The Angler Fish family, Osteichthyes. The female has a piece of dorsal spine that protrudes above the mouth, like a fishing pole. The teeth are translucent, conical and needle sharp, ideal for prehension of prey. They are ankylosed to the margins of the jaws but also to the vomer, the pharynx and the palate. The dentition is polyphyodont, that is, continually replaced. Interesting that they are ankylosed!
New LISTERINE® Advanced White
Helping give oral health a brighter future

Unique multi-action formula, proven to improve the appearance of teeth in **two weeks**

- Helps lift stains
- Helps prevent new stains forming
- Protects against plaque bacteria
- Fluoride helps strengthen teeth

LISTERINE® Advanced White should be used twice daily (10 ml twice daily for 60 seconds) after brushing as an adjunct to mechanical cleaning.
CONTENTS

292 Sugar tax... sweet benefits? - WG Evans

OBITUARY

293 Ronald George Melville - J Eloff

COMMUNIQUE

294 Caries and Company

RESEARCH

298 Factors affecting the preparation, constituents, and clinical efficacy of leukocyte- and platelet-rich fibrin (L-PRF). - MT Peck, D Hiss, L Stephen

304 In vitro antimicrobial comparison of three commercially available chlorhexidine-based oral rinses - BM Abdalrahman, H Holmes, MT Peck, NJ Basson

308 Availability, indications for use and main ingredients of mouthwashes in six major supermarkets in Gauteng - LM Sykes, M Comley, L Kelly

CLINICAL REVIEW


COMMUNICATION

319 Statistical terms Part 2: Principles of research study design: Understanding the options, indications and limitations - LM Sykes, F Gani, HD Dullabh

SEDATION

326 Continuous education in sedation 3: Obesity and the sedation practitioner- JA Roelofse, C Lapere, Y Omar

RADIOLOGY CASE

328 Maxillo-facial radiology case 143 - CJ Nortjé

ETHICS CASE

329 The motivation to be ethical - WG Evans

CLINICAL WINDOW

330 What’s new for the clinician? - V Yengopal

CONTINUOUS PROFESSIONAL DEVELOPMENT

334 CPD questionnaire

BUSINESS DIRECTORY

336 Listing of dental products and service providers

CLASSIFIEDS

338 Notice - Small advertisements on the new web platform
We have turned sugar, a biochemically harmful substance, into a comfort food, using it as a treat for rewarding good behaviours. - Frank Lipman.

It took a little time reading the various blogs on the proposed South African sugar tax, all those that I read targeted obesity as the basic reason for the introduction of the tax… but I did find the comment I sought, yes it is there… a recognition that a reduction in caries may also be a favourable consequence of a reduction in sugar intake.¹

If the tax does pass into law, South Africa will be joining a select group of countries who have either already implemented, or are contemplating the introduction of, a Sugar Tax, Denmark, France, Mexico, Norway, United Kingdom, St Helena, several states in the USA. It appears that in those countries the debate has also centred around obesity (and Type 2 diabetes) rather than caries.² A letter sent to the British Dental Journal, 220, April 2016, is relevant and is quoted: “Sir, the BDA should congratulate George Osborne on imposing a tax on sugary drinks in the recent Budget in an attempt to reduce the incidence of a major disease in the UK. Unfortunately he gave that disease the wrong name. It should have been dental caries rather than obesity! This is one disease where evidence supports sugars as having a contributory role. Obesity, however, is not a disease but a disorder with just one cause: calorie intake exceeding calorie expenditure.” (Rebutting the decision to impose the sugar tax, a UK MP described the legislation as “patronising, regressive and the nanny state at its worst”³)

It is an enduring proof of the commitment of the dental profession to high ethical standards that every effort continues to be made to eradicate the very disease on the management of which a significant proportion of our practice income is derived. Most certainly the profession will be keenly interested in the debate about the proposed tax on sugar. It may be observed that a second endeavour aimed at controlling caries has also over the years been the subject of intense controversy, fluoridation. Conflate the two, and we must recognise that the advent of fluoride, notably in toothpastes, has effected a change in caries experience, and any reduction in sugar intake may not then have the full effect which could otherwise have been expected.

The Journal of Dental Research published in 2013 a systematic review on the effects of restricting sugars intake on caries incidence.² Of the 55 eligible studies, 47 reported at least one positive association between sugars and caries. There was some evidence that the quantum of sugars ingested had an influence on the incidence of caries. This finding has been confirmed by a study on adults, conducted in Finland and reported in 2016 as concluding that “the amount of, but not the frequency of, sugars intake was significantly associated with DMFT.”⁴ However, that association was weaker in subjects who used fluoride toothpaste daily.

Now consider just how much sugar is actually taken in by sipping fruit juices, juice drinks and smoothies. A research team in the UK introduced a study with the comment “Free sugars are the most important dietary cause of dental caries”.⁵ The team investigated the sugar content of fruit juices, juice drinks and smoothies, reporting results which may be of concern. Sugar content ranged from 0 to 16 grams per 100ml. Of a total of 203 products surveyed, 85 contained at least 19 gms of sugars, an amount which is the entire recommended daily intake of sugars for a child in the UK. Smoothies contained on average 26gms per 200ml portion, translated into more than six teaspoons of sugar.

The etiology of dental caries is being revealed as truly complex. Coming from The Centre for Advanced Research in Public Health in Spain is the news that Streptococcus mutans, long considered the main causative agent, “accounts for only a tiny fraction of the bacterial community.”⁶ The conclusion is based on DNA and RNA studies that support the concept that multiple micro-organisms “act collectively in initiating and expanding the cavity.” A disturbing conclusion is that antimicrobial therapies are unlikely to be effective against this polymicrobial disease.

The imposition of a tax on sugary drinks is certainly likely to result in a reduction of consumption. The corollary may well be a switching to alternative foods which are also high in calories, such as 100% fruit juices and chocolate milk, which it has been pointed out, at least have some nutritional value (Wikipedia, Sugary Drinks Tax).⁶

Having suffered from a heart condition for some time, Ronnie Melville passed away peacefully on 15 June 2016 at his home in Alphenvale, Constantia.

Ronnie was born at Olifantshoek, Northern Cape, on 21 January 1932. He was educated at Kimberley Boys High, where he was a prefect, and also played 1st team rugby. He enrolled in the Faculty of Dentistry at the University of the Witwatersrand in 1949, and was awarded the Degree BDS in 1953. His post-graduate orthodontic training was undertaken at the Eastman Dental School in London. On his return to South Africa, Ronnie acted as a locum in the practice of the late Dr Barnet Braude, where he met his future wife Rene and her daughter Melodie. Ron and Rene got married in 1961, and moved down to Cape Town, where Ronnie took over the practice of Maurice Berman.

Ronnie was a Foundation Member of the South African Society of Orthodontists, attending its Inaugural Meeting in September 1964. During the first few years of its existence, the Executive Committee of SASO always resided either in Johannesburg or Pretoria. When it was first moved down to Cape Town, Ronnie was elected President, a post he filled with great distinction.

In 1970, Ronnie and Dr B Joffe were approached by the late Professor J van der Sandt de Villiers (at that time Dean of the Faculty of Dentistry at the University of Stellenbosch) with a view to becoming part-time Lecturers at the University, in order to train three new Orthodontists. Both agreed, and in 1974 three Orthodontists duly graduated. Ronnie and Dr Joffe continued in this role for many years, and some of their graduates attained great distinction overseas.

Ronnie was an outstanding Clinician, conducting a Private Practice for over 40 years. The lovely smiles of many Cape- tonians can be traced back to “braces from Dr Melville”. He was also a Foundation Member of an informal Study Group, aiming to promote a high standard of orthodontics in the Western Cape.

Ron and Rene lived life to the fullest. They collected antiques, and also loved travelling. He attended many Congresses and post-graduate Courses overseas. He was a faithful and caring husband to Rene, and felt devastated by her death in 2009. Among his hobbies was an interest in cooking, and he attended several culinary courses, both overseas and in South Africa. He kept fit with a morning exercise routine, which was eventually curtailed by hip problems. He also served as a Trustee in Alphenvale, where he spent his last few years. He enjoyed rugby, and was especially proud of his grandson, who was appointed coach of a “Super 12” Australian team.

Ron was a devoted family man. He leaves his daughter Melodie, son-in-law Tiger, four grandchildren and nine great-grandchildren.

The death of Dr Ron Melville constitutes a huge loss for the Dental Profession in general, and the Orthodontic Speciality in particular. Sincere condolences are extended to his family and friends.

Dr John Eloff
In the continuing battle against Oral Disease, the endeavour to control dental caries and periodontal disease ranks paramount, correctly so, for these diseases are historically considered by WHO as the “most important global oral health burdens”. Worldwide, caries affects nearly 100% of adults while periodontal disease ranks second in frequency only to the common cold. The focus during Oral Health Month will be on the motivation of the population to commit to the daily routines proven to have preventive influence on these afflictions. To this end the Association in conjunction with Colgate, sponsor of the Month, will arrange free oral examinations at the major malls throughout the country, together with the vital and yet simple instruction on oral health care. The question is put: caries and gum disease can be prevented, why not prevent?

But there is a wider dimension. The mouth is the portal to the body, it serves as the barbican, the outer defence to invasion. It is also a place of signals, for many systemic diseases have manifestations in the oral cavity. A July 2016 paper (http://emedicine.medscape.com/article/1081029-overview#showall), detailed a rather awesome list of illnesses which have signs and symptoms appearing in the mouth. Gastrointestinal, Nutritional, Haematological, Connective tissue disorders, Pulmonary conditions, Neurologic diseases, Endocrine diseases, Drug induced conditions, let us not omit HIV, amyloidosis, Kaposi sarcoma.

And lurking in this array is the possibility that oral infections may be the cause of Infective endocarditis. The dilemma of the role and responsibility of the Oral Health Care Team in the prevention of this serious problem has been considered by a Working Party of the Association. Their Report forms an ineluctable part of the commitment of the Oral Health Month. It is reproduced here, with appreciation to those who spent time and effort in their deliberations on all the sometimes conflicting evidence.

PREVENTION OF INFECTIVE ENDOCARDITIS BEFORE DENTAL PROCEDURES

SA Heart Position Statement, endorsed by the South African Dental Association

Infective endocarditis (IE) is a rare but severe disease and occurs when circulating microorganisms colonize cardiac valves (both natural and prosthetic), the endocardium, or intracardiac devices. Certain preexisting conditions render an individual more susceptible. Because of the serious associated morbidity and mortality, prevention of IE is an important clinical issue.

IE in South Africa (and other developing countries) is predominantly a disease of young patients with rheumatic heart disease (RHD) and carries a very poor prognosis. In contrast, IE in Europe / North America, (where guidelines and indications for antibiotic prophylaxis have been reduced) have a different spectrum of risk factors. These patients are older; suffer mainly with degenerative valve disease / mitral valve prolapse. IE may also occur as a result of invasive health care-associated procedures or in the setting of prosthetic valves and implantable cardiac devices.

The University of Stellenbosch conducted a three-year prospective epidemiological study of IE in the Western Cape. RHD was the major predisposing condition in 76.6% and 17% of the patients had prosthetic valves. Degenerative valve disease, intravenous drug use and HIV infection were not important risk factors. Outcome was extremely poor; six-month mortality was 35.6% (much higher reported international rates of 6 to 27%), while nearly half of the patients required subsequent valve replacement. Cardiac failure developed or worsened in just over 75%, which may in part be related to late referral and other inefficiencies in local health care services.

RHD markedly elevates the risk of IE. In a review of cases in the northern territories of Australia, the relative-risk for IE was 58, in those with RHD. This association is well documented in the developing world, but is no longer seen in many higher income countries, where the prevalence of rheumatic fever has declined, and the use of intravenous recreational drugs is more common.

It is obvious that the first step in the prevention of IE in developing countries would be to reduce the pool of patients who are susceptible to this infection. This would require effective programs to prevent rheumatic fever (and recurrences) and, hence, RHD. Regrettably, this has not happened.

The rationale for antibiotic prophylaxis is based on the assumption that bacteraemia subsequent to medical procedures may cause IE, particularly in those with predisposing cardiac disease; prophylactic antibiotics might prevent IE by minimizing bacteraemia, or by altering bacterial properties leading to reduced adherence to the endocardium. This concept led to the recommendation for antibiotic prophylaxis in a large number of patients with predisposing cardiac conditions who were undergoing a wide range of procedures.

Antibiotic prophylaxis has been accepted for decades, even though the efficacy has not been confirmed in a prospective randomized controlled trial. It is also unlikely that such a study will ever be conducted. Assumptions are based on non-uniform expert opinion, findings from animal
models, case reports and contradictory observational studies.1-3,11-20

In the majority of those who suffer IE, no potential index procedure can be identified beforehand. The estimated risk of IE following dental procedures is very low.1,2,12 Prophylaxis may therefore avoid only a small number of IE cases, as shown by estimations of one case of IE per 150,000 dental procedures (in intermediate risk patients) with prophylaxis and one per 46,000 for procedures unprotected by antibiotics.12

Bacteria originating from the mouth account for a significant proportion of cases of IE. Transient bacteraemia occurs not only following dental (and other) procedures, but also after routine oral activities such as tooth brushing, flossing and chewing. The high incidence and cumulative effect of low-grade daily episodes, especially in those with poor oral hygiene, is a more important risk factor than sporadic bacteraemia occurring with a single invasive / dental procedure. Patients with underlying heart conditions that predispose to bacterial colonization are therefore exposed to a low but continual lifelong risk of developing IE. Eliminating gingivitis would reduce the incidence and degree of spontaneous bacteraemia and hence IE.1-3,11-20

Oral health in South Africa is generally quite poor and addressing this at policy level will have more of an impact on IE prevalence than antibiotic prophylaxis.2 A recent SA study concluded that inadequate attention is paid to the maintenance of oral hygiene in patients with severe rheumatic heart disease (RHD) requiring cardiac surgery.21

All Expert Committees on IE prevention agree that the maintenance of optimal oral hygiene (by regular professional dental care and the appropriate use of manual, powered, and ultrasonic toothbrushes; dental floss; and other plaque-removal devices) is the most effective intervention for the prevention of IE of oral origin.1-3,11-20

It is recommended that patients with valvular heart disease be referred to a dentist / oral hygienist for ongoing treatment and advice. Patients and attending clinicians need to be educated in this regard. A medical history should be obtained from every patient before any dental treatment. A full oral examination, including dental radiography, should be performed. Further examinations at frequent and regular intervals will ensure maintenance of good oral hygiene, as well as early diagnosis and treatment of any oral infections. It is advisable to issue patients with a warning card to record their cardiac condition, drug therapy and suggested prophylactic measures to be taken before dental treatment.2,21,11,12

Patients should be informed about their valve disease and the possible development of what constitutional symptoms might be associated with IE. They should be advised to seek prompt medical care in the event of suspicious symptoms such as fever that is more than transient.

SA Heart is an affiliated member of the European Society of Cardiology (ESC) and hence adopts the practice guidelines of the ESC as its own. In 2009, the “Guidelines on the Prevention, Diagnosis, and Treatment of Infective Endocarditis” was endorsed by the European Society of Clinical Microbiology and Infectious Diseases, and by the International Society of Chemotherapy for Infection and Cancer.11 The task force justified revision of their previous position with respect to prophylaxis of IE. The existing evidence did not support the extensive use of antibiotic prophylaxis recommended in previous guidelines. The intention was to avoid extensive, nonevidence-based use of antibiotics for all at-risk patients’ under-going interventional procedures, but to limit prophylaxis to the highest-risk individuals. The indications for antibiotic prophylaxis for IE were therefore reduced in comparison with previous recommendations. The recently updated “2015 ESC Guidelines for the Management of Infective Endocarditis” maintains the same principles and recommendations.12

The ESC Guideline states that antibiotic prophylaxis should be limited to those with the highest risk of IE (Table 1), undergoing the highest risk dental procedure (Table 2). High-risk is defined as those with underlying cardiac conditions associated with the greatest risk of adverse outcome from IE, and not necessarily those with an increased lifetime risk of endocarditis.12

Table 1: Cardiac conditions at highest risk of IE for which prophylaxis is recommended, when a high-risk procedure is performed:

<table>
<thead>
<tr>
<th>Patients with a prosthetic valve or prosthesis material used for cardiac repair have a higher risk of IE, greater mortality and develop more complications than those with native valve and an identical pathogen; this recommendation also applies to transcatheter-implanted prostheses.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with previous IE have a greater risk for new IE, higher mortality and develop more complications than patients with a first episode of IE.</td>
</tr>
</tbody>
</table>

Prophylaxis was not recommended for any other form of native valve disease, with a small but increased life-time risk of IE: including the most commonly identified conditions, bicuspid aortic valve, mitral valve prolapse, and calcific aortic stenosis.1,12

Although the American Heart Association / American College of Cardiology recommend prophylaxis in cardiac transplant recipients who develop cardiac valvulopathy,16 this is not supported by strong evidence and is not recommended by the ESC Task Force.12

It is the opinion of SA Heart that recently published guidelines cannot be automatically applied in developing countries where RHD is common and oral hygiene is poor. We concede that the evidence in favour of prophylaxis is not robust; however patients with RHD (undergoing dental procedures) represent a higher risk for IE (and poor outcome) and should receive antibiotic prophylaxis prior to the dental procedures listed below (Table 2). This recommendation is made, given our prevailing circumstances and the absence of evidence of significant harm for a potentially effective intervention, for the prescribing of oral amoxicillin. Antibiotic prophylaxis should be prescribed after stressing the role of good oral health and informing patients of the ESC guidelines, and why the approach differs in South Africa.

Guidelines from other countries with populations with similar high RHD prevalence, have also kept RHD on the
HIV infection is not associated with an increased risk of IE. A significant number of patients with IE may be coincidentally HIV infected, given the high prevalence of both HIV and RHD in Africa. In a South African prospective observational study that examined the risk factors for IE, only one of their cohort of 92 patients was HIV seropositive. The main risk factors included RHD, in addition to prosthetic valves, CHD, and a previous history of IE. Antibiotic prophylaxis in the setting of HIV is therefore indicated only in those with high-risk cardiac lesions / factors (Table 1), undergoing the procedures outlined in Table 2.

The use of dental implants raises concerns with regard to potential risk due to foreign material at the interface between the buccal cavity and blood. Very few data are available. The opinion of the ESC Task Force is that there is no evidence to contraindicate implants in all patients at risk. The indication should be discussed on a case-by-case basis. The patient should be informed of the uncertainties and the need for close follow-up. Antibiotic prophylaxis should only be considered for patients at highest-risk described in Table 1 (in addition to those with RHD) undergoing any of the at-risk procedures (Table 2), and is not recommended in other situations. Oral streptococci are the main targets for prophylaxis. A single dose of antibiotic should be given before the procedure. There is no proven value to administering a follow-up dose six hours later. Table 3 summarizes the main regimens of antibiotic prophylaxis recommended before dental procedures. Fluoroquinolones and glycopeptides are not recommended due to their unclear efficacy and the potential induction of resistance.

Antibiotic administration carries a small risk of anaphylaxis, which may become more significant in the event of widespread use, however the risk of lethal anaphylaxis is extremely low when using oral amoxicillin. In fact no fatal case has been reported (over at least a 35-year period) after oral administration for IE prophylaxis. Curative antibiotics must be prescribed for any focus of bacterial infection. Periodontal and endodontic infections are mainly due to gram-negative bacteria. Merely covering these with amoxicillin will not be effective, and broader therapy is required. The choice of antibiotics should be determined and administered as instructed by local practice. The ESC also strongly recommends that potential sources of dental sepsis (which may pose a risk for post-operative sepsis and IE) should be eliminated at least two weeks before implantation of a prosthetic valve, other intracardiac or intravascular foreign material, unless the procedure is urgent.

In addition to antibiotic prophylaxis of IE, pre-procedural antiseptic mouth rinses (chlorhexidine or povidone–iodine) may reduce the incidence or magnitude of bacteremia occurring during invasive dental procedures. The results of studies of “oral degerming” have however been variable, and there is no conclusive evidence for this approach. The ESC protocol makes no reference to the use of antiseptic prophylaxis before at-risk dental manipulation.

Further research is required to determine the effectiveness of preprocedural mouth rinsing and to investigate new antiseptic protocols.

Other national / association guidelines on IE prophylaxis have been revised. The American Heart Association (AHA) guidelines, as well as those of the working party of the British Society for Antimicrobial Chemotherapy (BSAC) are similar to the ESC recommendations.

In 2008 the National Institute of Health and Clinical Excellence (NICE) radically recommended complete cessation of antibiotic prophylaxis, in any patient with valvular heart disease, whatever the risk. It was concluded that in the absence of prospective, randomized trials, there is a lack of proof for antibiotic prophylaxis, which is cost-ineffective. As a result, the United Kingdom is now the only place that does not recommend antibiotic prophylaxis for high-risk individuals; and has been a particular cause for concern amongst many dental practitioners. In addition Dayer et al, have recently reported a substantial fall in the prescribing of antibiotic prophylaxis in the five-years following the NICE recommendations, as well as a highly significant increase

<table>
<thead>
<tr>
<th>Situation</th>
<th>Antibiotic</th>
<th>Single dose 60 minutes before procedure – p.o or i.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No allergy to penicillin / ampicillin</td>
<td>Amoxicillin/ ampicillin</td>
<td>50mg/kg PO Adults 2g, Children 600mg 20mg/kg</td>
</tr>
<tr>
<td>Allergy to penicillin / ampicillin</td>
<td>Clindamycin</td>
<td>20mg/kg</td>
</tr>
<tr>
<td>Alternatively cephalexin 2g i.v. for adults or 50mg/kg i.v. for children; cefazolin or ceftriaxone 1g i.v. for adults or 50mg/kg i.v. for children. Cephalosporins should not be used in those with a history of anaphylaxis, angio-oedema or urticaria after penicillin or ampicillin due to cross-sensitivity.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
in the incidence of IE. There were 419 more cases of IE per year, than would have been expected from projection of the pre-NICE trends. These findings require cautious interpretation with respect to confounding factors, and in particular to an increase in healthcare-associated IE. Microbiological details were also not reported. It is therefore not clear whether the increased incidence of IE was due to bacteria covered by antibiotic prophylaxis or not. After further review of the effectiveness of prophylaxis against IE, NICE (www.nice.org.uk) has since found no need to change their existing guidance. They concluded that the longstanding increase in the incidence of IE is not well understood, and may be due to other factors.

The risk assessment suggests that it would be safer to recommend antibiotic prophylaxis, while waiting for a randomized controlled trial. It is likely that cumulative regular small bacteraemias from daily activities pose a significant threat to patients at risk of IE; this does not mean that occasional large bacteraemias from invasive dental procedures do not. Our aim should be to minimize all causes of bacteraemia in susceptible individuals. The evidence suggests that antibiotic prophylaxis may prevent a number of cases of IE, and at least for those without a history of penicillin allergy, oral amoxicillin prophylaxis is safe, with a low likelihood of anaphylaxis.

SA Heart recommends antibiotic prophylaxis to individuals with the greatest risk of an adverse outcome with IE. Outlined in Table 1, in addition to those with RHD, undergoing the procedures described in Table 2. We again emphasize the maintenance of optimal oral health, which is likely to play the most important role in protecting those at risk of IE, in addition to the education of patients in this regard. There should be close cooperation between the dental practitioner / physician / pediatrician / cardiologist / cardiac surgeon as to who should receive prophylaxis or not.

References
Factors affecting the preparation, constituents, and clinical efficacy of leukocyte- and platelet-rich fibrin (L-PRF).

**ABSTRACT**
Platelet-rich fibrin (PRF) was first introduced by Choukroun et al, in 2001 as a method of concentrating autologous human leukocytes, platelets and fibrin for autotransplantation into surgical wound sites to accelerate healing. Even though several clinical reports have documented the use of L-PRF, controversy still exists with regards to many aspects of this biomaterial. Diverse publications report the use of non-standardised methods to prepare L-PRF, resulting in variable clinical results. The impact of the type of centrifuge, as well as of the growth factor release kinetics, have recently been studied and have yielded new insights into the structure and function of L-PRF. The presence of bone morphogenetic proteins as well as stem cells has also been documented. In this report we analyse various factors affecting L-PRF preparation and its constituents and highlight some of the controversies surrounding the biomaterial.

**INTRODUCTION**
Platelet-rich fibrin (PRF) was first introduced by Choukroun et al. in 2001 as a method of concentrating autologous human leukocytes, platelets and fibrin for autotransplantation into surgical wound sites to accelerate healing.1 This method of concentrating blood platelets was different to previous techniques in that it centrifuged the collected blood only once, no anticoagulant agents were added, and leukocytes and fibrin were deliberately included in the final product. Previous similar techniques had sought to concentrate platelets only, with little consideration for the other constituents.2,3 Choukroun’s protocol (Process protocol, Nice, France) was simple and essentially consisted of collecting venous blood into dry glass tubes, after which the tubes would be spun at a low centrifuge speed to allow the blood to separate into the constituents.4 This resulted in three distinct layers forming in the blood collecting tube, i.e. a red blood cell layer at the bottom of the tube, an acellular layer at the uppermost part of the tube, and a leukocyte- and platelet-rich fibrin (L-PRF) layer formed in the middle of the tube.4 The L-PRF layer was considered as the active biomaterial and has, since its development, been promoted as an agent that accelerates wound healing and tissue regeneration.5 Even though several clinical reports have documented the use of L-PRF in oral and extra-oral surgical procedures, controversy still exists with regards to several aspects of this biomaterial. In this report we set out to highlight some of these debates.

**ACRONYMS**
- BMPs: bone morphogenic proteins
- G-CSF: granulocyte colony-stimulating factor
- HUVEC: human umbilical vein endothelial cells
- IGF-1: insulin-like growth factor-1
- MSC: mesenchymal stem cells
- PRF: platelet-rich fibrin
- PDGF-AB: platelet derived growth factor AB
- RCF: relative centrifugal force
- RPM: revolutions per minute
- VEGF: vascular endothelial growth factor

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In an attempt to distinguish various platelet concentrates from each other, Dohan Ehrenfest et al. used three key parameters i.e.; the preparation process, the pharmacological properties, and the characteristics of the final material to establish a functional classification.6 By applying specific criteria to these parameters, the authors were able to classify platelet concentrates into four distinct categories (Table 1).8

**Factors affecting the preparation, constituents, and clinical efficacy of leukocyte- and platelet-rich fibrin (L-PRF).**
Although this classification elucidates and simplifies the distinction of various platelet concentrates, it is not the only existing proposed system to classify platelet concentrates. However, Dohan Ehrenfest’s classification is widely quoted in the literature and at the time of its publication, in 2009, Choukroun’s PRF was the only platelet concentrate included in the category of L-PRF.

As the popularity of Choukroun’s protocol for the production of L-PRF grew, publications appeared describing processes that purported to produce L-PRF. However, none had applied the exact criteria as described by Choukroun (Process protocol, Nice, France). It is unclear whether L-PRF produced by other than the Choukroun method can be classified as a true L-PRF. Publications incorrectly use the terms L-PRF and Choukroun’s PRF interchangeably, even though the exact method as described by Choukroun has not been used to produce the platelet concentrate. This has lead to incorrect assumptions and a clear, unequivocal, classification of platelet concentrates that is universally accepted is therefore sought. For the purposes of clarity, the following proposed terminology will be used throughout this article:

- **L-PRF** – Leukocyte- and platelet-rich fibrin. Defined as a broad and all-inclusive category that is used to describe a mixed platelet, leukocyte and fibrin concentrate prepared using no-anticogulants and a single spin centrifuge technique.

- **L-PRF (C)** – Leukocyte- and platelet-rich fibrin (Choukroun type). Defined as a specific leukocyte and platelet-rich fibrin prepared using Choukroun’s protocol (the equipment and the preparation method follows the exact recommended protocol as outlined by Choukroun).

- **L-PRF (I/E)** – Leukocyte- and platelet-rich fibrin (Intraspin/ EBA 20 type). Defined as a specific leukocyte and platelet-rich fibrin prepared using either an Intraspin (Intra-Lock International, Boca-Raton, FL, USA), or EBA 20 (Andreas Hettrich GmbH & Co KG, Tuttingen, Germany) centrifuge and following the recommended protocol as outlined by Dohan Ehrenfest et al.

- **L-PRF (O)** – Leukocyte- and platelet-rich fibrin (Other). Defined as a leukocyte- and platelet-rich fibrin prepared in a manner similar to L-PRF (I/E) and L-PRF(C) production, but using a non-purpose-built centrifuge.

### TECHNIQUES AND METHODS OF PRODUCING L-PRF

Choukroun’s method of producing L-PRF was intended to be a simple technique that would allow for the production of high quality platelet and leukocyte concentrates, which could be prepared easily and used in everyday healthcare facilities. This method specified the use of a PC-02 table centrifuge and a collection kit from Process (Nice, France). Further, the blood sample was to be taken without anticoagulant in 10-ml blood collecting tubes which were then immediately centrifuged at 3000 revolutions per minute (RPM) (approximately 400g of relative centrifugal force (RCF)) for 10 minutes. The formed L-PRF clot could then be removed from the blood collecting tube and used as required.

The influence of centrifuge type and RCF on L-PRF

Even though Choukroun’s protocol was clearly outlined, a number of publications were subsequently produced that reported on procedures which did not follow the prescribed methods. Key to these differences was the failure to use a specific centrifuge (PC-O2, Process, Nice, France) and a specific RCF (400g). In many publications, the RCF was not reported, and instead the centrifuge speed and time was quoted. This is a significant deviation from the protocol since the influence of the RCF is underestimated and not considered.

Relative centrifugal force (RCF) can be defined as the amount of accelerative force applied to a sample in a centrifuge. It is not equivalent to revolutions per minute (RPM) and the terms cannot be used interchangeably. Centrifuges work by putting samples in rotation around a fixed axis, thereby applying an accelerative force perpendicular to the axis. This resultant force causes the separation of various elements in the sample based on the individual weight of the sample elements and is the basis for blood separation techniques carried out by laboratory centrifuges. RCF is measured in multiples of the standard acceleration due to gravity at the Earth’s surface (x g) and is based on two specific variables i.e. how wide the rotor is and how fast it is moving. The radius of the centrifuge or rotor is as critical to the process of producing a specific RCF as is the RPM. Only those processes where the RPM and the rotor radius are identical are comparable and any deviations from these criteria may result in inaccuracies. Consequently, RCF will only be constant for centrifuges with the same rotor radii. Results derived from investigations using centrifuges with different radii will produce differing RCF’s. Therefore one cannot assume that all centrifuges used for producing L-PRF and spinning at 3000 RPM will produce an RCF of 400g. This is a significant parameter that is often misunderstood. RCF is critical to the production of L-PRF and must be calculated for each centrifuge used, especially if this parameter is not pre-set on the machine.

The effect of varying RCF’s during platelet concentrate preparation was recently reported. Amable, Carías, Teixeira et al. analysed various factors affecting the production of Platelet-rich plasma (PRP), and showed that changes in RCF significantly influenced the platelet yield even though other parameters such as period of centrifuge time as well as temperature remained constant. Dhurat and Sukesh reviewed several PRP preparation methods. Based on their analysis, it was shown that the use by authors of different RCF parameters resulted in variations in the platelet yields of the PRP produced. More pertinently, scrutiny of the literature reveals that although PRP has been clinically used for several years, no standardised preparation protocol has yet been documented. With regards to the preparation methods of L-PRF that are published in the literature, similar inconsistencies exist.

Other centrifuge parameters that may influence L-PRF preparation

A series of articles recently published by a team of authors reported on investigations into the effect of various parameters on the quality of the resultant L-PRF5,19-21 Using the same centrifugal force (400g) as well as the same type of blood collecting tubes, the authors tested four different commercially available L-PRF centrifuges. The results indicated that centrifuge vibration as well as centrifuge type significantly affect the quality and quantity

### Table 1: Categories of platelet concentrates as proposed by Dohan Ehrenfest et al.

1. Pure platelet-rich plasma (P-PRP)
2. Leucocyte- and platelet-rich plasma (L-PRP)
3. Pure platelet-rich fibrin (P-PRF)
4. Leukocyte- and platelet-rich fibrin (L-PRF)
of the L-PRF clot produced. Under scanning electron microscope (SEM) analysis, the L-PRF clots produced from the different centrifuges showed variations in cell morphology and fibrin architecture, with some cells showing signs of significant damage. These differences were attributed to the type of centrifuge used.19-21 The Intra-Spin L-PRF centrifuge (Intra-Lock International, Boca-Raton, FL, USA) produced clots displaying cells with the most stable and normal shape.20 It is therefore critical that identical processes should be followed if the biomaterial product is to be standardised. Researchers cannot simply recreate the biomaterial by using any centrifuge with a setting of 400g RCF even at the appropriate spin time.

**Growth factors and their release kinetics**

The preferred use of L-PRF in clinical practice is largely due to its reported release of autogenous growth factors. It is assumed that the high concentration of these growth factors results in reduced healing time as well as the stimulation of tissue regeneration.8 These growth factors have been well documented in the literature.22 Recently, however, the release kinetics of these growth factors has been questioned.23 Schar et al. prepared L-PRF (I/E) with a single spin protocol at 400g for 12 minutes using an EBA 20 (Andreas Hettich GmbH & Co KG, Tuttingen, Germany) centrifuge.23 This is the same machine, recently upgraded, as the Intra-Spin L-PRF centrifuge (Intra-Lock International, Boca-Raton, FL, USA).24-26 The authors compared the release of various growth factors from L-PRF, L-PRP and a coagulated blood clot. The results demonstrated that the total growth factor release of vascular endothelial growth factor (VEGF) as well as of interleukin-1β (IL-1β) was higher from the blood clot than from any of the platelet concentrates. Furthermore, no statistically significant differences could be established between the blood clot and the various platelet concentrates as regards the amounts of insulin-like growth factor-1 (IGF-1) and of platelet-derived growth factor AB (PDGF-AB) that were released. The L-PRF (I/E) clot released the highest concentrations of transforming growth factor β1 (TGF-β1). When the release kinetics of L-PRF (I/E), L-PRP and the blood clot were investigated, the researchers found that the various growth factors were released at different times as well as for different lengths of time. An examination of this effect on the migration on human bone marrow-derived mesenchymal stem cells (MSC) and human umbilical vein endothelial cells (HUVEC) found no significant differences in the overall patterns of migration for any of the groups tested. However, it was reported that IGF-1 had a positive correlation with the migration of both cell types whereas PDGF-AB had a negative correlation with both cell types i.e. MSC and HUVEC. It may be of relevance that IGF-1 had the highest concentration in the blood clot and that there were no differences in the release kinetics of this growth factor when compared with those of L-PRF and L-PRP.23

In a similar study, in which the release of growth factors as well as the effect of platelet concentrates on tendon cells were compared with those of a whole blood clot, it was shown that the platelet concentrates had the ability to significantly increase cell proliferation as compared with that of the blood clot.27 However, it must be pointed out that the techniques of preparing these platelet concentrates were completely different between the two studies, thereby influencing the final architecture and possible biological properties of the various concentrates.

**Bone morphogenic proteins**

Bone morphogenic proteins (BMPs) are low molecular weight glycoproteins that are responsible for ectopic bone formation.28 First described in the 1960’s, these proteins play a critical role in various aspects of cell function, differentiation and tissue repair. More significantly, they are crucial in the maintenance of skeletal integrity and bone fracture healing. BMPs are released and synthesised by a number of cells including osteoblasts, osteoprogenitor cells, chondrocytes, platelets and macrophages,28,29 It is therefore clear that the synthesis of these key proteins is not restricted to bone forming cells.

It has recently been shown that L-PRF (I/E) releases BMP-2 over a period of seven days, but that the amounts released are relatively small.25 Dohan Ehrenfest et al. found it difficult to explain the exact origin of these BMPs, but suggested it was related to the presence of leukocytes in the platelet concentrate.21 However it had been shown previously that the platelets themselves contain significant amounts of BMP-2 and that the release of these proteins is pH dependent.26 As a result, it has been suggested that the release of BMP-2 by platelets may play a significant role in the initial stages of bone fracture healing, since the pH in this environment is optimal for platelet activation.30

Other researchers have found that other BMPs such as BMP-6, BMP-7 and BMP-4 are also released by platelets, and, further, that the concentration of BMPs contained in platelets is patient dependent.30,31 It has also been shown, by genome-wide micro analysis, that lysed platelets have the ability to upregulate proliferative pathways of osteoblast like cells in-vitro.31

The potentially ground-breaking findings from various studies investigating the BMP potential of L-PRF as well as its variants must be seen in the light of patient variation as well as the pH of the test environment.21,24,32,33 Further research into these factors may have clinical implications and could explain the reasons for the inconsistent clinical outcomes experienced when using platelet-rich concentrates for bone grafting or regeneration. By implication then, it would currently be difficult to control the amounts of BMP’s released from platelets when used in a clinical setting.

**Stem cells**

Stem cells are undifferentiated cells that can differentiate into specialized cells, including more stem cells or other cell types during development.34 Recently, a variant of L-PRF(C) has been analysed, thought to contain haematopoietic stem cells (HSC).35 The presence of these HSC cells is mostly determined using immunohistochemical analysis for the detection of specific cell markers, in this case, CD34. This is a transmembrane phosphoglycoprotein that is predominantly used as a marker for HSC as well as haematopoietic progenitor cells.36 Although traditionally linked to cells of haematopoetic cell origin, CD34 has recently been linked to other non-haematopoietic cells such as mesenchymal stem cells (MSC), endothelial progenitor cells and interstitial dendritic cells.36 Therefore, the mere presence of CD34 positive cells does not allow the assumption that a specific cell type such as HSC, exists. In order to verify the existence of HSC, the cells should, in addition to the proven presence of CD34, display other traits such as a low expression of CD90, a lack of expression of CD38 and human leukocyte antigen-DR (HLA-DR), as well as a panel of mature lineage markers (lin-).36
The potential of CD34 positive cell types in L-PRF(C) and its variants appears promising, but requires further investigation due to the variation in CD34 detection methods. Almost all CD34 detection methods use antigen-antibody interactions. These interactions are non-covalent and are reversible, with the potential of affecting the detection of the CD34 marker. Because of this, it is suggested that multiple methods be used to verify the presence of CD34.

Although peripheral blood has been used as a source for CD34 positive cells in many forms of therapy, the baseline concentration of these cells in peripheral blood is relatively low. As such, most therapies that require the use of CD34 positive cells enrich the presence of these cells in the vasculature by using granulocyte colony-stimulating factor (G-CSF). This allows for an adequate amount of cells to be harvested for local or systemic transplantation. Whether the levels of CD34 positive cells in L-PRF and its variants are at therapeutic concentrations, requires further analysis.

Clinical results from studies using L-PRF

Several randomised controlled trials have been published that involve the use of L-PRF in the clinical management of a variety of disorders. These trials have contradictory results, which may be related to a variation in the techniques and equipment used to prepare L-PRF. Nevertheless, several articles report positive clinical outcomes even when standardised preparation techniques have not been used. Whilst most of these publications are in fact case reports, nevertheless even randomised controlled trials where the RCF has not been verified, have shown positive clinical outcomes. This is similar to reports about the use of PRP, which show a variety of clinical results based on the various methods of producing PRP. Further research is therefore required to verify clinical differences which may be associated with the various methods of preparing L-PRF.

Does generic L-PRF exist?

L-PRF (O) is prepared using standard blood collecting tubes and a non-purpose built table top centrifuge delivering an RCF of 400g with a centrifuge time of 12 minutes. This method allows for the preparation of a platelet and leukocyte concentrate without the need for specialised equipment. Several case reports have demonstrated positive clinical results when using this preparation method. However one cannot assume that this generic type of L-PRF has properties similar to those of L-PRF(C) or to L-PRF(IE) since it has previously been shown that the centrifuge type may play a significant role in the final morphological features of the end product. Further analysis of this biomaterial is therefore required to determine equivalence to the established protocols for L-PRF preparation.

CONCLUSIONS

The concept of L-PRF as a bioactive material with possible regenerative properties has resulted in it being adopted for use in various clinical procedures. However, the widespread use of this material has resulted in the production of several variants. Whether the biological properties of all these variants are similar, is unknown. Contradictory clinical results are reported in the literature with several generic types of L-PRF showing diverse results. In order to minimise the controversies associated with L-PRF, further research is required to determine which factors affect the biological properties of the material and whether these factors are clinically beneficial and relevant.

Disclosure policy

The authors declare no conflict of interest regarding the publication of this paper. This paper forms part of the requirements for full partial fulfilment of the specifications for the degree PhD.

References


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**NEW**
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ADVANCED WHITE
Whitens | Cleanses | Fluoridates
In vitro antimicrobial comparison of three commercially available chlorhexidine-based oral rinses

ABSTRACT

Introduction: Commercially available chlorhexidine (CHX) formulations differ in their CHX concentrations (0.2% and 0.12%) as well as in various additives including alcohol, antimicrobials such as cetylpyridinium chloride and anti-discolouration chemicals such as ascorbic acid and sodium metabisulphite.

Aims and objectives: To compare in vitro the antimicrobial efficacies of three different CHX preparations (Corsodyl®, Curasept® and GUM® Paroex®) using 0.2% and 0.12% CHX concentrations as controls.

Methods: A disk diffusion test was performed using pure cultures of the organisms Streptococcus mutans and Candida albicans, and mixed cultures (facultative and strict anaerobes) prepared from oral rinse samples of 14 study participants. The means and standard deviations of the diameters of inhibition zones were calculated.

Results: A statistically significant difference (p value = 0.0001) was found only in Candida albicans cultures between the mean inhibition zones of the CHX preparation disks. Pure CHX preparations and Corsodyl® showed higher antifungal efficacy than Curasept® and GUM® Paroex.

Conclusion: Both CHX preparations (0.12% and 0.2%) and the 0.2% CHX preparation containing alcohol (Corsodyl®) have more potent antifungal properties against C. albicans than alcohol-free 0.12% CHX preparations such as Curasept® and GUM® Paroex®.

INTRODUCTION

Chlorhexidine (CHX) is the most commonly used antimicrobial agent in dentistry. Because of its wide range of antimicrobial activity, it has been incorporated as an antiplaque agent into several oral hygiene products such as dentifrices and mouthrinses. Based on its clinical efficacy, CHX is currently regarded as the “gold standard” for evaluating new chemical plaque control agents.1

Most commercially available mouthrinses, including some CHX based mouthrinses, contain alcohol, with concentrations being as high as 14-15%.2 However, the addition of alcohol is controversial because of its potential carcinogenic and tissue irritating properties. Several manufacturers have therefore developed alcohol-free CHX based oral hygiene products as alternatives.2 Limited data exists with regards to the antibacterial efficacy of these products, with studies indicating that alcohol-based CHX formulations are more effective than alcohol-free formulations.2

Commercially available CHX formulations differ in their concentrations as well as in the component additives. Most CHX mouthrinses are prepared in concentrations of 0.2% or 0.12%. In this study, the antimicrobial efficacy of three locally available CHX based mouthrinses i.e. Corsodyl Mouthwash® 0.2% CHX (GlaxoSmithKline, Epping, South Africa), Curasept ADS® 220 Oral rinse 0.2 % CHX (Curaden AG, Krein, Switzerland) and GUM® Paroex® 0.12% CHX (Sunstar Europe S.A., Etoy, Switzerland) were evaluated for their antimicrobial efficacy.

MATERIALS AND METHODS

Study design

An in vitro analytical comparative study was carried out to evaluate three commercially available CHX-based mouthrinses.

ACRONYMS

CHX: chlorhexidine
CFU: colony forming units
BHI: Brain Heart Infusion
Table 1: Inclusion and exclusion criteria used for recruitment of study participants.

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentate and partially dentate individuals</td>
</tr>
<tr>
<td>Adults &gt; 12 years of age</td>
</tr>
<tr>
<td>Systemically healthy</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edentulous individuals</td>
</tr>
<tr>
<td>Children &gt; 12 years of age</td>
</tr>
<tr>
<td>Patients with systemic conditions</td>
</tr>
<tr>
<td>Smokers</td>
</tr>
<tr>
<td>Individuals who have used antibiotics or immunosuppressive drug therapies during the past three months</td>
</tr>
<tr>
<td>Persons with active periodontal disease</td>
</tr>
<tr>
<td>Persons with clinically evident oral candidiasis</td>
</tr>
</tbody>
</table>

Study sample

Oral rinse samples were collected from 14 healthy staff members at the University of the Western Cape Dental Faculty (UWC) who met the inclusion criteria (Table 1).

Specimen preparation and data collection

Each subject was supplied with 10 ml of sterile saline in a universal container and instructed to rinse his/her mouth in the presence of the researcher for 60 seconds and then to return the mouth rinse to the container. 100µl of the rinse was inoculated onto previously prepared Brain Heart Infusion agar plates (BHI), by spreading the sample over the agar surface with a sterile glass rod. For each oral rinse sample, two plates were prepared, one for facultative anaerobic cultures, and the other for strictly anaerobic cultures. The latter was done to culture Gram negative anaerobic bacteria, such as Veillonella and Fusobacteria. The anaerobic conditions were created inside an anaerobic jar utilizing an Oxoid® Gas generating kit (UK), with palladium as a catalyst. A colour indicator was used to signal the transformation to an anaerobic environment. For the facultative anaerobic cultures, an anaerobic incubator was used. The incubation period for both culture types was 24 hours.

Preparation of pure cultures

Pure cultures of S. mutans NCTC 25175 and C. albicans NCTC 36801 were selected, as these microorganisms are known aetiological factors for dental caries and candidiasis respectively. These were cultured in the laboratory for 24 hours. Thereafter, a separate inoculum from each culture was prepared. This was done by selecting an appropriate culture and preparing a suspension thereof in saline using the direct colony suspension method.

The two suspensions (S. mutans and C. albicans) were standardized to 0.5 McFarland standard (corresponding approximately to 1.5 X 108 CFU/ml). The McFarland scale is used for measuring bacterial densities in suspensions. There was no need to standardize the turbidity of the oral rinse samples since its natural turbidity closely approximated that of the 0.5 McFarland standard.

100µl of each suspension was inoculated onto 14 standard BHI plates within a quarter of an hour of the suspension preparation. Sterile glass-rod filters were used to spread the suspension evenly over the surface of the plate. This produced an acceptable distribution of the bacterial colonies on the surface of the 28 agar plates.

The CHX preparations

Three commercially available mouth rinses, representing the most prevalent CHX-based rinses in South African markets, were purchased from local stores, whilst the controls ("only CHX formulations") were prepared by the Institute of Oral and Dental Research at the Faculty of Dentistry, University of the Western Cape (Table 2).

The control CHX formulations (referred to hereunder as "only CHX") were water based and alcohol free solutions that were prepared in two different concentrations i.e. 0.2% & 0.12%. The only CHX 0.2% acted as a control for Corsodyl® and Curasept ADS® 220 (both containing CHX 0.2% concentration), whilst only CHX 0.12% acted as the control for GUM® Paroex® which contained CHX 0.12%.

Disk Diffusion Test to measure inhibition zones:

The 56 agar plates used for the disk diffusion test were divided equally into four groups as listed below:

1. **Group 1:** 14 facultative anaerobically cultured plates prepared from oral rinse samples.
2. **Group 2:** 14 strict anaerobically cultured plates prepared from oral rinse samples.
3. **Group 3:** 14 plates of pure cultures of S. mutans bacteria.
4. **Group 4:** 14 plates of pure cultures of the fungus C. albicans.

The disk diffusion test was performed by adding five sterile, 6mm diameter filter paper disks to each of the 56 BHI plates. The disks were evenly distributed on the agar surface. Each disk was saturated with 10µl of a specific CHX

Table 2: Description of the Chlorhexidine (CHX) oral rinses used in the study

<table>
<thead>
<tr>
<th>Codes as per disk diffusion test</th>
<th>CHX preparation</th>
<th>Active ingredients</th>
<th>Inactive ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHX 1</td>
<td>only CHX 0.2%</td>
<td>CHX 0.2%</td>
<td>N/A</td>
</tr>
<tr>
<td>CHX 2</td>
<td>only CHX 0.12%</td>
<td>CHX 0.12%</td>
<td>N/A</td>
</tr>
<tr>
<td>CHX 3</td>
<td>Corsodyl Mouthwash®</td>
<td>CHX 0.2%, Ethanol 5-6%</td>
<td>Unassigned</td>
</tr>
<tr>
<td>CHX 4</td>
<td>Curasept ADS® 220</td>
<td>CHX 0.2%</td>
<td>ADS, Xylitol, propylene glycol, PEG 40, hyd. castor oil, ascorbic acid, Poloxamer 407, sodium metabisulfite sodium citrate, aroma Cl.42000</td>
</tr>
<tr>
<td>CHX 5</td>
<td>GUM® Paroex® (Sunstar Europe S.A., Etoy, Switzerland)</td>
<td>CHX 0.12%, Cetylpyridinium Chloride 0.05%</td>
<td>Aqua, propylene glycol, glycerine, PEG 40 hydrogenated castor oil, aroma, potassium aceacesulfame, methylparaben, propylparaben, C.I. 14720, limonene</td>
</tr>
</tbody>
</table>
product to be tested and an identifying code number assigned. The antibacterial effect of each CHX product was quantified in terms of the formation of inhibition zones around the disks, measured 24 hours following incubation (Figure 1).

All measurements were carried out using a digital calliper, by both the principal investigator and by a second clinician, who was blinded to the results obtained by the former. The diameter of each inhibition zone was measured thrice by each investigator. If a discrepancy of >1mm was found, the measurements were repeated. An average of the readings of each investigator was taken. Data capturing tables were used to record the readings.

**Data analysis**
The mean diameters and standard deviations of the corresponding inhibition zones were calculated and compared using the analysis of variance (ANOVA) test. A P value of less than 0.05% was considered statistically significant.

**RESULTS**
A statistically significant difference in the inhibition zones was found only in the fungal cultures, as analyzed by the ANOVA one-way test. Both Curasept®(0.12% CHX) and GUM® Paroex® (0.12% CHX) showed significantly smaller inhibition zones (p<0.05) while the only CHX (0.2% and 0.12%) as well as Corsodyl® (0.2% CHX), produced inhibition zones of comparable sizes (Table 2). When the inhibition zones produced by the different cultures were compared, all the formulations gave significantly larger zones towards *S. mutans* than did any of the other cultures. No significant differences were recorded between the zones produced by facultative anaerobic and strict anaerobes from the mixed saliva cultures.

When the means of inhibition zones for all CHX formulations were considered together, readings could be represented as in Figure 2.

**DISCUSSION**
The results of the study showed no statistically significant differences between the antibacterial activities of the three mouthrinses evaluated (Corsodyl®, Curasept® and GUM® Paroex®), regardless of the CHX concentration or the brand of oral rinse tested. The antimicrobial efficacies of all CHX formulations were highest against *Streptococcus mutans*, when compared with other cultures, supporting the anti-cariogenic role of CHX and its use as an adjuvant to mechanical oral hygiene measures.8

Even though a statistically significant difference was found with regard to the antifungal activity between the three oral rinses, the inhibition zones produced for *C. albicans* cultures were smaller than those recorded for *S. mutans* cultures. Only CHX preparations and Corsodyl® showed a higher antifungal activity compared with Curasept® or GUM® Paroex®. This finding is consistent with the literature where *C. albicans* displayed a lower susceptibility to CHX. This is thought to be due to the greater complexity of the fungal cell membranes as compared with that of Gram positive bacteria.10

Even though a statistically significant difference was found with regard to the antifungal activity between the three oral rinses, the inhibition zones produced for *C. albicans* cultures were smaller than those recorded for *S. mutans* cultures. Only CHX preparations and Corsodyl® showed a higher antifungal activity compared with Curasept® or GUM® Paroex®. This finding is consistent with the literature where *C. albicans* displayed a lower susceptibility to CHX. This is thought to be due to the greater complexity of the fungal cell membranes as compared with that of Gram positive bacteria.10

For both *S. mutans* and *C. albicans*, the readings for antimicrobial sensitivity across the 14 cultures were numerically closer than in both types of cultures prepared
from participants’ oral rinses. Such variability reflects the qualitative differences in oral microbial flora between individuals.

Only CHX (0.2%) exhibited the highest antimicrobial efficacy followed by Corsodyl® (containing 5% alcohol) and then Curasept®. The latter has a similar CHX concentration but is alcohol free. Alcohol acts as an emulsifier, as a solvent for active ingredients, as a preservative and as an antiseptic.13 Perhaps the alcohol in Corsodyl® acted as a diluent of CHX and the additive in Curasept® (anti-discolouration systems) could have decreased the antimicrobial efficacy of CHX4, due to interaction with the strong positive charge of the CHX molecule.9

Even though GUM® Paroex® contains 0.05% CPC, it was surpassed in antimicrobial efficacy by pure CHX 0.12%. This could probably also be attributed to the aforementioned chemical interactions between CHX and additives, thereby reducing its efficacy. Nevertheless, GUM® Paroex® had similar antimicrobial efficacy as Curasept® (0.2% CHX), and this was probably due to the fact that it contained 0.05% CPC.

CONCLUSION

The results of the study show that both the pure (0.12% and 0.2%) CHX preparations as well as the 0.2% CHX preparation containing alcohol (Corsodyl®) have more potent antifungal properties against C. albicans than does alcohol-free 0.12% CHX preparations such as Curasept® and GUM® Paroex®. CHX preparations are effective against most classes of oral microflora and is well chosen as an adjunct to plaque removal.

Ethical approval for the study was obtained from the UWC Dental Faculty.

Conflict of Interest: None declared.

Acknowledgements: The authors wish to acknowledge the staff of the Oral Medicine and Periodontology Department for their contribution towards the study.

References

Availability, indications for use and main ingredients of mouthwashes in six major supermarkets in Gauteng

ABSTRACT

Patients often ask oral health care practitioners to recommend the “best” mouthwash for their specific needs and desires. Considering the vast array of products available, the number of television, radio and printed media advertisements, and the promotional campaigns from dental representatives, selecting and recommending a single product can be daunting. As a result, advice and selection are often based on personal preferences, and may not identify a mouthwash most suitable for the specific needs of a particular patient. This study was undertaken to investigate the range, availability, advertised indications and ingredients of all the mouthwashes on offer in six large supermarket chains in Gauteng. After identifying all the available over-the-counter mouthwashes on sale, a descriptive cross sectional study was undertaken. The advertised indications for use, active ingredients, mode of action and cost of the collected samples were compared. The results may help clinicians have a better understanding of the range, nature and characteristics of a selection from each brand enabling a recommendation of the most suitable product to meet each individual need.

INTRODUCTION

Mouthwashes are amongst the many oral hygiene products available to help patients maintain maximal oral health. Oral practitioners are regularly requested by patients to recommend the “best” mouthwash for their specific needs. Considering the wide variety of products available, it may be difficult for clinicians to give justifiable advice unless they are familiar with a selection of products, their indications for use, active ingredients, availability, contra-indications, and scientifically documented efficacy. This study was undertaken to collect and collate relevant information, and present it in a format that clinicians may consult and adapt into a similar reference table for their own purposes. This could then be used as a quick reference guide when advising on the most suitable rinse for each patient’s needs.

LITERATURE REVIEW

Oral mouth rinses are amongst the oldest forms of dental hygiene techniques documented. Recipes for teeth whitening and halitosis-combating products date back as far as the ancient Egyptian, Greek, Roman and Chinese cultures. Their progression has been through a long developmental process, involving experimentation with a variety of ingredients, many of which were unhygienic or are now considered unsafe to use. The Egyptians were the first to put emphasis on a clean and healthy body, and mixed water with honey to maintain a good breath. The Romans used bottled Portuguese urine to get rid of bacteria in their mouths, as they believed its ammonia content was an effective cleanser. The ancient Chinese cultures believed that bad breath and caries were caused by worms, as a result they either extracted their decayed teeth, or treated them with materials containing ground mouse bones and children’s urine. There is also documented use of materials such as charcoal, fruit, fruit juices and dried flowers. However, there is no evidence to prove the efficacy of any of these.

In the late 1800’s, the first official oral cleansing products, namely toothpastes, were invented. This was closely followed by the mass production of mouthwashes. Most of these contained alcohol to not only kill bacteria, but also improve their stability. Fortunately in modern products, the alcohol has generally been replaced with more effective bactericidal agents and preservatives. In addition, specialised rinses have been developed to address specific needs such as sensitive teeth, gingival inflammation, halitosis, calculus (tartar) build-up, caries susceptibility, demineralised teeth, and even products for use by children with braces, or those who seek more natural herbal products. However, the main aims of mouthwashes, which are the prevention of plaque build-up and bad breath, have remained the same throughout time.

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Advocates of mouthwashes propose that they have many beneficial uses including: removal of excess food particles trapped between the teeth; softening food particles making them easier to clean and remove; protection of the oral cavity from harmful bacteria by physically removing them; inhibition of bacterial growth due to certain active ingredients; reduction of tooth or gingival sensitivity; elimination of plaque and calculus (tartar) build-up; and even tooth-whitening properties.4,5

Mouthwashes alone cannot achieve complete oral hygiene and need to be used in conjunction with regular visits to the dentist/oral hygienist, as well as a good daily brushing and flossing regime. Thus, their efficacy cannot be solely attributed to their constituent active ingredients.5

The oral biofilm is composed of gram positive and gram-negative bacteria, which produce the metabolites that ultimately lead to plaque build-up, caries, gingivitis and periodontitis. The use of antimicrobial mouth rinses has been proposed to reduce the levels of oral bacteria. As such, the daily use of an effective mouthwash may be a simple strategy to reduce oral microbe numbers, and could be beneficial for prevention of infection, or in patients with established gingivitis or periodontitis.6 In order to be effective antibacterials, they need to have active ingredients that target specific microbes such as Streptococcus mutans, Staphylococcus aureus, and Candida albicans, the most common yeast associated with oral disease.7 However, these active ingredients should selectively eradicate pathogens without having a negative impact on the normal oral flora.5

Mouthwashes may contain any combination of the following ingredients: active medicaments (e.g. antifungals, antiseptics, antibiotics, anti-inflammatoryatories), astringents, inorganic elements (e.g. sodium fluoride, calcium), plaque-fighting agents (e.g. chlorhexidine), breath fresheners and essential oils (e.g. menthol, thymol, eucalyptol), other active or inactive components (e.g. sodium hydroxide, sugars, artificial sweeteners), dilluents and solvents (e.g. deionized and demineralized water, alcohol, polyoxyl), preservatives, colourants and flavourants.8 Depending on their properties they may be classified as either therapeutic or cosmetic. Cosmetic products are generally used as breath fresheners, whereas therapeutic mouthwashes have added active ingredients and are advertised specifically according to these such as anti-caries, anti-plaque, anti-gingivitis, or tooth whitening products.8

### Table 1: Active ingredients commonly found in mouth rinses and their associated effects and side effects

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>Antiseptic and antimicrobial, reduces gingivitis and plaque. Although the FDA states that alcohol rinses are safe, some researchers are concerned that long-term use increases the risk of oral cancer due to its dehydrating effects.5</td>
</tr>
<tr>
<td>Fluoride</td>
<td>Prevention of caries. Higher concentrations reportedly decrease gingival inflammation and tooth sensitivity. It is considered the best approach for remineralization.9</td>
</tr>
<tr>
<td>Antibacterial Enzymes</td>
<td>Lysozyme and lactoperoxidase have bactericidal effects and can reduce xerostomia.8</td>
</tr>
<tr>
<td>Chlorhexidine gluconate</td>
<td>For treatment of periodontal disease and plaque fighting, with proven efficacy in eradicating micro-organisms.1 It binds to plaque, oral tissue and tooth structure and is released slowly which results in up to 12 hours of activity. May cause a burning sensation and pain in the oral mucosa, tooth staining or taste alteration.5</td>
</tr>
<tr>
<td>Detergents (such as lauryl sulphate and sodium benzoate)</td>
<td>Loosen plaque, and are designed for use in pre-brushing rinses. Sodium Benzoate is widely used as a preservative, as it prevents growth of micro-organisms.11 Lauryl sulphate may cause a burning sensation and desquamation of oral epithelium.10 Benzoate has been implicated in depriving cells of oxygen, which could lead to cancer.11</td>
</tr>
<tr>
<td>Essential Oils (such as Menthol, eucalyptol, methyl salicylate and thymol)</td>
<td>May have antibacterial properties as they are known to interfere with the inflammatory process, but are generally used as breath fresheners.2 Eucalyptol, menthol and thymol may be mildly anti-bacterial against S. aureus and E-coli, with limited actions against other bacteria. Thymol does have antifungal properties.5,11 They are mostly found in alcohol-based washes, therefore contraindicated for use by children, in patients with a history of alcohol abuse, or for those who are immune-compromised or undergoing radiation treatment. The negative effects of essential oils on the surfaces of composite restorations still require further study.12</td>
</tr>
<tr>
<td>Cetylpyridinium chloride</td>
<td>An ammonium compound, which inhibits the formation of plaque and causes the rupture of bacterial cell membranes, thus altering bacterial growth and metabolism.5 It is only effective for up to six hours after rinsing, but has less severe side effects than chlorhexidine. It may cause temporary staining of tooth structure.12</td>
</tr>
<tr>
<td>Zinc Chloride</td>
<td>Used in combination with other ingredients to aid remineralization.8</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>It has antibacterial properties, especially against anaerobes, thereby reducing gingivitis and plaque. It may whiten teeth.2 It is a highly reactive compound which can result in oral soft and hard tissue damage when used in high concentrations and for long term.14</td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td>May also whiten teeth, but due to its alkalinity may cause less damage than hydrogen peroxide.15</td>
</tr>
<tr>
<td>“Natural” Ingredients (such as sanguinaria, Echinacea, goldenseal, aloe and vitamin C)</td>
<td>Used as breath fresheners as well as anti-bacterial, as they may cause a disruption in bacterial cell walls.7 Herbs have been advocated for prevention and cure of many oral health problems such as tooth decay, halitosis, bleeding gums and mouth ulcers, with few reported side effects. In addition, they do not contain sugar, thus helping to eliminate halitosis-causing micro-organisms which feed off sugars. Chlorhexidine has however been proven as more effective at targeting pathogenic oral microbes,14 and mixed results have been shown in studies comparing “natural” ingredients with aloe vera and other essential oils.9</td>
</tr>
</tbody>
</table>
Many studies have shown fluoride mouthwashes reduce the incidence of caries in children, but it is questionable whether mouthwashes are cost effective, especially in South Africa. Perhaps the focus should rather be on prevention, with the adjunctive use of mouthwashes reserved for individuals with a high caries risk, and used in formulations that contain other remineralizing agents such as calcium and phosphate.8 Although the use of mouthwashes has drastically increased over the past few years, limited information is available on the efficiency and safety of many of the over-the-counter products. Most of the evidence supporting anti-plaque properties is related to chlorhexidine–containing products.6 In addition, it’s not always clear whether the purported product claims are due to individual ingredients, or the complete composition.7 This is further complicated by widely contradictory results on their effectiveness.5 A study comparing the effectiveness of ten different mouthwashes against four oral microbes showed that only six were effective against all four of the microbes tested. Interestingly all of these contained chlorhexidine gluconate.7 Although there have been studies

<table>
<thead>
<tr>
<th>Table 2: Products, availability and main ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouthwash brand &amp; type</td>
</tr>
<tr>
<td>Dischem Dentalmate kids (3 fl)</td>
</tr>
<tr>
<td>Dischem Dentalmate regular (5fl)</td>
</tr>
<tr>
<td>Dischem Dentalmate whitening</td>
</tr>
<tr>
<td>Dischem Dentalmate fresh breath</td>
</tr>
<tr>
<td>Dischem Dentalmate vanilla mint</td>
</tr>
<tr>
<td>Spar Oral Ultra</td>
</tr>
<tr>
<td>Spar Oral Spring mint</td>
</tr>
<tr>
<td>Spar Oral Blue mint</td>
</tr>
<tr>
<td>Spar Oral Vanilla mint</td>
</tr>
<tr>
<td>Clicks Germ fighting</td>
</tr>
<tr>
<td>Clicks Spring mint</td>
</tr>
<tr>
<td>Listerine Total care sensitive</td>
</tr>
<tr>
<td>Listerine Regular</td>
</tr>
<tr>
<td>Listerine Tartar control</td>
</tr>
<tr>
<td>Listerine Freshburst antibacterial</td>
</tr>
<tr>
<td>Listerine Listerfluor for kids</td>
</tr>
<tr>
<td>Listerine Advanced whitening</td>
</tr>
<tr>
<td>Listerine Zero</td>
</tr>
<tr>
<td>Listerine Total care(6 in one)</td>
</tr>
<tr>
<td>Listerine Stay white</td>
</tr>
<tr>
<td>Listerine Cool mint</td>
</tr>
<tr>
<td>Listerine Tooth &amp; gum protection</td>
</tr>
<tr>
<td>Sensodyne Cool mint</td>
</tr>
<tr>
<td>Sensodyne Long lasting extra fresh</td>
</tr>
<tr>
<td>Plus-white extra whitening (0 OH)</td>
</tr>
<tr>
<td>Aquafresh Extreme clean</td>
</tr>
<tr>
<td>Aquafresh Fresh mint (0OH)</td>
</tr>
<tr>
<td>Aquafresh intense mint</td>
</tr>
<tr>
<td>Dentyl active Mint or clove (0OH)</td>
</tr>
<tr>
<td>Dentyl active Pro series</td>
</tr>
<tr>
<td>Colgate Sensitive Pro-relief</td>
</tr>
<tr>
<td>Colgate Total 12 (Gum pro-guard)</td>
</tr>
<tr>
<td>Colgate Total 12 (Pro long lasting)</td>
</tr>
<tr>
<td>Colgate Plax Original</td>
</tr>
<tr>
<td>Colgate Plax Complete 12 in 1</td>
</tr>
<tr>
<td>Colgate Plax Soft mint</td>
</tr>
<tr>
<td>Colgate Plax White blancheur</td>
</tr>
<tr>
<td>Colgate Plax optic white</td>
</tr>
<tr>
<td>Colgate Plax Tea fresh</td>
</tr>
<tr>
<td>Colgate Plax Herbal</td>
</tr>
<tr>
<td>Colgate Plax Sensitive (0OH)</td>
</tr>
<tr>
<td>Biobalance</td>
</tr>
<tr>
<td>Gum Paroex</td>
</tr>
</tbody>
</table>

Key: * 0.12%chlorhexidine gluconate; # sodium hydroxide; ## hydrochloric acid
A cross sectional study was undertaken to identify all the available OTC mouthwashes in six major supermarket chains in Gauteng, and to compare their indications for use, active ingredients, mode of action and cost. The results may help clinicians approach patients in a more holistic manner, and allow them to recommend the most suitable product for each individual patient, based on their specific needs.

Six of the largest supermarkets chains in Gauteng were selected for this study (Spar, Checkers, Pick ‘n Pay, Clicks, Dischem and Makro). A list was compiled of all available mouthwashes, including bottle sizes and costs. They were grouped according to brands, noting the different variants within each brand, their main active ingredients, and alcohol content. For the analysis, the product labels were used to categorize each according to their advertised indications for use, as specified on their labels. Each product was then assigned to one of eleven categories, namely multi-purpose, kids, whitening, sensitive, tartar control, anti-bacterial, breath freshening, regular, long lasting, herbal, and gum protection.

It was difficult to carry out a cost analysis, as there were large variations in the prices between stores and in different product sizes, making a price/ml comparison impossible. Some chains only sold large sizes which were generally cheaper than the smaller bottles sold, and thus certain chains which stocked only large bottles appeared to be cheaper than their competitors who sold only the smaller sizes.

RESULTS

The results of this study show that in these six supermarkets alone, there was an enormous number and range of mouthwashes for consumers to choose from. In total there were 11 brands and 43 varieties, excluding different flavours within a type (Table 2). For the purpose of analysing the data, the mouthwashes were categorized into 11 groups according to the indications on their labels (Figure 1). However, when comparing the marketed specifications with the active ingredients it was interesting to note that most of the products had a very similar composition, with no extra unique constituents as may have been expected (Table 2). Of the six “whitening” products, only one, Dentalmate, the Dischem house brand, contained hydrogen peroxide for tooth whitening. There were three “herbal” mouth washes (Colgate Plax tea fresh, Colgate Plax herbal, Biobalance) yet only one, Biobalance, contained no active ingredients except menthol and essential oils which act as breath fresheners (Table 2). It was only available in Checkers. The other two both contained fluoride as well as cetylpyridinium chloride, and were widely available.

There was only one true anti-bacterial mouthwash, Gum paroex (Table 2), containing chlorhexidine gluconate as well as hydrochloric acid and sodium hydroxide. This too, was only available at Checkers. There were only two mouthwashes aimed specifically at children (Dentalmate kids and Listerine Listerfluor for kids). Both contained fluoride, but the latter also had alcohol. In total 27 of the 43 mouthwashes (63%) contained alcohol, while nine were marketed as breath fresheners (Table 2).

DISCUSSION

Dentalmate, the Dischem house brand, was the only whitening product to actually contain hydrogen peroxide for tooth whitening. This however may be seen as a positive aspect as studies have shown that hydrogen peroxide in high concentrations and used regularly can damage soft and hard tissue of the oral cavity, causing decreased enamel microhardness, and is therefore not recommended in a daily rinse. Interestingly, all the whitening products were more expensive than the regular mouthwashes, regardless of store or bottle size.

![Figure 1: Store availability](image-url)
Biobalance is the only herbal product to contain no active ingredients except menthol and essential oils as breath fresheners (Table 2). Menthol is purported to have limited anti-bacterial properties. Thymol is used as an antiseptic, and eucalyptol for its pleasant aroma. However, further research needs to be done on the effects of these, and other essential oils, when used intra-orally.

In Gum Paroex, the chlorhexidine gluconate is known to be efficient at removing bacteria and fighting periodontal disease. Unfortunately chlorhexidine gluconate has a list of side effects, including tooth staining, taste alteration, painful mucosa, and reported burning when rinsing. Long term and regular use should be discouraged. The hydrochloric acid is an abrasive added to counteract and remove the intrinsic staining from the chlorhexidine gluconate. However, it is known to etch enamel, therefore exposing dentin tubules, which could cause complications and tooth sensitivity if used often. The sodium hydroxide is used to neutralize acids as it is a strong alkali. In high concentrations it becomes extremely corrosive to metals and hard and soft tissues, making it a potentially dangerous addition to mouthwashes. Thus, this antibacterial mouthwash contains many harsh ingredients, and long term use and exposure to its constituent chemicals could cause more harm than good. The researchers believe that it should only be used if recommended by a dentist for severe oral health problems, and for a limited time period.

Both of the two mouthwashes for children contained fluoride, but it was a concern to note that the Listerine product also had alcohol. Topical fluoride is a beneficial aid in tooth remineralisation and caries prevention, however, ingestion of large amounts may lead to severe tooth fluorosis. For this reason the use of mouthwashes by children should be monitored by parents to ensure they don’t swallow it. In addition, many feel that children would benefit more from a regular brushing and flossing regime, than from the use of a mouthwash.

Only 37% of the mouthwashes were alcohol free. It was originally added as a preservative and solvent, with limited antimicrobial and antiseptic properties that may help reduce gingivitis and plaque formation. The main side effect is that it dries the mouth, thus exposing the oral cavity to other threats. Its use is contra-indicated in children, people with severely compromised immune systems, patients undergoing radiation treatment or who experience xerostomia, patients with a history of alcohol abuse, and others for religious reasons. In recent years, its deletion and replacement with other less toxic substances is becoming a desirable trend.

For breath freshening, additives such as zinc chloride, cetlypyridinium chloride, essential oils and natural ingredients are used to combat halitosis. One product, Listerine Total Care (6 in One), contained zinc chloride, menthol and fluoride which would make it an effective mouthwash to use against bad breath as well as for caries prevention. It was available in all six stores, making it a good all-round choice, except that it contained alcohol. Thirteen others also contained cetlypyridinium, but only eight of these also had menthol, none had zinc chloride, and three also contained alcohol. Only three of the thirteen were marketed as breath fresheners.

Triclosan is another antibacterial agent commonly added to many oral hygiene formulations, and is purported to be effective against Escherichia coli and Staphylococcus aureus. However, results of studies are contradictory as the concentrations and combinations with other ingredients in each product differ. In a toothpaste study, a combination of 0.5% triclosan and 1% zinc citrate resulted in greater plaque inhibition, than pastes containing zinc citrate or triclosan alone. Its effectiveness was also better when

<p>| Table 3: Example of a guidance chart |</p>
<table>
<thead>
<tr>
<th>Purpose of mouthwash</th>
<th>First choice</th>
<th>Availability</th>
<th>Alternatives</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>General- Herbal</td>
<td>Listerine Total care sensitive / zero</td>
<td>4 shops</td>
<td>Sensodyne Long lasting; Aquafresh Extreme clean *contains cetyl. Good for those with bad hygiene</td>
<td>6 shops; 6 shops</td>
</tr>
<tr>
<td>General- alcohol free</td>
<td>Dentimate whitening *not for long term, regular use</td>
<td>Only at Distchem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whitening action</td>
<td>Gum paroex *Use only if recommended by Dentist</td>
<td>Only at Checkers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor oral hygiene conditions – Antibacterial</td>
<td>Dentimate Kids *contains alcohol</td>
<td>Only at Distchem</td>
<td>Biobalance</td>
<td>Only at Checkers</td>
</tr>
<tr>
<td>Children</td>
<td>Listerine Total Care (6 in one)</td>
<td>6 shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tartar Control</td>
<td>Detyl Active Pro-series</td>
<td>3 shops</td>
<td>Colgate Total 12 (Gum Pro-guard); Colgate Total 12 (Pro long lasting)</td>
<td>4 shops; 5 shops</td>
</tr>
<tr>
<td>Breath Freshener</td>
<td>Listerine Total care (6 in one) *contains alcohol</td>
<td>6 shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caries prone / want remineralization</td>
<td>Listerine Total care (6 in one) *contains alcohol</td>
<td>6 shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitive teeth</td>
<td>Listerine Total care (6 in one) *contains alcohol</td>
<td>6 shops</td>
<td>Sensodyne Long lasting</td>
<td>6 shops</td>
</tr>
</tbody>
</table>
combined with methylvinyl ether / maleic acid (PVM/MA) copolymer. This could also explain its better performance in products such as Plax, where 0.03% triclosan is combined with sodium fluoride (225ppm fluoride), as well as 0.20% PVM/MA.22 The addition of ethanol may also contribute to its antimicrobial action.23 A different study, combining triclosan and cetylpyridium chloride showed no added antimicrobial advantage, however, the paper did not mention the concentrations of either.23 Thus further investigations into the interactions of triclosan with other ingredients are needed to establish its effect at different concentrations and in different combinations.23

An example of how clinicians could adapt the data from this research and compile their own charts based on a select few products for each desired indication is given in Table 3. This can serve as a quick reference guide when advising patients. For example, a patient who wants a more "natural rinse", would be advised to use the herbal product (Biofresh, 1:1-7. Aneja KR, Joshi R, Sharma C. The antimicrobial potential of ten often used mouthwashes against four different caries pathogens. Jundishapur Journal of Microbiology. 2007; 3(1):15-27.

Most patients are unaware which products would best suit their needs and as seen by this study, could be easily confused by product labels and advertising. They may purchase mouthwashes with potentially harsh ingredients, posing the risk of un-recommended use, abuse and dangerous oral side effects. Often these rinses are used as a hygiene aid because they are quick and easy, yet their breath freshening properties could be masking the halitosis associated with poor oral hygiene, dental decay or an underlying systemic condition. This compound is extremely efficient in eradication of bacteria and plaque, and although not as effective as chlorhexidine gluconate, has fewer side effects.

CONCLUSIONS

There is very little published data comparing the ingredients in OTC mouthwashes including their uses, efficacy, side effects, and interactions with other constituents. Most patients are unaware which products would best suit their needs and as seen by this study, could be easily confused by product labels and advertising. They may purchase mouthwashes with potentially harsh ingredients, posing the risk of un-recommended use, abuse and dangerous oral side effects. Often these rinses are used as a hygiene aid because they are quick and easy, yet their breath freshening properties could be masking the halitosis associated with poor oral hygiene, dental decay or an underlying systemic condition. This emphasises the important role dentists and oral hygieneists play in recommending products and care that is suited to each patient’s needs. However, the authors believe that rather than advocating any specific mouthwash, it may be more prudent for clinicians to educate their patients into following well balanced diets, limited oral exposure to sugars, alcohols and acids, and to teach them how to brush and floss correctly on a daily basis.

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Oral candidosis: an update on diagnosis, aetiopathogenesis and management

ABSTRACT
Candidosis is the most common oral opportunistic infection and can be caused by any member of the heterogeneous genus *Candida*. Diagnosis is based on clinical features and on microscopic identification of the candidal hyphae or pseudohyphae on a smear or in a biopsy specimen of the lesions tissue. Although *candida* in both commensal and pathogenic forms has similar immunogenic properties, commensal yeasts generate a state of immune tolerance while pathogenic hyphae or pseudohyphae provoke an immunoinflammatory reaction.

The first step in the treatment of oral candidosis is to moderate any local and systemic predisposing factors, and to prescribe a course of topical antifungal agent. Systemic antifungal treatment should be considered only if topical treatment has been unsuccessful or in cases of severe oral candidosis in debilitated or immuno-compromised subjects.

In this paper, we briefly describe the clinical variants, the diagnosis and the management of oral candidosis, and discuss the commonly used pharmacotherapeutic agents.

Key words: oral candidosis, commensal organism, hyphae, nystatin, miconazole, fluconazole, amphotericin B

INTRODUCTION
Candidosis is a common opportunistic oral infection. It is caused by members of the fungal species *Candida*, most commonly by *C.albicans*. The tongue, palate and the buccal mucosa are the oral sites most frequently colonised by the fungus.6,14 *C.albicans* is a unicellular dimorphic fungus that can undergo morphogenetic transition from a commensal yeast form to pathogenic filamentous pseudohyphae or hyphae which can invade tissue and cause symptomatic clinical infection.3,6-8 The pathogenic filamentous forms, but not the commensal yeasts, express genes encoding virulent proteins that can facilitate invasion of oral keratinocytes.9

The mere presence of *C.albicans* in whatever form but without clinical evidence of tissue abnormality cannot be considered to be clinical infection.10,11 Ultimately, the interplay between micro-environmental conditions, systemic and local host factors, and fungal genetic factors will determine whether the candidal micro-organisms will become virulent with the capacity to cause oral candidosis.6,8,11-13

The purpose of this article is to discuss some aspects of the aetiopathogenesis and the management of oral candidosis, focusing on topical antifungal agents.

DIAGNOSIS
Diagnosis of oral candidosis is based on the clinical features of the lesion and on microscopic identification of filamentous fungal elements either in a smear preparation or in a biopsy specimen from the suspected lesion.11,14,15 Although simple and convenient, the sensitivity of the cytological smear tests for erythematous candidosis is low, in contrast to its high sensitivity for pseudomembranous candidosis.6

Although a biopsy is by no means essential for routine diagnosis of oral candidosis, a definitive diagnosis can be made by demonstration of filamentous fungal elements invading the epithelium, with inflammation of the underlying lamina propria. *Candida* can be seen when stained with periodic acid-Schiff (PAS) or with Gram and Gomori methenamine silver, but not with haematoxylin and eosin. The various species of *candida* can be differentiated by the macroscopic characteristics of cultured colonies, by the microscopic morphology of the fungus, by immunohistochemical techniques, and by the polymerase chain reaction technique.6,16,17

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Table 1: Clinical variants of oral candidosis.6,7,14,20

| Pseudomembranous candidosis (thrush) | Discrete white pseudomembranous patches that may become confluent, comprising candidal elements, desquamated epithelial cells, fibrin, inflammatory cells and debris, affecting any oral mucosal site. The friable pseudomembrane can be rubbed off, revealing an underlying erythematous or bleeding surface. Nonspecific soreness or a burning sensation are variable. |
| Erythematous candidosis | Widespread erythema usually of the dorsal surface of the tongue or of the palate. Palatal erythematous candidosis is most frequently denture related. There may be some burning sensation. |
| Angular cheilitis | Manifests as erythematous fissures or macerations affecting both mucosa and skin at the corner of the mouth. Reduced intermaxillary dimension with associated maceration of the angular skin, and nutritional deficiencies are predisposing factors. Staphylococci and streptococci are aetiological co-factors. |
| Hyperplastic candidosis | A white patch that cannot be rubbed off that can affect any oral mucosal site, but most frequently the retro-commissural labial mucosa. The affected epithelium is hyperplastic, acanthotic, and may be dysplastic. |

Table 2: Common risk factors for oral candidosis.14,19,20

| Microenvironmental factors: | • lower pH • increased carbohydrate concentration • increased temperature • nitrogen or carbon starvation • products of inflammation and tissue breakdown • suppressed commensal bacterial population |
| Local factors: | • microtrauma • poor oral plaque control and generalized neglected oral self-care • poorly fitting dentures • reduced salivary flow • radiotherapy to the head and neck • oral cancer • oral immunopathogenic diseases (i.e. lichen planus, mucosal pemphigoid) |
| Systemic factors: | • old age • infancy • pregnancy |
| Nutritional: | • malnutrition • avitaminosis • iron deficiency |
| Medications: | • glucocorticosteroids • other immunosuppressive drugs • cytotoxic chemotherapy • broad spectrum antibiotics |
| Illnesses: | • cell-mediated immunodeficiencies • malignancies • diabetes mellitus • hypothyroidism • hypoparathyroidism • prolonged hospitalisation |

CLINICAL SPECTRUM OF ORAL CANDIDOSIS

There are several clinical patterns of oral candidosis (Table 1) but all have similar histopathological features. The superficial layers of the oral epithelium are penetrated by candidal elements with the formation of intraepithelial microabscesses, and with a chronic inflammatory cell infiltrate in the underlying lamina propria. In hyperplastic candidosis, the oral epithelium is hyperplastic and acanthotic.14,20

Oral candidosis has been said to occur in acute and chronic forms, and there are those who include median rhomboid glossitis and so-called linear gingival erythema in the spectrum of candida-associated oral lesions. In agreement with McCullough and Savage, the present authors are of the opinion that the terms ‘acute’ and ‘chronic’ are redundant and in median rhomboid glossitis, the fungal infection may be adventitious.11

AETIOPATHOGENESIS

The genus Candida comprises about 200 yeast species, with C. albicans accounting for most of candidal infections. However, in recent times, the prevalence of other candidal species in the mouth such as C. glabrata, C. tropicalis, C. krusei, C. dubliniensis and C. parapsilosis appear to have been on the increase as pathogens. It has been reported that candidal species occur as commensals on the normal oral and oro-pharyngeal epithelium of up to 60% of immunocompetent, non-hospitalized subjects who are free of clinically detectable oral candidosis.12,16,20

C. albicans exists in the mouth in three different morphological forms: the yeast cell, also termed blastopore or blastoconidium, the septe filamentous form termed the pseudohypha, and the non-septate filamentous form, the hypha.1,2,14 The yeast cell is commensal, avirulent, does not invade the oral epithelium, and in a healthy host, induces regulatory immune responses mediated by keratinocytes and epithelial immunocytes releasing into the local microenvironment a number of biological agents which induce protective immune responses, preventing the development of clinical infection.13,14

The transition from the commensal yeast form to the potentially pathogenic filamentous forms occurs in response to local micro-environmental stress signals on a background of systemic and local predisposing factors (Table 2). This transition is associated with the production of virulence factors that promote the adhesion of the fungus to the epithelium, colonization, proliferation, and then invasion of the oral epithelium with evasion of protective immune responses by the fungus.14

The outcome of this sequence of events is tissue damage with the induction of an immune-inflammatory response, thus establishing symptomatic clinical infection in the mouth. The effectiveness of the host immune response and the fitness of the invading candidal micro-organism, together with other systemic factors (Table 2) will determine the degree of severity of the infection.14 However, what factors determine the particular presentation of oral candidosis is unknown. Nevertheless, it has been suggested that differences in local cell-mediated immunity and variations in the virulence of different strains of C. albicans are important determinants.18

Candidal filamentous elements, but not yeasts, have the capacity to invade the epithelium. Only those species and strains of candida that produce sufficiently potent virulence factors in response to environmental signals will invade the deeper layers of the oral epithelium, causing damage. An inflammatory reaction is induced in the underlying lamina propria, and a clinically apparent oral infection is seen.21,24
Superficial invasion of the oral epithelium by candidal hyphae is seldom sufficient to bring about clinical evidence of inflammation. The deep invasion of candidal hyphae in the epithelium, however, results in an inflammatory reaction which is protective in nature, and is mediated by Th1 and/or Th17 lymphocytes. Together with their associated cytokines these cells recruit and activate neutrophils and macrophages that are the principle effector cells against the *candida*, causing the clinically apparent inflammation.

If invasion of the epithelium with consequent clinical infection is to occur, the candidal hyphae have to penetrate the epithelial layers at a rate faster than the rate of maturation and desquamation of the epithelial cells, otherwise the fungal elements will be shed together with the shedding keratinocytes.

Oral keratinocytes and dendritic immunocytes are said to have the capacity, through pattern-recognition receptors, to distinguish between the molecular structures of commensal yeast and of filamentous pathogenic forms of *candida*. The commensal yeasts will activate signalling pathways mediating an overall state of immune tolerance without generating an inflammatory response; but the filamentous forms which become invasive will activate signalling pathways mediating protective immuno-inflammatory responses.

### Table 3: Some antifungal preparations available in South Africa for the treatment of oral candidosis

<table>
<thead>
<tr>
<th>Class</th>
<th>Active ingredient</th>
<th>Trade names</th>
<th>Formulation</th>
<th>Administration</th>
<th>Possible side effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topical</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyene derivatives</td>
<td>Nystatin</td>
<td>Nystacid&lt;sup&gt;a&lt;/sup&gt;, Candacie&lt;sup&gt;b&lt;/sup&gt;, Carstat&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Suspension (100 000 IU/mL)</td>
<td>1-2 mL, 4-5x/day, 7-14 days</td>
<td>Swish and expectorate, Unpleasant taste, occasional nausea and vomiting</td>
</tr>
<tr>
<td></td>
<td>Amphotericin B</td>
<td>Fungizone&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Lozenges 10 mg (discontinued in South Africa)</td>
<td>Dissolve and swish 1 lozenge in the mouth</td>
<td>Unpleasant taste, occasional nausea and vomiting</td>
</tr>
<tr>
<td>Azoles: Imidazole derivatives</td>
<td>Clotrimazole</td>
<td>Canesten Troche&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Lozenges (10 mg)</td>
<td>Dissolve and swish 1 lozenge in the mouth</td>
<td>Raised liver enzymes, nausea, vomiting, oral irritation</td>
</tr>
<tr>
<td></td>
<td>Miconazole</td>
<td>Daktarin&lt;sup&gt;f&lt;/sup&gt;</td>
<td>Oral gel (20 mg/g - 2%)</td>
<td>Apply 2.5 mL, 4-5x/day, 14-21 days</td>
<td>Diarrhoea, headache, nausea, vomiting</td>
</tr>
<tr>
<td><strong>Systemic per mouth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azoles: Triazole derivatives</td>
<td>Fluconazole</td>
<td>Diflucan&lt;sup&gt;g&lt;/sup&gt;</td>
<td>Suspension (50 mg/5 mL; 200 mg/5 mL)</td>
<td>50-200 mg/day, 7-14 days</td>
<td>Swish and swallow, Nausea, vomiting, abdominal pain, diarrhoea, headache, skin rash</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diflucan&lt;sup&gt;h&lt;/sup&gt;; Floric&lt;sup&gt;i&lt;/sup&gt;; Difluzole&lt;sup&gt;j&lt;/sup&gt;; Mycocrest&lt;sup&gt;k&lt;/sup&gt;; Fluzof&lt;sup&gt;l&lt;/sup&gt;; Austell-Itraconazole&lt;sup&gt;m&lt;/sup&gt;; Gulf-Fluconazole&lt;sup&gt;n&lt;/sup&gt;; Clpila-Fluconazole&lt;sup&gt;o&lt;/sup&gt;; Aspen-Fluconazole&lt;sup&gt;p&lt;/sup&gt;; Mylan-fluconazole&lt;sup&gt;q&lt;/sup&gt;</td>
<td>Tabs (200 mg)</td>
<td>200 mg/day, 7-14 days</td>
<td>Swallow, Swallow</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Capsules (50, 150, 200 mg)</td>
<td>50-200 mg /once a day, 7-14 days</td>
<td>Swallow</td>
</tr>
<tr>
<td>Itraconazole</td>
<td>Sporanox&lt;sup&gt;r&lt;/sup&gt;</td>
<td>Oral solution (10 mg/mL)</td>
<td>100-200 mg/day, 7-14 days</td>
<td>Swish and swallow</td>
<td>Skin rash, GIT effects, headache</td>
</tr>
<tr>
<td></td>
<td>Sporanox&lt;sup&gt;s&lt;/sup&gt;; Adco-Sporanox&lt;sup&gt;t&lt;/sup&gt;; Mylan- Itraconazole&lt;sup&gt;u&lt;/sup&gt;; Trisporal&lt;sup&gt;v&lt;/sup&gt;</td>
<td>Capsule (100 mg)</td>
<td>100-200 mg/day</td>
<td>Swallow</td>
<td></td>
</tr>
<tr>
<td>Posaconazole</td>
<td>Noxafti&lt;sup&gt;w&lt;/sup&gt;</td>
<td>Oral suspension (40 mg/mL)</td>
<td>200 mg loading dose, 100mg/day 13 days</td>
<td>Swish and swallow</td>
<td>Dizziness, headaches, fatigue, somnolence</td>
</tr>
<tr>
<td>Azoles: Imidazole derivatives</td>
<td>Ketoconazole</td>
<td>Nizoral&lt;sup&gt;x&lt;/sup&gt;, Ketozol&lt;sup&gt;y&lt;/sup&gt;, Sandoz-Ketoconazole&lt;sup&gt;z&lt;/sup&gt;</td>
<td>Tabs (200 mg)</td>
<td>200-400 mg daily</td>
<td>Swallow, Hepatotoxic!</td>
</tr>
</tbody>
</table>

*For all topical agents, the residue must remain in the mouth and not rinsed away with water; # As almost all the azoles have potential to interact with other medications, before prescribing any of the azole derivatives the clinician should consult the MIMS*  
*All preparations in liquid form should be swished vigorously in the mouth for at least 90 seconds.*

<sup>a</sup>Aspen Pharmacare, Woodmead, South Africa;  
<sup>b</sup>Be-Tabs Pharmaceuticals (Sun Pharma), Centurion, South Africa;  
<sup>c</sup>Bristol-Myers Squibb, Sandton, South Africa;  
<sup>d</sup>Bayer, Isando, South Africa;  
<sup>e</sup>Janssen Pharmaceutica, Sandton, South Africa;  
<sup>f</sup>Pfizer South Africa, Sandton, South Africa;  
<sup>g</sup>Cipla SA, Bellville, South Africa;  
<sup>h</sup>Zydus Healthcare SA, Potchefstroom, South Africa;  
<sup>i</sup>Sandoz SA, Pinetown, South Africa;  
<sup>j</sup>Austell Laboratories, Johannesburg, South Africa;  
<sup>k</sup>Gulf Drug Company, Mount Edgecombe, South Africa;  
<sup>l</sup>Mylan South Africa, Modderfontein, South Africa;  
<sup>m</sup>Adock Ingram, Bryanston, South Africa;  
<sup>n</sup>Sanofi Aventis South Africa, Midrand, South Africa;  
<sup>o</sup>MSD/Schering-Plough South Africa, Midrand, South Africa.
The transition of *candida* from a commensal to a pathogenic form causing clinical infection is associated to a great extent with any reduction in the inherent fitness of the immune system. To a lesser extent the transition is influenced by changes in the microenvironment in response to antibiotic treatment, xerostomia, malignancy, systemic chemotherapy, pregnancy, or diabetes with possible secondary reduction in the fitness of the immune system.8,11,19

To add to the complexity of the pathogenesis of oral candidosis, it is now evident that in the mouth, *candida* usually resides in mixed fungal-bacterial biofilms encapsulated in, and protected by, a matrix of glycoproteins and polysaccharides. Within this biofilm, the bacterial-fungal interactions influence the morphogenetic status, virulence, proliferation and survival of *candida*.1 Nutrient availability, saliva composition and flow dynamics, and the level of oral cleanliness are some of the local factors that determine the density, thickness and the biological properties of the mixed biofilm.2

**TREATMENT OF ORAL CANDIDOSIS**

A thorough medical and dental history, and a comprehensive oral examination are essential to identify the presence of predisposing factors for oral candidosis (Table 2). Where possible, such predisposing factors must be eliminated or modified, otherwise the benefits of anti-fungal treatment may be transient.7,19 Regardless of any systemic risk factor, guidance should be provided with regards to improving nutrition and oral health care, cessation of cigarette smoking, and reduction of sugar intake.10,19 Removal of dentures of patients with oral candidosis must be well-fitting, thoroughly cleaned both physically and chemically, proper dentogingival plaque control should be effected and the patient be instructed to use an appropriate antimicrobial mouthwash.25,26

Owing to its effective antimicrobial activity against a broad spectrum of micro-organisms, including *candida* species, chlorhexidine gluconate is frequently used adjunctively in the treatment of oral candidosis, as a twice daily 0.2% mouthwash, and in a 2% solution as an overnight denture disinfectant.27,29 As it is evident that *candida* proliferates and survives within protective biofilms that are relatively resistant to drug penetration, it is imperative to mechanically disrupt the integrity of the biofilm as soon as oral candidosis is diagnosed. This will interfere with the fungal-supportive ecosystem and will permit the antifungal agent to come into contact with the fungus more readily.30 Therefore, when brushing the teeth, the gingiva, the dorsum of the tongue and the buccal mucosa should also be gently brushed.

Candidal microorganisms are eukaryotic cells having organelles identical to those of human cells. Therefore, there are not many classes of antifungal pharmacotherapeutic agents that are both effective and non-toxic.10,30 In general, oral candidosis is treated with topical agents which may be either fungicidal or fungistatic. It is preferable to start treatment with topical agents as their side effects and interactions with other drugs are less significant than are those of systemically administered antifungals (Table 3). Frequently used topical antifungal agents include the polyenes, amphotericin B and nystatin, and theazole, miconazole.12,21,32 Polyenes interact with the ergosterol component of the fungal cell membrane, increasing its permeability, allowing leakage of the cytoplasmic content and consequent death of the fungal cell. Polyenes are poorly absorbed by the gastrointestinal tract making them safe for use, with little side effect (Table 3). However the unpleasant taste, and the multiple dosage regimen tend to make for poor patient compliance.27,33-35 Patients who do take these drugs are inclined to quickly swallow or spit them out, before there has been sufficient contact time for therapeutic effectiveness,34 so the patient should be warned about the bad taste, and motivated to use the preparation correctly.

Azoles inhibit the biosynthesis of ergosterol with functional alterations of the fungal cell wall and consequent inhibition of cell multiplication, or cell death.36 Fluconazole and itraconazole given systemically orally are well absorbed in the gastrointestinal tract, and some of the fluconazole is secreted in the saliva giving it an additional topical effect.27 Azoles also inhibit several hepatic cytochrome P450 (CYP) microsomal enzymes, including CYP2C9 which is an enzyme involved in the metabolic breakdown of warfarin, so that the blood concentration of warfarin rises, increasing the potential for bleeding. Even topically applied miconazole oral gel, believed to be only negligibly absorbed in the gastrointestinal track, may result in an increase in the blood concentration of warfarin.37,38

As many other drugs, including diazepam and ritonavir, are metabolized in the liver by the cytochrome P450 enzyme system, the risk of hazardous interactions with azoles, which inhibit the action of the enzyme system, is significant. The prudent clinician should consult the Monthly Index of Medical Specialties Desk Reference (MIMS), before prescribing azoles.37,38 Therefore, nystatin and amphotericin B which are not absorbed in the bowel and thus do not have any significant drug interactions, are to be preferred for the treatment of oral candidosis in patients who are taking other drugs (Table 3).42

As a general rule, any topical agent used in the mouth should be left in situ for as long as possible and accordingly the patient must be instructed not to eat, drink, rinse the mouth or brush the teeth for 40-45 minutes after each dose.41 Any of the topical antifungal agents listed in Table 3 should be equally effective for first line treatment, if correctly used.

If the oral candidosis does not respond to a course of a topical antifungal, the agent should be changed. If treatment is still unsuccessful, the patient should be referred to a specialist in oral medicine for evaluation and for possible treatment with a systemic antifungal agent.8 Systemic antifungal agents used for the treatment of moderate, severe or refractory oral candidosis include fluconazole, itraconazole, posaconazole and ketoconazole. These agents should preferably be given in a liquid form as the local effect, if the patient is instructed to swish-and-swallow, appears to be additionally beneficial. Fluconazole should be used as the first choice systemic antifungal agent.13

**SUMMARY**

About 60% of healthy subjects have *candida* in their mouths as commensals. In the great majority of subjects, oral mucosal immunity mediates tolerance of yeast forms, limits colonisation by the potentially pathogenic filamentous forms and generates immuno-inflammatory
protection against invasion. Topical antifungal agents are the first line of treatment of oral candidosis. As a general rule, any topical agent used in the mouth should be left in situ for as long as possible, and accordingly the patient must be instructed not to eat, drink, rinse the mouth or brush the teeth for 40-45 minutes after each dose. If topical treatment proves to be ineffective, then a systemic agent should be prescribed.

Conflict of interest: None declared

References


INTRODUCTION

Consider this proposed study.

Aim: This cohort case study will use a causal, cross-sectional design, based on historical records, to explore and describe the long-term, sequential effects of eating.

H₀: This study will provide evidence to disprove the null hypothesis that “Of those who acquire the habit of eating, very few survive.”

By the end of this paper, it is hoped that you will understand each of the terms mentioned above, as well as how and when to use them depending on the study design. You may also then realize how ludicrous it is to use repetitive, redundant, superfluous, verbose, illogical jargon – not to mention that this study is impossible to carry out! The only hypothesis that could be proven with a hundred percent confidence is the alternative (H₁), namely, the well-known cliché that “A little knowledge is dangerous.”

Research begins with the formulation of a clear question, collection of evidence focused around that specific problem, analysis of the results, followed by a critical appraisal of their validity (closeness to the truth) and relevance (importance and usefulness). In order to do this, the study design needs to be appropriate for the specific problem, bearing in mind the levels of achievable evidence.

This paper will explain the different research study designs, highlighting Uses and Limitations of each, to help researchers select the one most appropriate for their needs. However, it is good to keep in mind where each fits into the “The Evidence Ladder” (Table 1), as that will affect the strength of the results which are to be published.

Study design refers to the plan used to address a research problem. The nature of the problem should guide the selection, and will determine which model will most effectively obtain the evidence needed to answer the designated question. It comprises the blueprint that will be used for data collection, measurement and analysis. In general, clinical research can be experimental or observational.

In experimental enquiry, the researcher has control over some form of intervention. In observational enquiry, the research participants/patients are observed at a specific time (cross-sectional) or over a time period (longitudinal). Where the observation looks forwards to gather new data it is a prospective study, while those that use existing data (e.g. old records) are retrospective studies.

Designs can vary considerably, but regardless of which is chosen, it should achieve the following objectives:
1. Identify the problem clearly.
2. Review, synthesize and critically analyze relevant published literature.
3. Specify a clear research question related to the problem (the hypothesis).
4. Describe which data is needed to test the hypothesis, and how the data will be obtained.
5. Justify which methods of analysis will be used to test the hypothesis
6. Critically appraise the evidence, assessing its validity (closeness to the truth) and relevance (importance and usefulness).

ACTION RESEARCH

Once a problem has been identified, some form of intervention (action) is carried out during which time observations are made pertaining to the outcomes. The intervention may be repeated in cycles over time until there is sufficient understanding of the problem.

Uses: Projects based on this type of research have no controls and are most suited to community situations, where the focus is on finding implementable solutions rather than testing theories. As Heinrich Heine observed “You cannot feed the hungry on statistics.”
LIMITATIONS: The projects are harder to conduct and to write up than conventional research, are subject to personal involvement and bias, and are time consuming as the studies occur in cyclical stages.

OBSERVATIONAL STUDIES
These compare subjects against a control group, the researcher having no control over the experiment. There are two types, direct observations where the subjects know they are being watched, and unobtrusive methods where they are unaware of being observed. Such studies are used for questions of diagnosis, prognosis and causation (and may then be called epidemiological studies).

USES: Observational studies are good in situations where it is unethical or impractical to carry out large research projects. Their structure is more flexible because there is no intervention, merely observation, and data is emergent over time. They are good for studying interactions amongst group participants. Results may reflect real life situations.

LIMITATIONS: Reliability is low and behavioral studies are almost impossible to replicate. The findings reflect only that study population and as such may not be generalized to other populations. They are susceptible to observer bias where the researchers see “what they want to see”, while the group under scrutiny may also behave differently, knowing they are being watched. The outcomes cannot be used to deduce any form of cause and effect relationship. A drawback in the reporting is that “Statistics do not convey emotion. They merely shock us for a while and then we move on” (Madeleine M. Kunin).3

CASE STUDIES
These are usually used to describe a rare condition or to explain a novel innovation, and involve an in-depth study of a particular situation. The detailed description may alert others to an important new problem who may try to narrow down a broad field into smaller, easier to test theories. However, along with expert opinions, case studies are considered the lowest levels of evidence.3

USES: These studies are used to examine real-life situations about which very little may be known, and to determine whether the observations can be applied to a broader population. They help provide detailed descriptions of rare conditions.

LIMITATIONS: Due to the single / small number of cases, the studies are uncontrolled, unreliable, and the results cannot be generalized to wider groups. They can also not be used to assess cause and effect relationships. Remember, “Society and medicine tend to treat us all as members of populations, whereas individuals are all unique, and population statistics do not always apply” (Craig Venter).3

CASE-CONTROLLED STUDIES
In these studies, people with a condition (the cases) are matched with a group of people who don’t have the condition (the controls). The researchers investigate historical data to try to identify whether the cases had been exposed to any common factor that may have led to the condition.

USES: They are quick and inexpensive to carry out and are useful for rare disorders, or conditions where there is a long delay between exposure and outcome.

LIMITATIONS: the main disadvantage is they rely on memory, in which case they may be prone to “recall bias”, or depend on medical records which may be inconsistent, incomplete or inaccurate.2

COHORT DESIGNS
In these studies, it is already known that a group of people have been exposed to some treatment or causative agent (e.g. a vaccine, drug, environmental toxin). These will form the study group, the treatment /exposed group. A separate cohort is drawn from the same population to which the study subjects belong and form the control group, the non- exposed sample. The two groups must be linked by some common feature that is relevant to the problem being investigated. This is easier than trying to look at an entire population. The subjects are then followed forward in time to see how many of each group develop a disease or outcome. The outcomes may be quantitative, in which case statistical occurrences within that subgroup will be analyzed, or qualitative, in which instance data is gathered by observation. Cohorts can be “open” or “closed”. Open cohort studies are dynamic and the study population varies with time, thus the involvement of each subject is relevant only for the duration of time in which they are being studied. Cohort studies are used to calculate rate-based data. Closed cohort studies use static populations. There is a set number of participants, which may remain constant or decrease due to dropout.

USES: They are less expensive and easier to carry out than randomized control trials (RCTs). In addition they can be used where a RCT would be unethical (e.g. you cannot expose a healthy population to study its effects, or withhold a potentially beneficial drug. Thus the test cohort would be a group of people who had previously been exposed to the toxin). Such a study would help to confirm the cause and effect relationship, and make it possible to monitor effects over time.

LIMITATIONS: The researcher cannot guarantee that cohorts are properly matched or that there are no other confounding variables between the two populations. Not satisfying these conditions could affect the results. The tests can compare the two groups only in terms of the one similar variable, and may take years to complete, as the researcher has to wait to observe whether the condition of interest develops. There is no random selection and thus few external validity. Consider yourself as part of a cohort of friends, “Statistics show that one out of every four South Africans is suffering from some form of mental illness. Think of your three best friends. If they’re okay, then it’s you!” (with apologies to Rita Mae Brown).3

LONGITUDINAL DESIGNS
These are a variation of cohort studies having only one group who have been exposed to some toxin or have been diagnosed with early stages of a disease. They are then followed with repeat observations and evaluation at set time intervals.2 This allows the researcher to track changes over time and to see how changing variables may influence the status. They help establish the direction and magnitude of causal relationships.

USES: They allow an analysis of the duration of a phenomenon, and measure changes in variables over differing time periods.
Limitations: In these studies there is a presumption that trends will remain unchanged, which is often not the case. In addition, the data collection methods and technology may change, both of which necessitate additional qualitative analysis to explain the fluctuations. A large sample is required, assembled under accurate sampling methods and the study takes time to complete. There is the added difficulty of maintaining the same sample over an extended time (sample attrition), and as a result the investigation is usually limited to studying just one variable at a time. For example tobacco usage where "Smoking has been shown to be a leading cause of statistics" (Fletcher Knebel).3

CROSS SECTIONAL DESIGNS
These studies try to establish an association between a causal factor and a condition.2 They have three key features: there is no time dimension (they happen at one specific point in time), they rely on existing differences (no changes due to an intervention), and groups are selected based on these existing differences (no random allocation). They can measure differences only, can establish an association, but changes are not considered nor can the data be used to make causal inferences.

Uses: They provide an overview of a specific event at a set point in time. There is no intervention on the part of the researcher, and all data is collected at that one time. The sample populations are purposefully selected based on existing differences, and the method can be used to study large populations. Survey techniques are generally used, which are quick and inexpensive to conduct.

Limitations: Identification of the sample population is not easy. Results are time bound and static, and cannot be used to predict sequences or progressions, nor to establish cause and effect relationships. There is no follow up, and thus the possibility exists that a different result could have been achieved if the same populations were to be studied at a different time.

EXPERIMENTAL DESIGNS
These follow a strict blueprint where all factors that may affect the results are under the control of the investigator, and the studies provide the highest levels of evidence. They are used in causal and effect situations, where cause precedes effect, where there is consistency between cause and effect, and where the two are closely correlated. They can be controlled, where there is an experimental and control group, randomization, and an intervention (the independent variable) administered to the former and not to the latter. Both groups are measured and compared on the same dependent variable. Uncontrolled experimental studies have no control or use historical data for the control and as such are very weak because circumstances may have changed, they are prone to bias and there is no guarantee of reliability and standardization of data collection.4

Uses: The researcher controls the situation in order to find out what causes an event, to identify cause and effect, and to distinguish placebo from treatment effects. Observational studies include case studies, cohort designs, case-controlled studies and cross-sectional studies.

Limitations: The intervention is artificial, and as such, the results may not be generalizable to the whole population. In addition, this setting could alter the research subject’s natural behaviour. They can be costly. For ethical or technical reasons, many problems cannot be studied with experiments, where “Consumers are statistics, patients are people” (Stanley Marcus).3

DESCRPIITIVE RESEARCH
These provide answers to questions of Who, What, When, Where and How, but cannot establish Why! They describe the current status of events, situations and conditions.

Uses: They allow for observation of subjects in a completely natural environment, and are often used prior to conducting a qualitative study to give the investigator a general overview of the situation, and help develop a more focused study.

Limitations: Although a large amount of data may be collected, the results cannot be used to provide definitive answers or disprove a hypothesis. Most studies are based on observations and thus cannot be replicated, and heavy reliance is made on observer related factors. In science one may tend to forget that “Life is not just a series of calculations and a sum of statistics. It’s about experiences, and participation, and is more complex and so much more interesting than what is obvious” (Daniel Libeskind).3

CAUSAL DESIGNS
These test the effect that a specific intervention or change has on an existing condition. They can be seen in terms of a condition statement: “If X, then Y, where X is the phenomenon that changes (the independent variable), and Y is the resulting situation (the dependent variable).” For any causal relationship to be valid, there needs to be an empirical association between the two variables, they must occur in the appropriate time sequence (cause must come before the effect), and they must not be confounded by some other variable(s).

Uses: These more searching designs help the understanding of how things work, based on linking variables and eliminating other influences. As such, they should be replicable.

Limitations: Not all relationships are causal, and it is difficult to prove that events may not be the result of other confounding variables. Thus, causality can only ever be inferred but never proven. There is a common statistician’s warning that “Correlation is not causation” (Thomas Sowell).3

EXPLORATORY DESIGNS
These are used to gain insight into situations where there have been very few previous studies, and form a basis for future research. They are very flexible and help address issues of all types (What, Why and How?).

Uses: They are good for gaining background information. They allow the researcher to form a clear picture of the details, settings and concerns, to generate new ideas, to formulate a tentative hypothesis, to determine whether a study will be feasible, and may help direct future research.

Limitations: They use small samples, and are exploratory in nature, thus findings cannot be applied in general, and definitive conclusions cannot be drawn. While the approach may be flexible, it is often unstructured and thus
lacks the usual rigorous standards of data collection and interpretation needed to draw conclusions. Mark Twain may have been suspicious of how investigators define the term “flexible” in exploratory studies when he mused “Facts are stubborn, but statistics are pliable.”

**HISTORICAL DESIGNS**

These entail collecting, verifying and evaluating past evidence in order to support or refute a hypothesis. The major limitation is that they rely on many types of documentary evidence like records, logbook, reports, archives and collections. It is difficult to ensure that the results are authentic, reliable and valid.

**Uses:** They are unobtrusive and have no actual interventions that may affect their results, or be biased by researcher-participant interactions. They are good for studying trends, providing background information, and can be used repeatedly for different studies or to replicate previous findings.

**Limitations:** They are totally reliant on the amount and quality of historical data available, which cannot be manipulated in any way to suit current conditions. They can be time consuming. Other major limitations are missing data, inconsistent reporting style or persons, personal biases, lack of control and internal validity, or gaps, which need to be identified and acknowledged. One hopes that these archived records are not akin to the ancient historical documents that Stephen Leacock mentioned when he stated that “In ancient times they had no statistics so they had to fall back on lies.”

**PHILOSOPHICAL DESIGNS**

Based on a broad approach, the philosophical approach sets out to challenge deeply embedded assumptions. Rational arguments are applied to challenge the relevance, logic and evidence about fundamental issues. The study can take on one of three forms:

- Ontology - describes the nature of reality (What is real and what is not?)
- Epistemology – explores the nature of knowledge and on what it depends. (How can we be certain of what we know?)
- Axiology – studies values and how these relate to interest, desire, will, experience and means-to-an-end. (What is the difference between a matter of fact and a matter of value?)

**Uses:** They provide a basis for ethical decision making, for understanding the purpose of research, and to help refine concepts and theories. Philosophy informs the methodology and critical thinking, and offers clarity to the practical and theoretical use of terms, concepts and ideas.

**LIMITATIONS:** The analysis is very abstract, answering “So what?” types of questions. Writing is often dense, replete with jargon and excessive quotations. It has limited practical use, as it is difficult to move from the philosophical thoughts to application in real-life issues. Philosophically, “If we knew about the real facts and statistics of mortality, we’d be terrified” (V.S Ramachandran).

**SEQUENTIAL DESIGNS**

These are carried out in a deliberate staggered approach, where one stage is completed and then followed by the next and so forth, with each stage building on the previous, until enough data is gathered. As such there is no predetermined sample size, as the researcher will analyze data after each sample set, decide whether or not to accept the null hypothesis, the alternate hypothesis or to repeat the study on a new group of subjects. Thus, a limitless number of subjects can be studied before a decision is taken by the researcher. Sequential designs can be quantitative in which case a sampling technique will be used to gather data and statistical methods will be used for analyzing the results. If a qualitative framework is used, then methods such as interviews and observations are used for data collection.

**Uses:** There is a limitless sample size and sampling schedule. Due to the sequential nature, there is scope to make minor changes in the study design with each new study population based on findings from the previous results. As such, it is useful for exploratory research, as it requires little effort, expense, time and workforce.

**LIMITATIONS:** The sampling is not randomized, each sample is usually small, and samples are not representative of the entire population, meaning that the findings cannot be generalized. It is also difficult to account for and interpret variations between sample groups over time.

**META-ANALYSES**

These advanced investigations systematically evaluate and summarize results from a number of previous studies. This serves to increase the overall sample size, allowing the researcher to develop a new understanding of a problem by applying critical reasoning to all of the combined results. They are good for analyzing differences in results between studies, which increases the precision of estimating effects. They must adhere to strict criteria of study selection, and depend on the accuracy of the results and analysis of each study. They become difficult to interpret when there are major differences in findings between studies. In order for a meta-analysis to be considered valid, the researcher must:

- Clearly define the objectives
- Formulate precise definitions of the variables and outcomes being evaluated
- Have good justification for identification and selection of the included and excluded studies
- Be able to assess and acknowledge research bias
- Evaluate the degree of heterogeneity among the sample sizes in each study, and
- Justify the techniques used to evaluate the studies.

**Uses:** Meta-analyses help identify gaps in the literature, allow for review of one topic over an extended time period and from a variety of sources, and help clarify which policies can be scientifically justified. They also overcome the problem of small sample sizes and highlight research problems for future studies.

**LIMITATIONS:** They are very time consuming, and data may be meaningless if the criteria used for analysis are not clear and strictly adhered to. The lack of uniformity within studies can make it difficult to synthesize the results. Ben Bernanke was correct in warning that “Aggregate statistics can sometimes mask important information.”
RANDOMIZED CONTROL TRIALS (RCTs).

These represent one of the highest levels of evidence (Table 1). In RCTs, participants are randomly allocated into one of two groups. The first group (the experimental group) receives the experimental treatment, while the other (the control) receives conventional treatment, a placebo or nothing.

**Uses:** They are used in many types of research, and are the best for questions related to therapy, such as testing of new drugs, devices or surgical procedures. These studies may be further divided into:

- a) Single blind, in which participants do not know in which group they are allocated so as not to influence their behaviour. However, the researcher DOES know who is in each group, which could jeopardize the study as the researcher can subconsciously influence the participants or the results.
- b) Double blind, in which neither the researcher nor the participants know the assignments to the groups. A third party will be privy to this information and can make it available at the completion of the study for analysis of the results. It is most useful when the control group receives an identical placebo drug. However, this cannot be used in a number of studies for ethical and acceptability reasons, such as a patient receiving “sham surgery”. These would then be considered “open” trials, as the investigator and patient know the intervention. One way to overcome this problem is to have three other persons blinded. Firstly someone other than the original investigator should evaluate the outcomes, secondly the statistician doing the analysis should not know details, and finally the investigators who write up the results should also be independent (this seldom actually happens). RCTs are so highly valued because the randomization keeps both groups as similar as possible, which along with blinding, sample size justification, and appropriate outcome measures and statistical analysis, help minimize bias.
- c) Two special types of RCTs used often in Dentistry are the cross-over studies and split-mouth designs. They require smaller sample sizes to detect an effect, but they need to adhere to stringent criteria and may be associated with ethical and technical issues.

**Limitations:** They may be difficult to carry out due to ethical, legal or technical factors.

INTEGRATIVE STUDIES

It is not advisable to base major clinical decisions on results of a single trial – no matter how large or well executed. Thus integrative studies take all relevant information from previous research that address the same issue and collate this into a systematic review. When it is possible to analyze the combined results statistically, it is called a quantitative systematic review or a meta-analysis.

**Uses:** Although these studies are retrospective observational research, they adhere to stringent inclusion and exclusion criteria and use scientific methods to control for bias. As such they are considered to provide the highest levels of evidence in the hierarchy.

**Limitations:** The researcher is required to carry out a thorough in-depth literature search, and to adhere strictly to the pre-established inclusion and exclusion criteria.

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**Table 1: The Evidence Ladder.**

<table>
<thead>
<tr>
<th>Evidence Ladder (From highest to lowest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-quality systematic reviews</td>
</tr>
<tr>
<td>Large randomized trials with clear-cut results</td>
</tr>
<tr>
<td>Small randomized trials with uncertain results (positive trends but no statistical significance)</td>
</tr>
<tr>
<td>Non-randomized trials with contemporary controls</td>
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<tr>
<td>Non-randomized trial with historical controls</td>
</tr>
<tr>
<td>Cohort studies</td>
</tr>
<tr>
<td>Dramatic results from uncontrolled studies</td>
</tr>
<tr>
<td>Reports of expert committees and opinions of respected authorities, based on clinical experience</td>
</tr>
</tbody>
</table>

Differing study designs, samples and analysis methods may make it impossible to compare results, despite the topics being the same.

GRADING EVIDENCE

Judging evidence in Dentistry is difficult due to the clinical nature of the discipline and variations in operator technique and skills. Guyatt (1992) proposed an evidence-based approach to tackle these challenges, stipulating that there should be formal rules for evaluating the trustworthiness of evidence. This led to the development of "The Evidence Ladder / Pyramid" (Table 1) which ranks evidence from the highest (top), to the lowest (bottom). Case reports and expert opinions are considered the lowest, while meta analyses and RCTs are ranked topmost in terms of reliability and biological plausibility. (Note that a low level does not imply poor quality or low value, but is used as a basis for making clinical decisions for humans.) Low level study designs often lead on to the formulation of more in-depth hypotheses and studies.

CONCLUSIONS

In conclusion, while one needs to acknowledge that research, science and advancement have beneficial potential, we must always remain cognizant that patients are people, and NOT as Horace put it "We are all just statistics, born to consume resources." In addition, all the evidence in the world means nothing unless findings are published and recommendations are implemented. After all, “Quoting statistics won’t stop the globe from warming if the globe is actually, you know, warming!” (Clive Thompson).3

**References**


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1 COMPLETE SENSITIVITY TOOTHPASTE
SPECIALLY DESIGNED WITH
7 BENEFITS*

Stannous fluoride forms a robust layer over the exposed dentin and within the exposed dentin tubules. This layer starts to build from first use and continues to build with twice-daily brushing.

Clinically proven relief from dentin hypersensitivity pain after 8 weeks.

Reduction in dentin hypersensitivity from baseline after 8 weeks.

Up to 20% reduction in plaque build-up after 24 weeks compared to regular fluoride toothpaste.

Helps control dental plaque.

29% improvement in gingival inflammation after 24 weeks compared to regular fluoride toothpaste.

Supports good gingival health.

For any product safety issues, contact GSK on +27 74 560 01 or 0800 118 274.
NEW SENSODYNE® COMPLETE PROTECTION PROVIDES ALL-ROUND CARE FOR YOUR PATIENTS WITH DENTIN HYPERSENSITIVITY*1-5

Stannous fluoride forms a robust layer over the exposed dentin and within the exposed dentin tubules. This layer starts to build from first use and continues to build with twice-daily brushing.

Clinically proven relief from dentin hypersensitivity pain†2,3

Helps control dental plaque4,5

Supports good gingival health4,5

Up to 66% reduction in dentin hypersensitivity from baseline after 8 weeks†3

20% reduction in plaque build-up after 24 weeks compared to regular fluoride toothpaste4,5

29% improvement in gingival inflammation after 24 weeks compared to regular fluoride toothpaste4,5

With twice-daily brushing, Parkinson C et al., 2013 reported a 33% reduction from baseline in Schiff sensitivity score at Week 8 for a stannous fluoride toothpaste. Sensodyne® Complete Protection combines active ingredient 0.454% stannous fluoride with 5% sodium tripolyphosphate to help prevent extrinsic tooth stain historically associated with stannous fluoride-containing toothpastes.4,5


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Sedation providers are often faced with difficult decisions when they plan a sedation technique for very anxious patients. Not only must they decide which technique to use, but they need to assess the patient’s suitability for sedation in the surgery.

Sedation guidelines indicate which patients can safely undergo sedation in the dental surgery. There are particular conditions that may preclude surgery-based sedation e.g. the obese patient.

Keywords: Obesity, Body Mass Index, ASA status

The most important and crucial question is whether the obese patient is suitable for safe sedation in the dental surgery? All international sedation guidelines recommend that only ASA 1 and 11 patients can be sedated in primary care. So we need to understand what in fact are ASA 1 and 11 patients?

According to the ASA classification (American Society of Anesthesiologists Physical Status Classification System), only patients with an ASA I (normal, healthy) or ASA II classification (patient with mild systemic disease) qualify for sedation outside the traditional theatre, or hospital environment. The classification is often used to evaluate the patient before sedation but it is only a clinical status evaluation; not a risk assessment, especially in the case of our obese patient.

Furthermore, what is the definition of an obese patient? Weight alone unfortunately does not tell us the whole truth about obesity. In general, we use the Body Mass Index (BMI) to tell us whether a patient is obese. It gives us an indication as to what ASA classification applies. The BMI can be calculated by a specific formula: BMI = weight (kg)/ height (meter)^2. Our problem, then, is what should the BMI be in order that we may be prepared to treat the patient in primary care under sedation?

Following is a suggestion of how we can decide in adults. It gives the BMI, obesity grade, and ASA classification.

- BMI < 18.5, underweight
- BMI 18.5-25, normal weight
- BMI 26-29, overweight or pre-obese
- BMI 30-34, obesity class 1, ASA 1
- BMI 35-39, obesity class 2, ASA 11
- BMI > 40, obesity class 3, ASA 1115

Any patient with a BMI of 35-39.9 is seen as severely obese, BMI 40-44.9 as morbidly obese, and a BMI 45 – 50 as super obese. They should not be sedated in the dental surgery or in any primary care facility.

Some clinicians suggest a definition of obesity based on percentage of body fat:
- Men are obese if the percentage of body fat is greater than 25%
- Women, when the percentage of body fat is greater than 33%

The body fat percentage can be calculated from a person’s BMI by using the following formula:
Addt Body Fat % = (1.20 x BMI) + (0.23 x Age) – (10.8 x gender) – 5.4, where values for “gender” are 0 if female, and 1 if male.

Obese patients present special challenges to the sedation provider, even when the provider is qualified and experienced. The biggest challenge is obstructive sleep apnoea (OSA) which is common in obese patients. They must be monitored carefully during sedation as airway obstruction and hypoxaemia can compromise safety. Sedative/analgesic drugs can contribute to respiratory depression. The drugs must be carefully administered intravenously.

Obese patients must be carefully evaluated before sedation for any concomitant disease. A focused airway evaluation is mandatory. The sedation practitioner must...
ensure that all resuscitation and rescue equipment is available in the surgery. It is good policy to keep the reversal agents nearby: flumazenil for benzodiazepines and naloxone for opiates. Pharyngeal collapse is a serious complication during sedation in the obese - mask ventilation or rescue by endotracheal intubation may even be impossible.

The sedation technique used in an obese patient depends on the experience of the sedation practitioner. Transmucosal midazolam, inhalational sedation nitrous oxide/oxygen, or intravenous drugs may be used. Remember that extra large patients do not need extra large doses of sedative drugs; safe sedation always requires careful titration of drugs.

The obese patient should not be sedated in the head-down position. This may decrease the functional residual capacity and the patient’s ability to cope with hypoventilation.

Obese patients often have restricted mouth opening, increased soft tissue due to fat deposition in their cheeks and pharynx and are therefore at higher risk for upper airway obstruction. Opening the airway with mild neck extension and chin elevation will decrease the risk of obstruction. The surgeon also plays an important role by not depressing the jaw while operating.

For analgesia, instead of using an opiate, consider using an alternative opioid such as Tramadol since it does not depress respiration. And do consider the use of the NSAID’s and/or paracetamol. The patient must be carefully monitored, clinically and electronically by all the members of the sedation team.

Obese patients may be on appetite suppressants which may cause serious adverse events e.g. hypertension when a vasoconstrictor is used with the local anaesthetic. Appetite suppressants should be stopped two weeks before administering procedural sedation.

Pulmonary aspiration remains a threat in the obese patient. It is advised that a histamine (H2) receptor antagonist be administered before sedation to reduce gastric volume and acidity. Fasting before sedation is a must in the obese.

Ensure that obese patients are fully recovered before discharge ...and then only with an escort.

CONCLUSION

Procedural sedation for obese patients can be a great risk in a primary care facility. Risk stratification and classification of the patient’s ASA status and obesity level according to the guidelines are keys to safe practice.

References

Maxillo-facial radiology case 143

This 30 year old female presented with slight pain and discomfort and intermittent attacks of severe, itching pain in the third quadrant. The affected jaw is enlarged (Figures 1 & 2). What is your diagnosis?

**INTERPRETATION**

The cropped pantomograph demonstrates a tooth presenting an extensive carious lesion with widening of the periodontal ligament space, and a well circumscribed diffuse radiopaque mass of sclerotic bone surrounding the root apices (red arrow). This is suggestive of focal sclerosing osteomyelitis, also known as condensing osteitis. The condition can be described as a predominantly proliferative reaction occurring in the periapical region as a result of pulpal necrosis. It is rather common, and is usually found in young individuals, especially before the age of 20 years. The mandibular molar teeth seem to be the most frequently involved. Focal sclerosing osteomyelitis is usually asymptomatic, but some patients have mild symptoms. The only classical sign may be a large carious tooth or a large restoration with marginal deficiencies. The second type of sclerosing osteomyelitis is known as diffuse sclerosing osteomyelitis (Figure 3) which is similar to the focal form except that the proliferative reaction is more generalized and commonly results from generalized periodontal disease instead of pulpal degeneration. Diffuse sclerosing osteomyelitis is not a very common condition. It can occur at any age but, in contrast to focal sclerosing osteomyelitis, is more common in older patients, especially black females. It is also more common in the mandible; especially in the edentulous regions. It is usually symptomatic. The patient complains of tenderness and pain in the affected part of the jaw. These exacerbations are usually accompanied by suppuration, elevated temperature and an increased erythrocyte sedimentation rate. In young patients facial asymmetry is a common feature, resulting from swelling along the lower border of the mandible. In summary, sclerosing osteomyelitis can be described as a predominantly proliferative reaction of bone to infection occurring in patients with high host resistance or a low grade infection. The infection acts as a stimulus rather than irritant, producing proliferation instead of destruction. Bone is deposited along existing trabeculae, resulting in thickening of the trabeculae and reduction or obliteration of the marrow spaces. The success of operative treatment is often questionable, and since in many cases there is a tendency to a spontaneous regression, conservative treatment and observation is often recommended.

**Reference**

The motivation to be ethical

SADJ August 2016, Vol 71 no 7 p329

WG Evans

Ethics is knowing the difference between what you have a right to do and what is right to do.

Potter Stewart (1915 -1985)

Most would agree that in the dentist-patient relationship it is the professional who must carry the major burden of ethical responsibilities, ensuring that at all times the rights of the patient are respected and upheld. It is to this end that the HPCSA has set the statutory requirement that health care workers must acquire a minimum number of Ethical points to satisfy the CPD regulations. Pertinently, it has been suggested that because a right may be regarded as an entitlement to something valuable, a claim to that right requires no justification. Central to this philosophy is the Patients’ Rights Charter, which is based on the Bill of Rights, appearing as Chapter Two of the Constitution.

Moodley and Naidoo explore the somewhat paradoxical situation wherein one person may well be entitled to enjoy a particular right, and another person may have an obligation to ensure that the right may be enjoyed, BUT that the person enjoying the privilege also has obligations related to claiming that right. A patient legitimately expects certain rights, such as competent and confidential treatment, but also carries in turn a responsibility to heed the professional advice of the dentist.

The South African Department of Health has addressed this intriguing balance and has formulated two documents which succinctly clarify the duality of the relationship, the Patients’ Rights Charter and the Responsibility Charter. Consider the lists developed in that enterprise, as they appear in Ethics and the Dental Team:

**THE PATIENTS’ RIGHTS**

Every patient or client has the right to the following:

- A healthy and safe environment
- Access to health care
- Confidentiality
- Informed consent
- Be referred for a second opinion
- Exercise choice in health care
- Continuity of health care
- Complain
- Participate in decision making that affects his or her health
- Be treated by a named health care provider
- Refuse treatment
- Knowledge of their health insurance /medical scheme policies.

A rider is added: This Charter is subjected to the provisions of any law operating within South Africa and to the financial means of the country.

The reciprocal relationship between care giver and patient is crucial to the success of the delivery of health care. By expecting and accepting these Rights, the patient assumes responsibilities, an action which is central to achieving a sound partnership between dentist and patient. Moodley and Naidoo continue with a summary of the Responsibilities of the Patient.

Every patient or client has the responsibility to do the following:

- Take care of his or her life and live a healthy lifestyle
- Care for and protect the environment
- Respect the rights of other patients and health providers
- Utilise the health system optimally without abuse
- Get to know his or her local health services and what they offer
- Provide health care workers with relevant and accurate information for diagnostic, treatment, rehabilitation or counselling services
- Advise the health providers of his or her wishes with regard to death
- Comply with the prescribed treatment and/or rehabilitation procedures
- Ask what the related costs of the treatment and/or rehabilitation will be and arrange for payment
- Take care of his or her own health records

At the outset it was suggested that it was the professional who must set the standards, and that remains a firm principle. Ethical behaviour resides with and commences with the dentist. There may however be occasion when it is justified that a reminder be given to the patient of the shared partnership responsibilities to ensure successful treatment of a high standard. That may be an action “what is right to do”!

References


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What’s new for the clinician?
Summaries of and excerpts from recently published papers

1. Do adolescents who are night owls have a higher risk of dental caries? – a case–control study


Tooth decay is amongst the most common diseases in the world affecting more than 90% of the world population.1 Dental caries in adult, adolescent and child populations thus remains a major public health problem in most communities around the world despite a significant input of resources in the last few decades.

The risk of developing caries is associated with physical, biological, environmental, behavioural and lifestyle-related factors such as inadequate salivary flow, high number of cariogenic bacteria, frequent intake of food or drinks containing sugar, insufficient fluoride exposure, poor oral hygiene and poverty.1 As dental caries is mainly related to the individual’s lifestyle, and to behavioural factors within a person’s control, it can be prevented by good dietary habits in combination with tooth brushing with fluoride toothpaste twice daily.1 Many adolescents have neither breakfast nor lunch, and they consume too little fruit and vegetables. Furthermore, the consumption of soft drinks and sweets has increased in the last decades. A frequent intake of soft drinks and candy, and a low consumption of fruit and vegetables, increases the risk of an inadequate intake of nutrients and hence an elevated risk of health problems such as caries.

Circadian rhythm is the internal body clock that regulates biological processes in a 24 hour cycle. This internal clock is controlled by two pin-head sized structures in the brain called the suprachiasmatic nucleus or SCN.

The SCN ensures certain body functions work in harmony with our sleep-wake cycle including body temperature, urine production, and hormone secretion like melatonin which is key to helping us sleep. Those who have a rhythm of 24 hours or more, and so belong to the evening sleep-cycle group, might want to postpone their sleep. These evening people are alert in the evening and tired in the morning. People belonging to the morning group have a short circadian rhythm, close to 24 hours. Morning people are more tired in the evening and more alert in the morning.1

As the morning approaches, the body begins to wake up as certain hormone levels change, body temperature rises and the metabolism starts to use carbohydrates as energy.1 If people are not hungry in the morning, it may be due to eating late the night before or because they have been forced to wake up earlier than is natural for their particular circadian rhythm. For people who have a stable circadian rhythm and regular meal habits, hunger will occur at about the same time every day.

Circadian rhythm changes throughout life, and during puberty, morning tiredness is more common than it is later in life. During the teen years, a substantial shift in circadian rhythms takes place and the proportion categorized as evening types increases.2 Young people who stay up late are seldom in phase with the daily rhythm of the rest of society. When it is time to wake up and go to school, they are often tired and not hungry; and therefore, most of them probably choose to stay in bed as long as possible and skip their breakfasts.

Lundgren and colleagues (2016) in Sweden reported on a case-control study that sought to investigate the correlation between dietary habits, oral hygiene behaviour, circadian rhythm and dental caries among adolescents.1

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MATERIALS AND METHODS
This was a comparative cross-sectional, case–control study. Adolescents, 15 to 16 years old, who were regular
patients at the Public Dental Service clinics in Sweden with one dental health examination scheduled for the year ahead, and categorized as healthy (control) or sick (case) at the clinical examination the year before were considered for inclusion in this study. Exclusion criteria were as follows: individuals with a general disease that might influence the development of dental caries, those who were dependent on others for their daily oral hygiene, and individuals who did not understand Swedish. The patient’s dental hygienist or dentist assessed the risk category of each individual and after examination and assessment of their history were classified as: healthy, dubious and sick.

The case group was made up of adolescents categorized as sick (high caries risk) and with two to three new caries lesions documented in their patient records at their previous examinations. The control group was categorized as healthy (low caries risk) and caries-free, that is, no registered decayed or filled teeth in their patient records (decayed-filled-teeth/surface (DFT/DFS) level = 0). The consecutive inclusion continued until both groups were equally large (n=130 in each group) and evenly distributed with regard to gender.

Participants filled in a 31 item questionnaire regarding self-reported oral health, tiredness, sleeping habits, diet, breakfast habits, tooth brushing behaviour and background and demographic data. The instrument consisted of seven items, which dealt with preferences and habits concerning activities and time. The participants were categorized into three groups based on circadian rhythm: evening types, neutral types and morning types, based on the mean value of the sum of the seven questions. A mean value between 1.0 and 2.0 was categorized as evening type, between 2.01 and 2.99 as neutral type, and between 3.0 and 4.0 as morning type.

In the analysis of each question regarding the circadian rhythm, different response options were distributed into four numbers, where “1” was regarded as extreme evening options, “2” and “3” neutral options, and “4” extreme morning options. The relationship between circadian rhythm, case and control, tooth brushing behaviour and breakfast habits were analysed with chi-square test.

RESULTS

A total of 196 individuals of the 260 invited adolescents completed the questionnaire. Of these, 95 (48.5%) were girls and 101 (51.5%) were boys. Of the sample, 91 (46%) individuals were categorized as case (sick) and 105 (54%) were categorized as control (healthy). No statistically significant correlation could be found between case/ control and gender.

The mean circadian rhythm score for evening people was 1.73 (SD 0.04), neutral people, 2.48 (SD 0.02) and morning people, 3.14 (SD 0.03). Neutral types made up the most common category (n = 97 (60%) followed by evening types (n = 72 (37%)) and morning types (n = 27 (13%)). Many of the evening type respondents (82%) reported that they were tired daily or almost daily at school compared with neutral types (53%) and morning types (35%) (P < 0.001). No statistically significant correlation could be found between circadian rhythm and gender.

In the case group, a significantly higher proportion were evening types (22%) compared with the group of caries-free individuals (14%). More individuals in the control group were neutral types or morning types than in the case group (P = 0.003). Around 13% of the adolescents who were evening types reported that they brushed their teeth less often than twice a day compared with 4% of the morning types. Significantly more adolescents among neutral types and morning types brushed their teeth twice daily (P = 0.01). Breakfast habits differed between the circadian rhythm types; 41% of the adolescents who were neutral types reported that they had breakfast every day compared with 22% of evening types. Significantly more individuals among evening types skipped breakfast than did those among morning types and neutral types (P = 0.003).

A total of 143 (74%) adolescents brushed their teeth twice daily, and 141 (72%) had breakfast regularly. In the control group, 88 (62%) adolescents reported that they brushed their teeth twice a day or more compared with 55 (35%) of the adolescents in the case group (P = 0.001). Breakfast habits differed between the case and control group; 53 (38%) of the adolescents in the case group reported that they had breakfast every day compared with 88 (62%) of the adolescents in the control group (P = 0.001).

When the effects of variables associated with dental caries were analysed simultaneously in a binary logistic regression, being an evening person, not having breakfast regularly and tooth brushing less than twice daily were all factors significantly associated with having a high risk of caries (categorized as sick). Belonging to the evening group was the variable most closely associated with having a high risk of caries. The predicated probability of having a high risk of caries (categorized as sick) was almost four times higher for an evening type individual than for a morning type individual (OR 3.8; 95% CI 1.3–10.9).

CONCLUSION

The authors found that adolescents who described themselves as evening types brushed their teeth more seldom, did not have breakfast regularly and had a higher caries risk than morning types. A patient’s circadian rhythm ought to be considered when planning oral health education for adolescents with a high risk of caries.

IMPLICATIONS FOR PRACTICE

Different circadian rhythms have been found to affect young people’s general health. Information on circadian rhythms should be included in oral health education programmes for adolescents as there is evidence that the internal clock of adolescents and their habits and lifestyle is a risk marker for caries.

Reference

Halitosis is a general term used to describe an unpleasant or offensive odour emanating from the oral cavity. It is well accepted that the pathogenesis of oral malodour is associated with the bacterial degradation of sulphur-containing amino acids (methionine, cysteine and cystine) into volatile sulphur compounds (VSCs), the principal components of which are hydrogen sulphide (H₂S), methyl mercaptan (CH₃SH) and, to a lesser extent, dimethyl sulphide ((CH₃)₂S).¹

Increased public awareness and demand for remedies for oral malodour have resulted in a substantial growth of the breath industry and a saturation of the market with breath-improving products such as mints, chewing gum, breath sprays and pills. Although some of these products provide modest breath improvement, the majority have only a short-term ‘masking’ effect on bad breath and are essentially ineffective.¹

A malodourous breath upon awakening is a common condition known as ‘morning bad breath’ (MBB). This problem tends to be transient in nature, in contrast to persistent halitosis. Low salivary flow, particularly during the night, creates a favourable environment for bacterial proliferation and putrefaction and results in physiological ‘morning breath’, which is the most common breath complaint.¹

To reduce MBB, several consumer websites suggest that rinsing with or drinking water upon awakening is effective because MBB can be caused by a dry mouth.¹ The hypothesis is that drinking water helps to stimulate the production of saliva and to saturate the whole mouth.¹ This home remedy is, however, not supported by any scientific evidence.

Van der Sluijs and colleagues (2016) reported on a randomized clinical trial (RCT) that sought to evaluate the effects of the use of water on MBB parameters in periodontally and systemically healthy participants.¹ The secondary aim was to compare the effects of rinsing with water with those of drinking a glass of water.

MATERIALS AND METHODS

Non-dental students from different universities and colleges in and around Amsterdam who had indicated in a database that they were potentially interested in participating in clinical research were notified by email and flyer about applying for a screening appointment. Participants with self-reported MBB at least five times a week were potentially eligible for inclusion. The participants were assessed for the following eligibility criteria: age ≥18 years old; classified as systemically healthy, as assessed by the medical questionnaire, and periodontally healthy, as assessed by a Dutch Periodontal Screening Index DPSI score ≤3 and the presence of at least five teeth per quadrant. Respondents who presented with an orthodontic appliance or a removable (partial) denture or who were smokers were excluded. Additional exclusion criteria were the following: caries, any pathological alterations of the oral mucosa, pregnancy, acute sinusitis or severe oral-pharyngeal infections; any medications that can cause malodour; and a reduced salivary flow due to pathological reasons. In addition, respondents who had participated in a clinical study within the previous 30 days were not allowed to participate.

Prior to the experiment, the participants were instructed to adhere to specific lifestyle rules to avoid factors that may have influenced the oral malodour odour examination. For example, they were told not to eat spicy food or consume alcohol for a period of 48 hours before assessment.

Assessments were carried out during a single visit in the same room where pre- and post-scores were obtained before and after the allocated intervention, which was performed in another room to ensure that the examiner was blinded to the intervention. The clinical assessments were taken between 7:00am and 12:00pm for each participant during the study. Lifestyle rules requested participants to avoid spicy foods, alcohol and the use of any kinds of perfume.

The primary MBB outcome variable was the organoleptic score, which was determined by one blinded examiner who was a trained and calibrated judge. As a refresher, the judge tested the ability to distinguish odours using the Smell Identification Test®; in addition, the judge tested the ability to detect odours at low concentrations using a series of dilutions of the following substances: skatole, putrescine, isovaleric acid and dimethyl disulphide. Each participant was instructed to close his/her mouth for two minutes and then to slowly open his/her mouth at the request of the examiner. Immediately upon the mouth opening, the judge sniffed the dorsum of the tongue of the participant at a distance of approximately 3–5cm.

Participants were instructed to breathe through the nose throughout this procedure. The judge performed two consecutive organoleptic assessments, and the mean of both scores was used as the individual organoleptic score. The organoleptic scale was defined as follows: 0 = absence of odour, 1 = barely noticeable odour, 2 = slight odour, 3 = moderate odour, 4 = strong odour and 5 = extremely strong odour.

In addition, Volatile Sulphur Compound (VSC) assessments were performed using the Halimeter® RH-17 and the OralChroma™ CHM-1 using the data management software: ABIMEDICAL for Windows version 3.5.0. Prior to the study, a calibration of the apparatuses was performed according to the manufacturer’s recommendations. The OralChroma™ and Halimeter® were switched on 24 hours before each visit to enable their acclimatization to the ambient air. Before the assessments, each apparatus was calibrated to approximately zero. A second examiner was responsible for operating this equipment in the absence of the organoleptic judge to avoid introducing any feedback bias to the organoleptic assessment based on the outcomes of the oral malodour equipment. Before the VSC examinations, each participant was instructed to keep his/her mouth and lips closed, to breathe through the nose for two minutes and not to swallow, which facilitated the build-up of VSCs in the oral cavity.

Upon the request of the examiner, the mouth was slightly opened. A sterile disposable syringe was inserted through
this opening into the oral cavity and placed between the front teeth. The participant was instructed to avoid touching the tip of the syringe with the tongue. The piston was subsequently pulled to the very end of the syringe to fill the syringe with a breath sample from the oral cavity. The syringe was then removed from the oral cavity. Any adherent saliva was wiped off the syringe with tissue paper. A gas injection needle was connected to the tip of the syringe, and 0.5ml of the breath sample was discarded. The remaining 0.5ml of the breath sample was injected into the OralChroma™ with a single push. The VSC reading of the OralChroma™ provided the concentration values of H₂S, CH₃SH and (CH₃)₂S in (parts per billion) ppb and ng ml⁻¹. These values were recorded separately, and chromatograms were printed for analysis.

The VSCs were also scored using a portable industrial sulphide monitor (Halimeter®). The unit was zeroed to ambient air before each measurement. A disposable straw was placed between the participant’s front teeth. The participant placed his/her teeth around the straw and held his/her breath as the instrument drew air from the mouth to the sensing chamber. The operator recorded the peak concentration of VSCs, displayed in ppb. The values were recorded, and the mean of these values was determined in ppb of sulphide equivalents.

The tongue coating (thickness and colour) was examined to assess tongue coating. The tongue was assessed from the vallate papillae to the tip, that is the back third, the middle third and the front third as well as from the left to the right, that is the left third, the middle third and the right third. For each of the nine sections, discoloration and coating were visually assessed. The discolouration was scored on a scale from 0 to 4 (0=pink, 1=white, 2=yellow/light brown, 3=brown and 4 = black), and coating was scored according to thickness on a scale from 0 to 2 (i.e. 0 = no coating, 1 = light-thin coating and 2 = heavy-thick coating). Light-thin coating was scored when the pink colour underneath remained visible through the coating. Heavy-thick coating was scored if no pink colour could be observed under the coating. For each section of the tongue, more than 1/3 had to be covered to obtain a score other than 0. As a potential source of oral bacteria, the presence or absence of fissures on the tongue surface was also recorded.

The participants were also asked to provide details about their daily use of oral hygiene tools and products. In addition, their own perception of their MBB before and after the intervention was assessed using a visual analogue scale (VAS). On a 10-cm-long uncalibrated line, 0 corresponded to ‘stale’ and 10 corresponded to ‘fresh’. The participants indicated their perception by placing a vertical mark along this line.

Due to the nature of the interventions, the participants were aware of the intervention to which they were assigned, but they were requested not to reveal this information to the examiners. The participants received and read the detailed written and illustrated instructions in a room shielded from the examiners. Based on the randomization sequence, participants were assigned to the drink or rinse group. The drink group drank 200ml water and were instructed to drink the 200ml of water calmly and gradually within the time frame that was given. The other group rinsed with 15ml water with moderate power on the cheeks, for 30 seconds. A stopwatch was used to keep track of the time of either rinsing or drinking.

RESULTS
A total of 63 participants were screened for this clinical trial; 13 were excluded and 50 participants completed the single visit.

A mean score for each of the nine sections of the tongue surface was calculated. The analysis showed no significant difference in total tongue surface discolouration scores ($P=0.264$) or tongue coating thickness scores ($P = 0.158$) between the groups.

With both regimens, tongue discolouration most frequently received a score of 2 (yellow/light brown) in the posterior and mid-dorsal regions of the tongue. Tongue coating thickness most frequently received a score of 2 (heavy-thick) in the posterior dorsal sections of the tongue. Both tongue discolouration and tongue coating mostly received scores of 0 in the anterior sections (pink and no coating, respectively). The prevalence of tongue fissures was low in both groups (4–6%).

Both regimens yielded a significant decrease in the organoleptic score. The score reduction was 0.46 (0.51; $P=0.01$) in the drinking group and 0.33 (0.48; $P = 0.05$) in the rinsing group. There was no significant difference between the regimens at any time point, nor was the incremental change following the regimen different between the groups ($P = 0.360$). The correlation coefficients between tongue discolouration and organoleptic scores ($P = 0.248$, $P = 0.083$), as well as between tongue coating thickness and organoleptic scores ($P = 0.175$, $P = 0.224$), were small and not significant.

Most of the VSC outcome data measured by the Halimeter® and OralChroma™ showed a non-normal distribution. Following the two regimens, the Halimeter® outcome showed a reduction between the pre- and post-intervention results of 11.12 in the drinking group and 14.17 in the rinsing group, neither of which was significant ($P = 0.884$). Regarding the VSC levels as assessed by the OralChroma™ apparatus, there was a significant decrease in the levels of the two different gases, H₂S and CH₃SH, in both regimens. (CH₃)₂S showed a reverse trend, namely a non-significant increase of 10.77 in the drinking group and 23.14 in the rinsing group was found. None of the OralChroma™ outcomes related to the three gases showed a significant difference between the groups with respect to the incremental changes between pre- and post-assessments.

The mean scores and standard deviations of the subjective perception of the participants related to their MBB before and after the assigned regimen were not significantly different between the two groups. The change in the VAS score in the drinking group was 0.59 (2.00), which was not significant ($P=0.146$). The rinsing group perceived a change of 1.00 on the VAS scale, which proved to be statistically significant ($P=0.001$).

CONCLUSION
The researchers concluded that rinsing with 15 ml water or drinking a glass of 200 ml water had a statistically significant effect on the morning bad breath (MBB) parameters. No significant difference was obtained between the two regimens.

IMPLICATIONS FOR PRACTICE
This trial provided scientific efficacy for two common home “remedies” for the treatment of morning bad breath (MBB). Both drinking and rinsing with water had significant effects on the MBB outcome, with no significant difference found between the two interventions.

Reference
GENERAL

Factors affecting the preparation, constituents, and clinical efficacy of leukocyte- and platelet-rich fibrin (L-PRF). (p 298)

1. In Choukroun’s method, the use of a specific centrifuge and a specified relative centrifugal force are imperative.
   a. True
   b. False

2. Scanning electron microscopy did not reveal any variations in cell morphology and fibrin architecture, in the L-PRF clots produced by different centrifuges.
   a. True
   b. False

3. When L-PRF is used, Bone Morphogenetic Proteins (BMP) have been shown to be released from.
   a. Platelets and Leucocytes
   b. Platelets and erythrocytes
   c. Osteocytes and leucocytes
   d. Platelets and myocytes

In vitro antimicrobial comparison of three commercially available chlorhexidine-based oral rinses (p 304)

4. Chlorhexidine has no antifungal properties.
   a. True
   b. False

5. Corsodyl® is an alcohol free mouthrinse.
   a. True
   b. False

6. Curasept® ADS 220 is a chlorhexidine free mouthrinse.
   a. True
   b. False

7. GUM® Paroex® contains 5% Cetyl Pyridinium Chloride.
   a. True
   b. False

Availability, indications for use and main ingredients of mouthwashes in six major supermarkets in Gauteng. (p 260)

8. Urine was used as a mouthwash by the Romans because they believed the uric acid content was effective in reducing halitosis.
   a. True
   b. False

9. Of the mouthwashes tested in this study, over half contained alcohol.
   a. True
   b. False

10. Triclosan appears to be a valuable antibacterial component especially when combined with sodium fluoride in mouthwashes.
    a. True
    b. False

Oral candidosis: an update on diagnosis, aetiopathogenesis and management (p 314)

11. Preferred management of oral candidosis lies in moderating any local and systemic predisposing factors, and the prescription of a course of topical antifungal agent.
    a. True
    b. False

12. Polyenes, which are effective agents against the candida fungal cell, are well accepted by patients who show considerable compliance with the directions for use.
    a. True
    b. False

13. Identify the incorrect statement:
    Important predisposing factors leading to active candidosis include
    a. Inadequate nutrition
    b. Ankylosis of posterior teeth
    c. Poorly fitting dentures
    d. Inadequate oral hygiene
    e. Cigarette smoking

Obesity and the sedation practitioner (p 326)

14. The Body Mass Index and the Physical Status Classification System may not be used together in the determination of whether a patient is safe for sedation in the dental surgery.
    a. True
    b. False

15. It is recommended that for analgesia in obese patients an opioid should be used which does not depress appetite.
    a. True
    b. False
Maxillo-Facial Radiology case 143 (p 328)
16. A large carious tooth is the classic sign in focal sclerosing osteomyelitis.
   a. True
   b. False

17. Diffuse sclerosing osteomyelitis is a very common form of osteomyelitis.
   a. True
   b. False

Clinical Windows (p 330)
18. In the Lundgren et al study, the predicated probability of having a high risk of caries (categorized as sick) was almost four times higher for a neutral type person than for a morning type individual.
   a. True
   b. False

19. In the Van der Sluijs et al random clinical trial (RCT), both regimens yielded a significant decrease in the organoleptic score.
   a. True
   b. False

20. In the Van der Sluijs et al random clinical trial, the Halimeter® and OralChroma™ can be regarded as subjective measures of morning bad breath (MBB).
   a. True
   b. False

ETHICAL
The motivation to be ethical (p 280)
21. A patient has an inherent right in respect of expecting professional treatment in an ethical manner.
   a. True
   b. False

22. It is ethical for a dentist to expect a patient to respect the fact that there are patient responsibilities in the relationship.
   a. True
   b. False

23. Identify the correct statement.
   Patients have the right to:
   a. Refuse treatment
   b. Refuse to pay for treatment
   c. Refuse to provide personal details
   d. Refuse to wait their turn

24. Whilst the Rights of Patients have been promulgated, some may not be achievable as a result of national financial constraints.
   a. True
   b. False

25. The dictates of the dentist are paramount in any situation and the patient is regarded as having no role to play.
   a. True
   b. False

Readers will note that we have reduced the number of General Questions to twenty whilst retaining five Ethics based questions. Our allocation of CPD points remains unchanged. There is optimism that this section will continue to provide members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure Continuing Education. Please note that SADA is no longer offering the ‘CPD via SMS’ service.

Contact Ann Bayman at SADA, Tel: 011 484 5288, for any enquiries and assistance.

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