•	1.80
Gordon and colleagues, 1985	1981	United States	Y	Y	Ν	2	V/SW	1.80
DePaola and colleagues, 1989 ^{††}	1984	United States	Y	Y	Ν	2	H••	1.95
Overholser and colleagues, 1990	1987	United States	Y	Y	Ν	2	Н	1.95
Mankodi and colleagues, 1989 (DOF)	1988	United States	Y	Y	Ν	2	Н	1.95
Charles and colleagues, (2004) ^{††}	1988	United States	Y	Y	Ν	2	Н	1.95
Mankodi and colleagues, 1990 (DOF)	1990	United States	Y	Y	Ν	2	Н	1.95
Overholser and colleagues, 1992 (DOF)	1991	United States	Y	Y	Ν	2	V	1.95
Mankodi and colleagues, 1993 (DOF)	1992	United States	Y	Y	Ν	2	V	1.95
Sharma and colleagues, 1997 (DOF)	1995	Canada	Y	Y	Ν	2	Н	1.95
Mankodi and colleagues, 1997 (DOF)	1995	United States	Y	Y	Ν	2	Н	1.95
Charles and colleagues, (2001)	1997	Canada	Y	Ν	Ν	6	Н	1.75
Charles and Vincent, 1999 (DOF)	1998	United States	Y	Ν	Ν	6	Н	1.95
Sharma and colleagues, 2002	2000	Canada	Y	Ν	Ν	6	Н	1.95
Barouth and colleagues, 2003	2000	United States	Y	Ν	Ν	6	Н	1.95
Sharma and colleagues, 2004	2002	Canada	Y	Ν	Y	6	Н	1.95
Charles and Peng, 2009 (DOF)	2004	Canada and United States	Y	Ν	Ν	6	Н	1.95
Charles, 2012 (DOF)	2005	United States	Y	Ν	Ν	2	Н	1.95
Santos and colleagues, 2006	2005	Canada	Y	Ν	Ν	6	Н	1.95
Santos and colleagues, 2012	2006	Canada	N	Ν	Ν	6	Н	1.95
Charles and colleagues, 2013	2007	United States	N	Ν	N	6	Н	1.95
Sharma and colleagues, 2010	2008	Canada	Y	Ν	Ν	6	Н	1.95
Simmons and colleagues, 2010	2008	United States	N	Ν	N	6	No negative control rinse	1.95
Cortelli and colleagues, 2012	2009	Brazil	Y	N	Ν	6	Н	1.95
Cortelli and colleagues, 2013	2010	Brazil	Y	N	Ν	6	Н	1.95
Junker and colleagues, 2012 (DOF)	2010	Canada	N	N	Ν	6	Н	1.95
Lynch and colleagues, 2014 (DOF)	2010	Canada	N	N	Ν	6	Н	1.95
Cortelli and colleagues, 2014	2012	Brazil	Y	Ν	Ν	6	Н	1.95
 B/F: Brushing and flossing H: 5% Hydroalcohol control 	† DOF: †† Gingi	Data on file val index was used in the	se 2 studies.	‡ Y:Yes § N:No		<pre>¶ Vehicle # SW: Ste</pre>	control rile colored wat	er control

Table 2: Demographics and sample baseline characteristics across all randomised studies.

Parameters	Mechanical only (N=2,562)	Mechanical with mouth rinse use*	Total (N=5,106)	
ige, y				
4	2,449	2,483	4,982	
/lean (SD†)	34.7 (11.1)	34.6 (10.9)	34.6 (11.0)	
Aedian	34.0	34.0	34.0	
1inimum-maximum	(17-73)	(17-74)	(17-74)	
ex, n (%)				
1ale	930 (37.2)	956 (38.4)	1,886 (37.8)	
emale	1,569 (62.8)	1,531 (61.6)	3,100 (62.2)	
ace, n (%)				
Vhite	1,415 (72.5)	1,438 (72.0)	2,853 (72.2)	
Jon-white	538 (27.5)	560 (28.0)	1,098 (27.8)	
moker, n (%)				
'es	485 (19.0)	443 (17.4)	928 (18.2)	
lo	2,072 (81.0)	2,100 (82.6)	4,272 (81.8)	
mokless tobacco use, n (%)				
es	1 (<1.0)	0	1 (<1.0)	
lo	951 (99.9)	996 (100)	1,947 (99.9)	
aseline mean plaque index				
	2,503	2,488	4,991	
lean (SD)	2.8 (0.4)	2.8 (0.4)	2.8 (0.4)	
1edian	2.8	2.7	2.	
/inimum-maximum	(1.7-4.7)	(1.8-4.4)	(1.7-4.7)	
aseline percentage plaque-free sites				
	2,503	2,488	4,991	
1ean (SD)	2.6 (5.5)	2.6 (5.5)	2.6 (5.	
1edian	0.0	0.0	0.0	

flossing, these results suggest that for optimum gingival health, adults should add an antiplaque ... agent to their oral hygiene regimen".5 To provide greater perspective of the situation, Araujo and colleagues (2015) also cited the Boyle et al. (2014) and Gandini et al. (2012) analyses regarding the use of mouth rinse and the risk of common oral conditions.¹ These reviews, which focused on large epidemiologic studies, found that using mouth rinse is advantageous when it comes to reducing the risk of dental plaque, to help protect against gingivitis and caries.¹ Differentiating their meta-analysis from previous reports, Araujo and colleagues (2015) explained that it was created to offer clinicians an alternative way in which to interpret clinical data, as well as to put forward an approach whereby responder analyses and ORs could be used to assess the potential benefits for patients.¹ Ultimately: "The results of the responder analyses suggest that after six months of use, clinicians could expect that approximately ... 37% of participants would have at least 50% of sites without plaque (PI = 0 or 1). In addition, the implementation of a long-term oral care routine that provides seven times greater odds for plaque-free sites ... can be compelling information for the clinician when educating patients on the appropriate oral care routine".1





n = 2.382n = 2,363 100 90 Percentage of patients 80 70 60 50 40 30 20 10 0 10 20 0 . 30 40 . 50 60 70 80 90 100 Percentage of plaque-free sites (baseline)

In conclusion

As stated concisely by Araujo and colleagues (2015), their meta-analysis "allowed for the identification and investigation of protocol differences and the exploration of heterogeneity of the treatment effect, thereby helping clarify the implications of any heterogeneity on the results. An implication of the analyses of heterogeneity appears to be that the studies that more closely mimic real world experience seem to produce larger estimates of the benefit of mouth rinses as part of daily oral hygiene".1 The outcomes of the meta-analysis support the notion that using an essential oil-containing mouth rinse on a daily basis offers a clinically-relevant benefit beyond that offered by mechanical cleaning alone.1 In support of dental professionals motivated to keep their knowledge base as current as possible, the meta-analysis concludes: "[The] addition of daily rinsing with an EO mouth rinse to mechanical oral hygiene provided statistically significantly greater odds of having a cleaner ... mouth, which may lead to prevention of disease progression. Clinicians may find this novel format of data representation for a range of responses helpful in reaching decisions to manage plague [which can therefore help to protect against the development of gingivitis] for all patients".1

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Mechanical only — Mechanical with mouth rinse use

FIGURE 2: Responder analysis of percentage of plaque-free sites (28 studies) intention-to-treat population.

Does anyone need mouth rinse?

Professor Anthony Roberts looks at the evidence surrounding mouth rinses.

Not many members of the public would answer correctly if they were asked to identify the disease with the following attributes:

- recognised by the World Health Organisation as a global problem;
- severe forms are the sixth most prevalent disease of humans affecting over 11% of the world population;
- majority of the human population has a mild form of the disease, which could progress to form what is likely to be the most prevalent disease in humans; and,
- the disease can affect quality of life, self-esteem and is associated with other diseases such as cardiovascular disease and diabetes.

Perhaps they should be forgiven for not getting it right, but should we as dental healthcare professionals? The statements above should have a huge impact but when we realise that this disease is periodontal disease, for multiple reasons, attitudes change. This happens not just in Ireland, but globally. So should we bury our heads in the sand? Of course not. Here in Ireland, the most recent data from the 'Oral Health of Irish Adults 2000-2002' fits snugly within these European and worldwide parameters. From a periodontal perspective, only 8.4% of adults aged 35-44 years are considered healthy. Using the basic periodontal examination (BPE)/ community periodontal index of treatment needs (CPITN) maximum scores as an indicator of periodontal disease, then 4.9% of the same cohort would have bleeding on probing (code 1), calculus (45.2%; code 2), shallow pocketing (33.9%; code 3) and deep pocketing (6.3%; code 4), with a shift towards deeper pocketing in the over 65-year-old cohort (12%; code 4).

Early intervention

There are a broad range of periodontal diseases and conditions, with the majority of cases being plaque-induced conditions and therefore responsive to non-surgical periodontal therapy. Early intervention significantly improves treatment outcomes and yet a mindset is prevalent amongst the profession whereby gingivitis is tolerated, as it is "not significant". A paradigm shift in our appreciation of the importance of gingivitis treatment should have emanated following the fifth European Workshop in Periodontology.

The consensus was clear that patients who develop periodontitis would have previously had gingivitis (Kinane and Attström, 2005). Put another way, if we have a patient who has gingivitis, there is a significant opportunity here to prevent further deterioration into periodontitis. The strategies to manage gingivitis are easily stated, but not as easy for patients to perform and whilst many patients respond to oral hygiene instruction and technique demonstrations, some patients either choose not to perform these techniques or are unable to perform them. As a consequence, the dental healthcare professional is placed in a situation where conventional approaches to management have been attempted without success and there is the head-scratching moment of what to do next. Certainly it is clear that establishing high levels of plaque control is paramount to success in the management of periodontal diseases. When a clinician reaches the point with a patient where there are no further improvements due to sub-optimal plaque control, then it is crucial to examine our own role on their situation:



FIGURES a and b: Clinical images of patient with persistent chronic gingivitis demonstrating: (a) poor oral hygiene and associated gingival inflammation with bleeding after gentle probing; and, (b) following the application of disclosing dye as part of oral hygiene instruction and demonstrations to a patient. The adjunctive use of an EO mouth rinse in addition to manual cleaning may provide additional benefit in managing this patient's gingivitis.

- Did you really spend enough time with the patient?
- Did the patient demonstrate to you at the chair side that what you were asking them to do was realistic and achievable, etc.?

Was the importance of plaque control emphasised sufficiently? If the answers to these (and similar) questions are positive and yet the patient's oral hygiene routine was insufficient to improve their plaque levels, then adjunctive therapies are a potential avenue. In 2015, the 11th European Workshop in Periodontology published its findings across the broad theme of 'Effective Prevention of Periodontal and Peri-implant Diseases', with working group 2 evaluating the evidence associated with the 'Primary prevention of periodontitis – managing gingivitis' (Chapple *et al.*, 2015; Serrano *et al.*, 2015). These workshops evaluated the research evidence to substantiate or refute a key question: in humans with gingivitis, what is the efficacy of chemical plaque control? Indeed, the question was further divided into three sub-questions

Indeed, the question was further divided into three sub-questions with the conclusions reached based on the systematic review and meta-analysis:

- Do chemical anti-plaque agents within mouth rinses and/or dentifrices, used adjunctively with mechanical plaque removal, provide additional improvements in gingival inflammation and plaque levels?
 - Yes when used as an adjunctive therapy to conventional manual tooth brushing with a fluoridated dentifrice.
- Does the delivery format of the chemical agent employed (dentifrice and/or mouth rinses) impact upon its efficacy in reducing gingival inflammation and plaque levels?
 - Yes as an adjunct to tooth brushing, the magnitude of improvement in gingival inflammation and plaque levels was larger in mouth rinse than delivered by dentifrice only.
- Should adjunctive chemical anti-plaque agents (dentifrice and/or mouth rinse) be recommended in addition to mechanical oral hygiene measures for routine daily use to manage gingival inflammation and prevent plaque accumulation?
 - Yes as an adjunct to tooth brushing.

Which mouth rinse?

So, the conclusions from the European workshop are clear in advocating mouth rinses as an adjunct (not replacement for) mechanical brushing. But which mouth rinse should be recommended? Indeed, this is a question that clinicians are asked regularly and how should we answer?

The response to such a question really should be: "different mouth rinses are recommended in different clinical situations", as there is no single mouth rinse that can be recommended for all circumstances. In 2014, Boyle *et al.* published a systematic review and meta-analysis on the value of mouth rinses and demonstrated clear evidence of benefit in using mouth rinses to reduce dental plaque and gingivitis as an adjunct to standard care.

Of interest were the effects of different mouth rinses over time, with evidence suggesting that chlorhexidine products were of greater value in studies of three-month duration (or less), whereas essential oil (EO) mouth rinses had greater value beyond six-month usage. Indeed, this would reflect my own personal prescribing pattern, where I find value in recommending chlorhexidine adjuncts for short-term acute conditions or post-surgical use, whereas for longer-term daily adjunctive usage I recommend EO mouth rinse. An interesting clinical question is: "Can we quantify the benefit for patients"? After all, if we are recommending products to our patients, we should be in a position to determine the level of improvement that we should expect to see. In 2015, a meta-analysis of the effects of EO mouth rinses produced a 'responder analysis', which answered this guestion following daily use of EO mouth rinse at six months (Araujo et al., 2015). In the analysis, of the patients using mechanical cleaning alone, 14.4% had up to 50% of their mouths classed as healthy sites, whereas, of patients using EO mouth rinse, 44.8% had up to 50% of their mouths classed as healthy sites. What would you want for your waiting room; 14.4% or 44.8% of patients having 50% healthy sites?

Conclusion

We have a sizable population of patients in Ireland that have gingival inflammation and an opportunity to prevent susceptible patients deteriorating into periodontitis by improving personal plaque control. In those patients with periods of sub-optimal plaque control, clinicians should definitely consider a mouth rinse as an adjunct to their brushing regime. In recommending a mouth rinse, clinicians should be mindful of the diagnosis so that they prescribe appropriately and retain mechanical plaque control as the core message to patients.

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Biography:

Professor Anthony Roberts is Professor/Consultant in Restorative Dentistry at Cork University Dental School and Hospital. He is Head of the Restorative Department, Clinical and Academic Lead of the Dental Hygiene Programme and his clinical service and academic focus is in the field of periodontology.

Effecting change

In conclusion, we present an overview of the evidence available to support dental care professionals considering whether to update their recommendations to patients, to influence positive change over their everyday oral health habits.



As written by Araujo and colleagues (2015) in their meta-analysis: "Recommendations on oral hygiene practices from dental practitioners have largely focused on the mechanical methods of daily oral hygiene, including tooth brushing and interdental cleaning as standards to achieving and maintaining good oral health. However, systematic reviews and meta-analyses have reported that mouth rinses can provide a benefit beyond mechanical oral hygiene alone in preventing plaque accumulation".¹

This, in turn, can help to prevent the development and progression of ginigivitis.¹ Building on these findings, 2015's Araujo *et al.* meta-analysis became the first to make use of long-term clinical data incorporating responder analysis of both published and unpublished results of the beneficial aspects of using an essential oil-containing mouth rinse, alongside brushing and interdental cleaning, in maintaining gingival health. The significance of the results is further bolstered by the fact that the reviewers used responder analysis of healthy sites, plaque-free sites and plaque index (PI) reduction to demonstrate the treatment effect of a mouth rinse containing essential oils on plaque within a six-month period (between dental visits).¹

In further consideration of the strength of the study, Araujo and colleagues (2015) stated: "One of the main strengths shown here is the fact that data developed from over 30 years of research were generated by using the same clinical research method applied to the protocols of all studies, generating a unique database with over 5,000 participants, from three different countries, aged 18 years and older, both sexes, and with other demographic characteristics that reflect a diverse population".¹

Essentially, the meta-analysis established the oral health benefits of using an essential oil-containing mouth rinse as an adjunct to mechanical cleaning.¹

Responder curves* plotted by the authors demonstrated that a mean average of 36.9% of subjects using mechanical methods with essential oil-containing mouth rinses (MMEO) experienced at least 50% plaque-free sites after six months, compared to just 5.5% of patients using mechanical methods alone (MM).¹

A further responder curve for percent reduction in whole-mouth mean PI indicated that 83% of MMEO participants achieved a 20% reduction in PI from baseline in the six months of the study, compared to only 25% of MM subjects.¹ (*See Table 1 for further information.*) In principle, this meta-analysis demonstrates statistically significant greater odds of patients achieving a "cleaner ... mouth, which may lead to prevention of disease progression" if they add an essential oil-containing mouth rinse as an adjunct to their mechanical cleaning regimen on a daily basis.¹

*Responder curves plot the proportion of participants within each treatment group achieving at least the given percentage of healthy sites, for all possible percentages of healthy sites (0-100%).

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Table 1: Araujo et al. (2015) meta-analysis plaque-related results.

Variable	Effect measure	Estimate (MMEO vs MM)	Estimate 95% confidence interval
Plaque-free sites	Odds ratio	7.8**	[5.4, 11.2]
Percent change in PI	Difference in means	-27.7%	[-32.9%, -22.4%]

** Odds ratio >1 indicates greater odds of having healthy sites (or plaque-free sites) for MMEO than MM.