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Angulated Tortoise: *Chersina angulata*

Tortoise teeth?... yes a tortoise may bite, but has no teeth. There is evidence that prehistoric specimens did have teeth, perhaps tiny homodont structures. Turtles have bony plates in the maxilla, whilst tortoises have jaws with tough and pointed edges, so a bite from their strong jaws can be quite effective. Tortoises rely on saliva to make their bite-sized food swallowable.
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Stress... or ataraxia*?

It has been noticeable that South African Dentists have enjoyed special opportunities for Continued Education towards the closing months of the year, SADA and Nomads Congresses being the major events, accompanied by meetings of several Special societies. All have provided opportunities to garner knowledge, whether to reinforce what is already known, or to excitedly open doors to new horizons in the discipline. The benefits of attending are legion, ranging from knowing you are at the cutting edge of Dentistry (a deliberate pun!) to the sheer joy of establishing or re-establishing contact with colleagues. Have you ever been to a dinner with fellow practitioners when Dentistry was not a major part of the conversation? The lectures, the demonstrations, the Trade Show, the entertainment, what a formula! But take a deeper perception... all those events and exposures and excitements combine to relieve to some extent the stress that it is our lot to endure. The change in routine, the different environment, the chance to select our next direction... all contribute to a sense of relative freedom from the rigours and dictatorship exerted by practising our profession.

For yes, Dentistry is indeed a high stress occupation. Many years are spent in education to become a dentist. Further years of experience and continuing education are needed to become a comprehensively good dentist. We operate in dimensions measured in microns...an infinitesimal slip leads to failure! At a recent function, our CEO, KC talked eloquently about choices that must be made everyday, choices that may affect our patients in serious ways, choices that may keep us from straying into unethical practices. Stress compounders!

And it starts when the budding practitioner is a student...look back at the February issue of the SADJ...a paper reporting on stress levels among, and their management by, dental students. There were some frightening statistics reported... students apparently nearing the end of their tether. BUT nevertheless coping in a surprising variety of ways. Many had contemplated changing their registration from Dentistry. Not surprising was the observation that the most common causes of stress were fear of failure and the demands of a heavy and unrelenting workload. Clinical year students reported increasing levels of stress as they handled greater numbers of patients.

Oh my... a bleak picture!

I am told, not being a golfer, that even a fearfuly poor round can be entirely forgotten if there was one... just one...excellent shot!

And that is the marvellous reprieve of Dentistry. One, just one...truly happy smile that our work has enabled, nay, that we have constructed and fashioned, will compensate for yards of stress. Robert Ricketts, one of the most influential orthodontists of our time, spoke about the mouth as the source of communication, of pleasure, of sustenance, of life itself. How privileged we have been to shoulder the stresses associated with achieving that great good feeling that we have a happy patient!

At this time of the year students are of course entering a period of enormous and understandable stress... how will they cope with the next examination, the next assessment? It will be the privilege of the profession to welcome these neophytes into our midst and it will be our responsibility to offer them the guidance and wisdom that years of experience have enabled us to deal with, and even to welcome, the stress of Dentistry. We exhort our patients to seek that elusive Smile... we should also enjoy its discovery!

To all those facing examination stress at this time, the most sincere wishes for sound preparation, fair papers, common sense and just reward.

And finally, there is some stress associated with editing a Journal... and I confess to being considerably stressed that the issues are so late, and I apologise.

Perhaps there may be some smiles when readers recognise some cogent point in the articles. That could be my reprieve to a state of ataraxia*.

*Ataraxia: a state of calmness untroubled by emotional disquiet. (Oxford English dictionary)
As we approach the end of the year, there are many things that are happening which will change the face of dentistry in South Africa. The first one is where South Africa aims to make significant strides in moving towards universal health care (UHC) through the implementation of National Health Insurance (NHI) based on the principle of the Constitutional right of citizens to have access to quality healthcare services that are delivered equitably, affordably, efficiently, effectively and appropriately based on social solidarity, progressive universalism, equity and health as a public good and a social investment. The second one aims to acquire data from dental practices (private and state) through an application that will be loaded onto a tablet or an android phone. In collecting information about South African patients’ oral health status, quality of life, behaviours and access to services, it is hoped that the information gathered will assist health institutions and educational institutions in the drawing up of health policies that will be beneficial to all South Africans.

THE NHI IMPLEMENTATION

The Department of Health gazetted the White paper on NHI in June of this year. Since then SADA has engaged on numerous occasions with the Director and Deputy Director General of Health with regards to how we as can assist in making the NHI implementable with regards to oral health services. We have taken the initiative to invite representatives of the entire oral health profession to participate in drafting a submission to the Health Ministry that will encompass the basket of oral health services we would expect to be covered under NHI at primary, secondary and tertiary levels of care.

The NHI Task Team consisting of representation from SADA, OHASA, DENTASA, SADTA, APSA, SASPIO, SASO, SASMFOS, Community Dentistry as well as the various academic institutions met for the first time earlier this month. The Team had the opportunity to seek clarity on a number of questions from the Deputy Director General of Health, Dr Anban Pillay following an informative presentation by him. Thereafter a robust discussion was held and the way forward defined.

The team will meet again early December to collate feedback received from their respective associations/societies where we will hopefully begin the first draft of our submission. We are very encouraged by the overwhelming positive feedback received from the oral health profession and are confident we will be able to make a substantial impact in advising the NHI Benefit Advisory Committee on defining the oral health package.

FDI ORAL HEALTH OBSERVATION SURVEY

The South African Dental Association was selected as one of the 10 National Dental Associations (NDA's) to participate in an Oral Health Observation Survey. The FDI hopes that this information will provide a more current picture of the Oral Health landscape in South Africa.

The project will be conducted in two phases in South Africa. This is because ethical clearance is required to conduct this research at state clinics. The FDI is currently in the process of developing or compiling this document. Head Office initially requested 26 members of the SADA National Council to participate in the first phase of the project. However due to poor participation by the National Council members, the offer to participate in this study has thus been extended to all SADA members so as to acquire the 26 dental practices required. The accompanying excel document summarizes the process on how the dental practices are to be selected in South Africa across all provinces.

The document explains as to which regions the dental practices need to be located in order for the sample to be as representative as possible (private dental practices). A Memorandum of Understanding, as well as a dentist toolkit, will be sent to participating dental practices to know how to roll out the survey. The Association is in discussions with FDI with regards to the translation of the app menus and questions into some of the most spoken languages in South Africa for the patients to understand what information is required from them.

The SADA FDI Liaison Officer is the contact person for information and inclusion in the study.

KC Makhubele: SADA CEO, E-mail:kcmakhubele@sada.co.za
A comparison of radiation doses to selected vital organs in the maxillofacial region using three different settings on the Galileos CBCT machine housed in the Wits Dental Hospital.

ABSTRACT
A comparison of radiation doses to selected vital organs in the maxillofacial region at three different settings on the Galileos® cone-beam computed tomography (CBCT) machine in the Wits Dental Hospital was conducted with the courtesy of the Department of Medical Physics of the Charlotte Maxeke Johannesburg Academic Hospital. The study made use of the RANDO® phantom and TLD-100 detector chips which provided detailed mapping of the dose distribution from the Galileos CBCT machine. Sixty-two Sanford® lithium fluoride dosimeters - (TLD-100) were irradiated using a calibrated known x-ray source after having undergone a recommended annealing cycle.

The data showed acceptable consistency in the results. Association between the different imaging modalities was further investigated using Kruskal-Wallis equality-of-populations rank test and Chi-squared test. A p-value of <0.05 was considered statistically significant.

Since there do not appear to be major differences between the radiation doses for the different settings of the Galileos CBCT machine, the authors recommend the use of the combined setting at all times for optimum image quality.

INTRODUCTION
The currently most common usages of the cone beam machine have been for implant planning, diagnosis of ectopically placed teeth for orthodontics and to a lesser extent for the diagnosis of pathoses in the maxillofacial region.1,2 This recent practice of using cone beam as a single primary technique, however, harbours risks of over-exposing patients to excessive radiation together with possible misdiagnoses. The reason for the latter is the fact that the new dimension provided by a cone beam image requires advanced expertise in diagnosis, often beyond the scope of a general dentist. It must therefore be emphasized that a cone-beam image must not constitute a routine radiographic view but should require a definite indication for its use. Cone-Beam Computerised Tomography (hereafter referred to as CBCT) may ultimately contribute to improvement of patient care, but users must be aware of their adherence to the ALARA principle to prevent latent untoward effects of radiation. Radiation risk is frequently spoken about but all too often not taken seriously. A study done by Buch and Fensham in 2003 using thermoluminescent dosimeters (TLDs) and a female RANDO phantom3 showed that a panoramic X-ray examination from a Siemens Orthophos® machine imparted to the thyroid no more than ten days of additional background radiation and to the eyes a mere two and a half days.4 Buch, Fensham and Maritz in 2009 compared absorbed doses to the eyes, thyroid and uterus imparted by a Gendex® panoramic machine with those from a full-mouth intraoral X-ray examination using films and digital technology.5 They found that the dose to the eyes from a full-mouth intraoral examination using films was higher than that from the panoramic machine although the dose to the thyroid was half that of the panoramic examination.

ACRONYMS
ALARA: as low as reasonably achievable
CBCT: cone-beam computed tomography
Gy: Gray unit: the absorption of one joule of radiation energy per kilogram of matter
PMMA: polymethyl-methacrylate
TLDs: thermoluminescent dosimeters
μSv: Sievert Unit of ionizing radiation
A measure of the health effect of radiation

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These doses were much reduced when using digital technology. Low doses to the uterus were similar in all cases and were unchanged when a lead apron was used.\textsuperscript{5,6}

In all the above experiments a RANDO\textsuperscript{®} phantom was used. The Alderson RANDO phantom has been in use for over 30 years.\textsuperscript{7} It consists of a human skeleton surrounded by tissue-equivalent material. Such material approximates the average radiation density of human tissues; in fact a study published in 2001 concluded that the tissue equivalence of a RANDO phantom does not differ by more than 15% from that of a cadaver. The phantom is transected horizontally into 2.5 cm thick slices. Each slice has holes containing plugs which can be replaced with TLD chips.\textsuperscript{4}

Current studies provide comparative measurements of doses from different CBCT equipment, but do not take into account dose differences which may occur at different settings of the same machine. In 2006 Ludlow et al used TLDs and a RANDO phantom to determine radiation doses of three different CBCT machines.\textsuperscript{8} Their study has clearly shown that considerable differences exist between the various makes of CBCT machines. Furthermore in 2008 Palomo et al. modified CBCT equipment to allow for different mA and kV choices.\textsuperscript{9} For this experiment TLD chips, a RANDO phantom and a fresh cadaver were used.\textsuperscript{4} Although the radiation dose in this instance was comparatively low, it resulted in a low quality image.\textsuperscript{9}

A systematic review has revealed that no comparative doses corresponding to the different settings on the Galileos\textsuperscript{®} CBCT appear to be available.\textsuperscript{10}

Doses quoted by the manufacturer are average full-body doses which have no relevance to specific vital organs at the different settings. Most purchasers of CBCT machines in South Africa are dentists. Their limited imaging and technical knowledge is largely accountable for the confusion encountered in clinical literature. Technical device settings and their properties were not constant in the abovementioned studies. Apart from the lack of evidence-based data for CBCT radiation doses, there was an associated inconsistency of terminology. The use of CBCT will undoubtedly improve patient care in the long term, but practitioners must be aware of their responsibilities in holistically interpreting the data collected at each examination.

In 2005 Tsiklakis et al. published a study in which seventy-five TLD-100 dosimeters and a male RANDO phantom were used to compare radiation doses imparted by the New Tom\textsuperscript{®} 9000 CBCT machine with those from a standard panoramic machine. The result was that CBCT appeared to have a three to seven times higher risk compared with a panoramic examination.\textsuperscript{11}

In all the above experiments thermoluminescent (TLD) dosimeter chips were used to monitor radiation doses, and these chips continue today to constitute the primary mode of the monitoring of radiation exposure.\textsuperscript{12,13} The reliability of the method was studied by Buch and Keddy in 1987 and successfully shown to have high fidelity.\textsuperscript{14} The authors showed that TLD chips provide an acceptably accurate measurement of doses of absorbed radiation to certain areas of the body during dental x-ray examinations. TLD dosimeters allow for the determination of a wide range of absorbed doses. This makes them useful in dose detection from $\mu$Gy to several Gy. TLDs are easy to transport, can be mailed and can be used for many different applications.\textsuperscript{12} TLD 100 dosimeter chips made from lithium fluoride (LiF) material have a wide potential in radiation dosimetry. They are accurate for X-, gamma, beta, electron and neutron radiations, are reusable and are nearly tissue-equivalent.\textsuperscript{12,13}

When impurities are added to LiF, the forbidden region i.e. the band gap*, can trap electrons. Those trapped electrons represent the energy acquired in the process of irradiation. When the chips are heated with a laser the electrons return to the valence band and light is emitted. The emitted light is measured in a photomultiplier tube and the reading interpreted by algorithms contained in computer software.\textsuperscript{12,13}

Radiation received is cumulative throughout life.\textsuperscript{15} It is therefore essential to reduce the number of radiographs taken and to choose the most appropriate imaging modality. The International Commission on Radiological Protection (ICRP) provides tissue-weighting factors, which represent the relative contribution of that organ or tissue to the overall risk.\textsuperscript{16} Salivary glands, thyroid gland and eyes are the most susceptible to radiation in the head and neck region. Tissue-weighting factors were not taken into consideration by the authors as the purpose of this study was to accurately measure and compare doses using different settings of the Galileos CBCT machine.

The diagnostic quality of the Galileos CBCT machine improves with increased contrast. This in turn increases the radiation dose.\textsuperscript{17} Diagnostic quality also improves with an increase in the field of view. Different clinicians use different parameters to achieve the desired result.\textsuperscript{18} The use of mandibular, maxillary or a combined setting of Galileos CBCT by clinicians appears to be subjective rather than for any specific indication. An operator may well believe that the patient is exposed to less radiation if a modality is used that provides half of the complete view. This practice, however, may lead to a radiograph of inferior diagnostic quality.

Many studies refer to full-body dose, and a literature search did not find studies measuring doses for specific vital organs in the head and neck for Galileos CBCT settings, which the current study aims to determine. It is accepted that the risk of exposure to ionizing radiation should be balanced with the potential benefit to the patient. An important strategy of any dental radiologic service is to ensure that a revised or newly developed radiographic protocol should be implemented at all teaching institutions, in line with the latest national radiological policy.

The Radiology section of the Wits Dental Hospital admits 12 000 patients annually for radiographic examinations. During the first seven months of its installation, 168 CBCT examinations were performed on the Galileos machine, which is accessible to all registrars in the various fields of dentistry but whose expertise in the use of this new equipment is limited. It would appear that the increased radiation dose to patients was seldom considered. The need for a study that would provide guidelines for more effective and responsible use of the CBCT machine at the Wits Dental Hospital was therefore obvious.
RESEARCH

AIMS

The aim of this study was to measure the effective doses of radiation imparted by the Galileos CBCT\textsuperscript{*} using in the first instance each of the maxillary and mandibular settings only, followed by the combined maxillary and mandibular setting. The effective doses in all three settings were then compared.

\*Dentsply/Sirona

MATERIALS AND METHOD

A set of sixty-six (66) TLD 100 detector chips (dosimeters) were used in this study. All 66 TLD chips were annealed in a PTW-LTDO\textsuperscript{*} oven. The prescribed annealing procedure recommended by the manufacturer was followed: The chips were placed in each of 66 wells contained within a metal slab and preheated to 400°C. They were kept at this temperature for three hours and thereafter kept at 100°C for an hour before being left to cool to room temperature. TLDs were kept in the metal slab and covered with a metal lid between the annealing and irradiation processes. Vacuum tweezers were used to transfer the TLDs at the time of measurement and calibration.

Since lithium fluoride chips vary from one to another in their responses to the same dose of radiation, selection and calibration process was necessary.\textsuperscript{12} All 66 annealed dosimeters were placed on a polymethyl-methacrylate (PMMA) phantom and exposed to a known dose of radiation i.e. 1Gy in a Siemens\textsuperscript{®} Linear accelerator. The TLDs were then read in a HARSHAW\textsuperscript{®} QS 3500 TLD reader.\textsuperscript{*} A specific calibration factor was programmed into the reader. A 15% tolerance was considered acceptable for the measurement of absorbed doses. Fifty-seven (57) TLDs gave similar readings and were selected for the experiment. The position of the chips remained unchanged in the reading plate during the experiment and each chip was allocated a unique code- A1A, A2A etc. Each of those procedures as well as the subsequent reading of the chips was carried out in the Department of Medical Physics.

\*ThermoFisher Scientific Inc. Waltham, USA 02451

The phantom head had initially been scanned in a CT scanner in order to determine the exact positions into which the TLD detector chips were to be placed. The chips were then positioned within the head of the phantom in sites corresponding to the eyes, the thyroid and the parotid glands. The head was then transported to the Radiology section of the Wits Dental Hospital and positioned in the Galileos CBCT machine for subsequent exposure.

Eight chips were used for each of the nine exposures.

The chips were positioned as follows:
- Thyroid gland- anterior (superficial) and posterior (deep).
- Parotid gland- right parotid deep, right parotid superficial, left parotid deep and left parotid superficial.
- Eyes- right eye (at the position of the lens), left eye (at the position of the lens).

The Galileos CBCT was set to VO1 HC, 85 kV, 42 mAs, for all exposures.

The constant position of the phantom head in the CBCT for all exposures was ensured by means of laser markers. Three different settings of the Galileos CBCT were used i.e. mandibular exposure only, maxillary exposure only and combined maxillary and mandibular exposure. Each set of exposures was repeated three times giving a total of nine exposures.

At the completion of all exposures the TLD detector chips were read in the TLD reader housed in the Department of Medical Physics.

An additional three annealing cycles and sequential readings were performed in order to determine the background radiation, using all 57 TLD detector chips.

Data was entered in an MS Excel spread sheet and analyzed using Stata under the guidance of two statisticians. The analysis included descriptive analysis of the study population. Cross-tabulations were also used to investigate associations between readings of the TLD detector chips for the different modalities. Association between the different imaging modalities was further investigated using Kruskal-Wallis equality-of-populations rank test and the Chi-squared test.\textsuperscript{19} A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Mandibular/Maxillary readings for the different settings of the Galileos CBCT (\(\mu\text{Sv}\)).

<table>
<thead>
<tr>
<th></th>
<th>Man/Max 1\textsuperscript{st}</th>
<th>Man/Max 2\textsuperscript{nd}</th>
<th>Man/Max 3\textsuperscript{rd}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid Anterior</td>
<td>277.9</td>
<td>64.23</td>
<td>132.2</td>
</tr>
<tr>
<td>Thyroid Posterior</td>
<td>313.3</td>
<td>105.01</td>
<td>255.6</td>
</tr>
<tr>
<td>Right Parotid Deep</td>
<td>181.1</td>
<td>120.9</td>
<td>107.8</td>
</tr>
<tr>
<td>Right Parotid Superficial</td>
<td>104.6</td>
<td>57.57</td>
<td>85.69</td>
</tr>
<tr>
<td>Left Parotid Deep</td>
<td>77.91</td>
<td>83.53</td>
<td>89.42</td>
</tr>
<tr>
<td>Left Parotid Superficial</td>
<td>87.70</td>
<td>80.73</td>
<td>81.37</td>
</tr>
<tr>
<td>Right Eye</td>
<td>54.05</td>
<td>38.45</td>
<td>21.83</td>
</tr>
<tr>
<td>Left Eye</td>
<td>44.27</td>
<td>39.05</td>
<td>42.05</td>
</tr>
</tbody>
</table>

Table 2: Maxillary readings for the different settings of the Galileos CBCT (\(\mu\text{Sv}\)).

<table>
<thead>
<tr>
<th></th>
<th>Man/Max 1\textsuperscript{st}</th>
<th>Man/Max 2\textsuperscript{nd}</th>
<th>Man/Max 3\textsuperscript{rd}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid Anterior</td>
<td>114.7</td>
<td>305.7</td>
<td>58.76</td>
</tr>
<tr>
<td>Thyroid Posterior</td>
<td>148.7</td>
<td>152.1</td>
<td>232.1</td>
</tr>
<tr>
<td>Right Parotid Deep</td>
<td>125.2</td>
<td>123.21</td>
<td>129.7</td>
</tr>
<tr>
<td>Right Parotid Superficial</td>
<td>140.5</td>
<td>154.8</td>
<td>72.59</td>
</tr>
<tr>
<td>Left Parotid Deep</td>
<td>89.91</td>
<td>108.2</td>
<td>73.32</td>
</tr>
<tr>
<td>Left Parotid Superficial</td>
<td>82.33</td>
<td>69.41</td>
<td>83.70</td>
</tr>
<tr>
<td>Right Eye</td>
<td>39.91</td>
<td>36.85</td>
<td>41.51</td>
</tr>
<tr>
<td>Left Eye</td>
<td>44.27</td>
<td>39.05</td>
<td>42.05</td>
</tr>
</tbody>
</table>
DISCUSSION

Despite the fixed position of the phantom for each set of exposures, small differences in dose readings for the various organs are apparent for the same machine settings. Certain of these differences may be related to scatter radiation, the annealing procedure or the stability of the TLD-100 detector chips. Scatter radiation is unpredictable and not necessarily related to the accuracy of the reading method. Nevertheless a minimum error of 10% in the accuracy of any single chip must be allowed for.13

Many of these small discrepancies may also be due to background radiation as much of the background radiation in the premises where the experiment took place emanates from the heavy surrounding concrete structures of the building.

Table 3: Mandibular readings for the different settings of the Galileos CBCT (μSv).

<table>
<thead>
<tr>
<th></th>
<th>Man/Max 1&lt;sup&gt;st&lt;/sup&gt;</th>
<th>Man/Max 2&lt;sup&gt;nd&lt;/sup&gt;</th>
<th>Man/Max 3&lt;sup&gt;rd&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid Anterior</td>
<td>133.5</td>
<td>347.7</td>
<td>90.88</td>
</tr>
<tr>
<td>Thyroid Posterior</td>
<td>151.9</td>
<td>471.0</td>
<td>100.9</td>
</tr>
<tr>
<td>Right Parotid Deep</td>
<td>50.71</td>
<td>192.3</td>
<td>53.35</td>
</tr>
<tr>
<td>Right Parotid Superficial</td>
<td>32.44</td>
<td>59.09</td>
<td>23.71</td>
</tr>
<tr>
<td>Left Parotid Deep</td>
<td>36.50</td>
<td>29.71</td>
<td>25.45</td>
</tr>
<tr>
<td>Left Parotid Superficial</td>
<td>28.19</td>
<td>27.18</td>
<td>19.12</td>
</tr>
<tr>
<td>Right Eye</td>
<td>15.54</td>
<td>15.59</td>
<td>10.55</td>
</tr>
<tr>
<td>Left Eye</td>
<td>11.74</td>
<td>15.53</td>
<td>11.39</td>
</tr>
</tbody>
</table>

Table 4: Background exposure (μSv) of the TLD chips in the reading plate.

<table>
<thead>
<tr>
<th>TLD Position letter</th>
<th>Mean values out of three background exposures for positions A to G</th>
<th>TLD position No:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14.86 6.252 5.205 6.361 5.786 8.009 7.095 1</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>5.394 15.61 3.818 5.883 6.553 6.418</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>20.41 6.686 7.734 9.509 5.754 6.325</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.526 5.785 3.811 6.666 5.434 5.268</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.351 5.583 4.652 5.510 4.066 5.126</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Median exposure values for the different settings of the Galileos CBCT (μSv).

<table>
<thead>
<tr>
<th></th>
<th>Mandibular/Maxillary Exposure – 85 kV/42 mAs/HC</th>
<th>Maxillary Exposure – 85 kV/42 mAs/HC</th>
<th>Mandibular Exposure – 85 kV/42 mAs/HC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid Anterior</td>
<td>131.00</td>
<td>152.9</td>
<td>133.5</td>
</tr>
<tr>
<td>Thyroid Posterior</td>
<td>196.55</td>
<td>192.1</td>
<td>151.9</td>
</tr>
<tr>
<td>Right Parotid Deep</td>
<td>114.35</td>
<td>124.205</td>
<td>53.35</td>
</tr>
<tr>
<td>Right Parotid Superficial</td>
<td>88.44</td>
<td>114.395</td>
<td>32.44</td>
</tr>
<tr>
<td>Left Parotid Deep</td>
<td>85.405</td>
<td>83.775</td>
<td>29.71</td>
</tr>
<tr>
<td>Left Parotid Superficial</td>
<td>82.49</td>
<td>81.77</td>
<td>27.18</td>
</tr>
<tr>
<td>Right Eye</td>
<td>33.68</td>
<td>40.71</td>
<td>15.54</td>
</tr>
<tr>
<td>Left Eye</td>
<td>40.55</td>
<td>39.52</td>
<td>11.74</td>
</tr>
</tbody>
</table>
Table 5 further illustrates that the values for the right parotid are higher than those for the left. This paradox has been mentioned in a number of studies and is due to fact that the rotation of the CBCT machine appears to have a bias, the right side being more heavily exposed than the left. As a result the calculated p-values for the three different settings for the deep parotid are 0.58 for the right and 0.05 for the left.

Statistically this too is not considered significant.

The same applies to the superficial parotid as illustrated in Table 5, the radiation values on the right side being higher than those on the left. There is a 25% difference between maxillary and combined maxillary/mandibular exposures on the right side and almost no difference on the left. Mandibular exposures on both sides are about 2.5 times less than both maxillary and combined exposures. However, the calculated p-value for the right side is 0.06 and that for the left is 0.0455 (0.05 if rounded).

These two p-values are considered statistically non-significant.

The lens of the eye, one of the most radiation-sensitive anatomical structures in the head region appears to be well protected owing to the engineering design of the Galileos CBCT machine. The radiation dose to the eye for the mandibular setting is equivalent to background radiation. For the maxillary and combined settings it is about two to two and a half times the background dose. It may appear surprising that the calculated p-value for the right eye is 0.0406, which is statistically significant, whereas 0.0487 for the left eye (rounded to 0.05) is statistically non-significant. This very small difference could be due to the higher exposure on the right side and a greater amount of scatter radiation.

Reproducibility of the results of this study is confirmed by the fact that there was no overall variation greater than 15% between repeated examinations. There were, however, significant deviations in the TLD readings for specific locations, especially in the region of the thyroid gland. Similar deviations were reported in 2006 by Ludlow et al. The surface orientation of the TLD chips was not taken into account as the TLDs were placed in the existing holes in the phantom, their position being constant for all exposures.

CONCLUSION

The results obtained justified the use of the combined setting for the attainment of improved diagnostic information. Since there were no major differences between the radiation doses for the different settings of the Galileos CBCT machine, the authors recommend the combined setting to be used at all times for optimal diagnostic quality.

Table 6: Kruskal-Wallis equality of population rank test

<table>
<thead>
<tr>
<th>Type</th>
<th>Thyroid anterior</th>
<th>Thyroid posterior</th>
<th>Right Parotid deep</th>
<th>Right Parotid superficial</th>
<th>Left Parotid deep</th>
<th>Left Parotid superficial</th>
<th>Right Eye</th>
<th>Left Eye</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandibular</td>
<td>3 21</td>
<td>3 17</td>
<td>3 14</td>
<td>3 7</td>
<td>3 6</td>
<td>3 6</td>
<td>3 6 3 6</td>
<td>3 6</td>
</tr>
<tr>
<td>Max/Max</td>
<td>3 22</td>
<td>3 23</td>
<td>3 23</td>
<td>3 26</td>
<td>3 30</td>
<td>3 32</td>
<td>3 27 3 31</td>
<td>3 28</td>
</tr>
<tr>
<td>Maxillary</td>
<td>3 23</td>
<td>3 26</td>
<td>3 29</td>
<td>3 33</td>
<td>3 30</td>
<td>3 28</td>
<td>3 33 3 29</td>
<td>3 35</td>
</tr>
</tbody>
</table>

Chi-squared 0.386 0.144 1.078 5.589 6.000 6.182 6.409 6.045
P-value 0.8243 0.9306 0.5840 0.0609 0.0498 0.0455 0.0455 0.0487

References

Candidiasis – has anything changed in the way we manage these patients?

SADJ September 2017, Vol 72 no 8 p355 - p359
E Blignaut

SUMMARY
Candida albicans remains an infection of the very old, the very young and the medically compromised patient. It not only affects the oral cavity but C. albicans biofilms form on most prosthetic devices and indwelling catheters with life-threatening consequences. The behaviour of this organism in biofilm formation has received much research interest. Understanding disease processes and the importance of prevention and disruption of C. albicans biofilms lie at the heart of successful treatment of such infections. Of equal importance is that patients also understand the rationale behind the treatment which will encourage adherence to the prescribed rigour. Experience in the South African context, together with the latest scientific evidence regarding the behaviour of C. albicans, is shared with the objective of enabling treatment leading to the effective and efficient resolution of the infection, but also to describe measures appropriate to prevent invasion by the organism.

INTRODUCTION
Oral candidiasis remains an infection that is associated with the very young, the elderly, the medically compromised and/or immunosuppressed individuals.1,2 Much has, however, changed in terms of our knowledge regarding the genetic composition, or genotype, and the behaviour, or phenotype, of the most frequently associated infectious agent, namely C. albicans. While C. dubliniensis received attention because of its initial association with HIV-patients in Europe,3,4 no consistent association has been established among South African HIV-patients.5 This article therefore will focus on C. albicans. Other Candida spp. associated with human colonisation include C. tropicalis, C. parapsilosis, C. glabrata, C. krusei, and C. lusitaneae, but these have mostly been isolated together with C. albicans, and have not yet been significantly implicated in oral disease in the South African context.6,7 C. albicans is carried in the mouths of approximately 50% of normal healthy individuals with a possible higher prevalence in intestinal sites. Under conditions of disease, the carriage rate as well as the number of colony forming units (cfu) isolated from a particular individual can increase significantly. When C. albicans is isolated from inanimate objects in the clinical setting, this is most likely due to contamination by humans or animals.5,9

Characteristics of C. albicans
C. albicans is referred to as a dimorphic or pleomorphic yeast due to the ability to switch between oval/round yeast cells and an elongated hyphal or fungal appearance. The foremost characteristic of C. albicans is its ‘high degree of plasticity’, which means that it is exceptionally well equipped to adapt to extremes in its macro- and micro-environment by switching between these different morphological forms.10 In a healthy mouth, the organism occurs as mainly vegetative, oval to round, budding yeast cells, referred to as blastoconidia, sometimes erroneously reported as Candida ‘spores’. When the organism presents on smears as shorter or longer pseudohyphae or true hyphae, pathologists regard the organism as candidiasis.11

C. albicans propagates mainly through budding, or clonal expansion, as confirmed by DNA fingerprinting studies on large numbers of clinical isolates.10 These molecular studies have revealed approximately seven distinct genetic sub-groups, or clades, with some clades being found more frequently in particular geographic sites across the world. It may be relevant that none of these large studies could demonstrate any unique pathogenic subtypes of C. albicans that are frequently associated with disease.13-15 In addition, several studies have found the same genetic subtype of C. albicans to be associated with a particular individual throughout episodes of both health and disease, further dispelling the perception that there are specific pathogenic subtypes of the organism that cause disease and others that are commensals or normal flora.15,16 Another important finding regarding the predominant genetic subtype of C. albicans that was isolated from South African individuals, was a stable antifungal resistance to amphotericin B. This has developed as a result of the widespread use/abuse of a related antifungal agent, namely an aqueous oral solution of nystatin, as prophylaxis against or treatment

ACRONYMS
NUG/NUP: acute necrotising gingivitis/periodontitis

REFERENCES

of oral candidiasis.\textsuperscript{7,18} Findings like these support the global drive against the indiscriminate prescription of antimicrobial agents and that all attempts should be made to ensure a speedy and complete resolution of infections at the first attempt.\textsuperscript{19}

Contrary to prior belief that \textit{C. albicans} propagates exclusively through budding, DNA sequencing of the entire genome revealed mating type genes which later led to the discovery that the organism can indeed mate through a so-called ‘parasexual’ cycle.\textsuperscript{20} The term ‘parasexual’ is used because the DNA from the two mating cells in the zygote is not reduced through meiosis, or reduction division, as in other eukaryotic cells. This ‘parasexual’ behaviour of \textit{C. albicans} was elucidated under a wide variety of laboratory conditions, many of which resembled conditions in the oral cavity, such as low oxygen supply, interaction with other micro-organisms and host defences. It is regarded as yet another mechanism by which the organism adapts to adverse conditions and protects itself against unfavourable environmental conditions or antifungal agents.\textsuperscript{21} The resultant offspring from this mating in biofilms were found to have varying amounts of DNA which is subsequently lost in a random fashion during repeated clonal propagation (budding).\textsuperscript{22,23} While unexplained at the time, earlier research investigating the genetic composition of \textit{C. albicans} from periodontal pockets had found considerable variation in genetic composition. At the time the researchers were of the opinion that these isolates constituted unique pathogenic sub-species.\textsuperscript{24-26} However, the most recent research findings suggest that the most probable explanation is that in periodontal pockets the organism mated in an undisturbed biofilm, under anaerobic or low oxygen conditions, producing offspring with random amounts of DNA.\textsuperscript{23}

Candida biofilms form on in-dwelling catheters, prosthetic joints and valves, and more importantly in the context of this article, on dentures, dental implants, orthodontic appliances and the oral mucosa. Because of the possible life threatening consequences, biofilm formation is receiving significant attention from both basic and clinical researchers with the number of publications having steadily increased from one in 1994 to approximately 300 per year in 2015.\textsuperscript{27} In a biofilm the increased fungal biomass of hyphae present an increased load of putative pathogenic traits, carried on the surface of the organism, as well as secreted, harmful enzymes. Extracellular matrix consisting of substances secreted by the organisms, and of food debris and desquamated epithelial cells, further contribute to the biofilm becoming impenetrable to antifungal agents. Not only are antifungal agents not capable of reaching the yeast cells, but \textit{C. albicans} isolated from biofilms have been found to be resistant to antifungal agents.\textsuperscript{28} Investigation continues into a myriad of substances that may inhibit \textit{C. albicans} biofilm formation on prosthetic surfaces but conclusive evidence has yet to emerge on agents that inhibit the process on the oral mucosa.\textsuperscript{29} The interaction between the organism and human mucosal surfaces, and how the oral mucosa itself may keep \textit{C. albicans} in check receives equal attention.\textsuperscript{29} It is reiterated that \textit{C. albicans} becomes pathogenic only when the host’s defences permit and, most regrettably, often the first indication of an underlying failure in host defences is when oral candidiasis develops.

**TREATMENT**

The question is how all of this translates into the effective and efficient prevention and treatment of disease? There are three important aspects to consider before prescribing antifungal agents to patients presenting with suspected Candida infections:

- Apart from pseudomembranous candidiasis which has a typical clinical presentation (Figures 1A, 1B and 2), it is strongly recommended that the presence of Candida hyphae is first confirmed before routinely prescribing an antifungal agent.
- While not in the scope of this article, all health professionals have a duty to either attempt to establish a possible underlying systemic condition in patients who present with oral candidiasis or to refer the patient to a medical doctor and to follow-up and ensure that the referral was indeed heeded and the patient is appropriately managed.
- Another very important aspect in the management of patients presenting with Candida infections is the disruption of biofilms and prevention of the formation thereof.

Candida does not become pathogenic unless the host’s immune system is compromised.\textsuperscript{3} Specific antifungal agents and dosages are summarised in Table 1. Of importance is the application of that information, and the need for full understanding of the additional therapeutic measures, which should be conveyed to patients to ensure the complete resolution of the candida infections at the first attempt.

**Pseudomembranous candidiasis**

The topical antifungal treatment of choice remains Daktarin Oral Gel\textsuperscript{\textregistered}. Not only has it been found to be effective in treating oral candidiasis but is available in both the public and private health sector. In order to ensure efficacy of the medication, patients should be instructed on how it should be applied. Approximately 1cm of gel from the tube should be placed on the forefinger and applied everywhere on the oral mucosa and tongue, including the lateral borders of the tongue, with a rubbing action. The application is followed by swishing around in the mouth for a minute before swallowing. Rubbing results in the mechanical dislodging/disturbance of biofilm or the white pseudomembranous patches and may have a secondary effect in stimulating the circulation of the mucosa. Importantly, patients should be instructed to apply the gel after a meal and not to eat or drink for at least an hour. The final application at night should be immediately before going to bed and nothing should be consumed afterwards, keeping the medication in contact with the mucosa for as long as possible. It is recommended that patients continue this regimen three times daily for at least five days, during which time patients should be encouraged to exercise optimal oral hygiene to remove dental plaque which serves as a niche for \textit{C. albicans} to thrive and co-exist with other micro-organisms. Patients should also be encouraged to eat solid food which could have some abrasive action in removing plaque or pseudomembranous patches. Upon resolution and if an underlying systemic cause was identified, patients should be encouraged to be vigilant regarding the formation of white patches and to gently brush the oral mucosa and tongue with a soft toothbrush, without causing injury. The existence of oral hairy leukoplakia is not contested, but in...
the experience of the author, white striations on the lateral border of the tongue have always been associated with pseudomembranous candidiasis, and disappear with resolution of the infection. Patients should therefore be reminded to also include the lateral borders of the tongue when applying medication.

The demonstration of C. albicans in carious dentine strongly suggests that the organism is continuously shed from carious teeth, with the potential to re-infect the oral mucosa. Wherever possible carious teeth with exposed dentine should be restored or removed if effective resolution of oral candidiasis is to be achieved, particularly if an underlying medical condition or immunosuppression prevails in patients.31

Despite the topical application of an aqueous oral solution of nystatin having been proven ineffective as both a prophylactic and therapeutic agent, it continues to be prescribed to adults.18 While nystatin itself has been shown to have some efficacy, it is probable that the aqueous solution/suspension does not provide for the antifungal to remain in contact with the mucosa for sufficient periods of time. Clinicians are urged to avoid prescribing this aqueous solution of nystatin to adult patients. In other countries a tablet formulation of nystatin should be eliminated. Trauma from ill-fitting dentures should also be avoided, however, if the mucosa is thin and inflamed, in which case only gentle massaging with a finger is recommended when Daktarin Oral Gel® is applied. Care must be taken to ensure that the dentures do not cause mucosal trauma.

In elderly patients it may be warranted to prescribe systemic antifungal agents such as fluconazole or itraconazole if resolution is not achieved through the topical application of myconazole.

**Angular cheilitis**

It is seldom that this condition is due only to a Candida infection. It is encountered mostly in otherwise healthy edentulous patients or patients with ill-fitting dentures with excessive freeway space and saliva accumulating in the folds around the mouth. Frail elderly patients, malnourished edentulous patients, and/or very ill

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**Table 1: Management of oral conditions involving C. albicans**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Agent and dosage</th>
<th>Application and special mention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudomembranous, erythematous candidiasis and angular cheilitis associated with oral candidiasis</td>
<td>DaktarinOral Gel® 3 times daily.</td>
<td>Spread on mucosa with rubbing action. Do not eat or drink for at least 1 hour after application. Apply to the corners of the mouth only and not the lips.</td>
</tr>
<tr>
<td>Oesophageal candidiasis</td>
<td>Diflucan® or Sporanox®</td>
<td>In consultation with or referral to a medical doctor.</td>
</tr>
<tr>
<td>Angular cheilitis in the absence of oral candidiasis</td>
<td>Quadriderm cream. Synalar C cream.</td>
<td>Quadriderm or Synalar C should only be applied to the corners of the mouth 2 – 3 times daily and not the lips or the perioral skin. Decrease freeway space of dentures.</td>
</tr>
<tr>
<td>Chronic hyperplastic candidiasis</td>
<td>Refer to a medical practitioner or hospital outpatient of emergency department.</td>
<td></td>
</tr>
<tr>
<td>Denture stomatitis</td>
<td>Daktarin Oral Gel® 3 times daily.</td>
<td>Apply to oral mucosa, particularly fitting surface of dentures. Apply to dentures after thorough cleansing and disinfecting in aqueous 0,2% chlorhexidine solution.</td>
</tr>
<tr>
<td>Denture stomatitis in frail elderly refractory to topical antifungal treatment</td>
<td>Diflucan® (Fluconazole) 50-100mg once daily for 7 – 14 days. Sporanox® (Itraconazole) 100-200 mg twice daily</td>
<td>Cleanliness of dentures should be exercised. Trauma from ill-fitting dentures should be eliminated. Sporanox only in cases that may be refractory to fluconazole.</td>
</tr>
<tr>
<td>Refractory chronic periodontitis and peri-implant stomatitis</td>
<td>Systemic Diflucan or Sporanox</td>
<td>Only upon confirmation of the presence of Candida hyphae.</td>
</tr>
</tbody>
</table>

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**Figure 1A:** Pseudomembranous candidiasis revealing the typical white pseudomembrane on tongue.

**Figure 1B:** Pseudomembranous candidiasis presenting as white striations on the lateral border of the tongue of the same patient.

**Figure 2:** Rampant caries associated with pseudomembranous candidiasis in an HIV-positive child. Candidiasis recurred every 3-4 weeks until all carious teeth had been cleared.

**Figure 3:** Hyperplastic candidiasis revealing thick, non-removable covering in a terminally ill patient.
hospitalised patients are the other most likely candidates to present with angular cheilitis. If oral candidiasis or denture stomatitis is clinically diagnosed concomitantly with candidiasis, then the Daktarin Oral Ge® should also be applied to the corners of the mouth. As an alternative in the absence of oral candidiasis, topical agents such as Quadriderm® or Synalar C® can be prescribed, with special instructions not to apply these ointments widely to the skin of the perioral region or the rest of the lips. Attention should be paid to the improvement of the dentures in order to decrease freeway space whilst the attempt should be made to convince edentulous patients to have dentures.

**Chronic periodontitis and or peri-implant mucositis**

The association of *C. albicans* in oral biofilms with other oral bacteria, including periodontal pathogens, further exacerbates the pathogenic qualities of Candida. Biofilm formation on dental implants has demonstrated the presence of *C. albicans*, but whether this plays a significant role is unclear. It is again emphasised that the presence of fungal hyphae should first be established through microscopy and/or culture before antifungal therapy is administered. When taking a specimen for a smear, all supra-gingival plaque should be removed before a sterile curette is passed along the length of the periodontal pocket or around an implant and the collected material smeared on a glass slide, fixed with an appropriate agent and sent to a laboratory for staining and microscopy. Sterile endodontic paper points may be inserted in the periodontal pocket after removal of supra-gingival plaque for the purpose of microbial culture. The reduction of periodontal pockets would facilitate maintenance of good oral hygiene and biofilm disruption. Only once the presence of Candida, refractory to conventional treatment, has been confirmed in periodontal lesions or peri-implant mucositis, can a systemic antifungal agent be prescribed. The management should include irrigation of periodontal lesions with an 0.2% aqueous solution of chlorhexidine.

*C. albicans* does not play a contributory role in acute necrotising gingivitis/periodontitis (NUG/NUP). However, because this condition is also associated with immunosuppression, it should be established whether a patient presenting with NUG/NUP is also suffering from candidiasis. If so, the topical application of miconazole is recommended for the treatment of candidiasis together with chemotherapeutic agents and clinical debridement for NUG/NUP.

**Oesophageal candidiasis**

Once pseudomembranous candidiasis has spread to the oesophagus, it is obviously not possible to mechanically disrupt the pseudomembranes through rubbing. At this advanced stage of the disease (Figure 3), patients are generally very ill and the regular intake of food is hampered and it is best that they be referred to a medical practitioner for further management. If it would take time for such patients to reach a medical practitioner then systemic antifungal agents should be prescribed. In the public health sector special motivation is required when fluconazole (Diflucan®) is prescribed. Fluconazole, as well as itraconazole (Sporazole®) are both available to patients in the private sector.

**Chronic hyperplastic candidiasis**

Patients presenting with this condition are rarely encountered in dental practice as they are very ill, most probably have other systemic conditions that require hospitalisation and should best be managed by a medical practitioner. In the unlikely event of a dental professional being consulted, it is best to direct the patient and or family to the nearest outpatient or emergency department of a hospital where the patient would hopefully be admitted and receive appropriate treatment.

**CONCLUSION**

While the reasons for the rising cost of health care in both public and private sectors across South Africa are debated, it is the patients who ultimately pay the price and health care professionals are urged to be prudent in the prescription of antimicrobial agents. Insight into disease processes or the nature of infecting agents will assist in the selection of the most appropriate treatment options together with the provision of appropriate advice to patients on maintaining health. Assumptions should not be made that Candida is indeed present but should be established through microscopy. In the case of oral conditions caused by *C. albicans*, there is no reason why resolution of the condition cannot be achieved with the initial treatment if patients are guided in the correct application of therapeutic agents (Table 1). Integral to the proper management of oral *C. albicans* infections is the recognition that an underlying systemic condition may be established, which may contribute to the fungus exerting pathogenic traits. Candidiasis seldom occurs in completely healthy individuals, a situation calling for closer collaboration between oral health professionals and their medical counterparts.

**References**

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C. Mating is rare within as well as between clades of the human pathogen Candida albicans. Fungal Genet Biol 2008;45(3):221-31.


The burden of dental caries in the Western Cape and a recommended turn-around strategy.

ABSTRACT
Oral diseases are mostly preventable and their prevention should be a top priority for health managers and oral health professionals. Oral health services data from 2011 to 2015 is compared with the National Children Oral Health Survey conducted in 1999 - 2002. Dental caries is amongst the most common diseases experienced in children. The Western Cape records the highest prevalence of dental caries among children of the ages 4 - 5, 6, 12 and 15 years, which has increased between 2002 and 2015, for six year olds (2011: 82% to 2015: 84%) and for 12 year olds (2003: 62% to 2015: 67%). Caries severity was measured in dmft- and DMFT-scores. Between 2003 and 2015, dmft in 6-year-olds increased by 13%, from 5.5 to 6.2, whilst DMFT in 12 year-olds showed an increase of 0.5 (2 to 2.5). Given these persistently high levels, current prevention strategies are clearly failing. It is crucial that decision makers implement health strategies that focus on promoting good oral health and preventing oral disease. This requires a shift away from the current predominantly emergency service of dental extractions.

INTRODUCTION
The mouth plays a vital role in general well-being and contributes to the social life of the patient.1 Oral diseases, especially dental caries, can result in severe pain and discomfort and lead towards escalating health care costs. Pathological changes in the oral cavity may contribute to inadequate food intake and possibly, malnutrition. Oral diseases are, however, mostly preventable and therefore the promotion of oral health and primary prevention should be a top priority for health managers and oral health professionals.

The serious nature of early childhood caries in the Western Cape is evidenced by the high number of young children who are treated under general anaesthetic in various facilities.2 In most cases treatment is limited to multiple extractions, a treatment intervention which can have further psychological and functional consequences. Oral diseases are generally not life-threatening but contribute towards a morbidity that affects the majority of people in the country.

This article reports on a comparison of recent oral health services data (2011 – 2015) with historical epidemiological data extracted from the last National Children's Oral Health Survey which was conducted in 1999 - 2002.3 It will also advocate for an integrated oral health strategy to promote primary oral health.

LITERATURE REVIEW
Dental caries is amongst the most common of the childhood diseases.4 The prevalence and severity of dental pain among children in South Africa is much higher than in England and the USA.5 Children with both poor oral health and weak general health are 2.3 times more likely to perform poorly in school.6 Dental disease in children leads to lost school time and increased absence from school had been shown to decrease academic performance.7

The Western Cape is the South African province with the highest prevalence of dental caries among children of the ages 4 - 5, 6, 12 and 15 years while the province with the lowest prevalence is Limpopo.8 Dental caries is particularly severe in the primary dentition, where it is measured by using dmft-scores referring to the number of decayed, missing and filled teeth. The prevalence of dental caries refers to the percentage of children in a sample who have a d-component score of more than zero.

Caries experience refers to the percentage of children who have a dmft-score of more than 0.9. The last South African National Oral Health Survey conducted in the period 1999 – 2002, indicated that the caries experience of 4 - 5-year-old children in the Western Cape was 77.1% and in 6-year-olds, 82.3%.8 This is much higher than the national means which are 50.59% and 60.32% for these particular age groups.3 A factor which adds more concern to these alarming statistics is the high percentage of unmet need. Almost 80% of carious lesions in 6 year-old-children within the province are untreated.
The consequences of untreated caries are among the most common reasons why children are hospitalized due to infectious complications. Successful treatment of these infections can significantly diminish their quality of life. Furthermore, untreated dental decay can affect a child’s growth and general health and wellbeing.

Poor oral health can also contribute towards loss of school days, and loss of productivity in the work place. In some cases children are embarrassed to smile. Dental caries is a silent epidemic that affects many people. It restricts activities in schools, work, and home, and often significantly diminishes their quality of life.

The dental treatment performed under general anesthesia is usually dental extractions. An analysis on dental general anesthetic (GA) cases on pre-school children in the Western Cape indicated that 1 in 10 000 cases (0.0001%) received restorative treatment. The average number of teeth being extracted per patient was ten. The alarming findings from that study are contrary to the generally suggested guidelines which advocate preserving the primary dentition. Furthermore, the probability of retreatment for dental caries after dental GA can be as high as 45.5%.

According to national policy documents, basic oral health care must be available in public dental clinics. These documents include the National Oral Health Policy, National Oral Health Strategy, and Norms and Standards for Oral Health Care in South Africa. The basic oral health care package includes prevention of oral disease, mainly dental caries, promotion of oral health and lastly basic oral health care treatment which includes an oral examination, bitewing radiographs, scale & polish, 1-3 surface fillings and extractions. However, only a third of clinics in the province can offer the basic oral health care package and 60% of clinics are limited to offer only dental extractions. The study conducted by Smit also found that less than half of the clinics (43%) are able to offer scale & polish, 1-3 surface fillings and extractions.

The estimated prevalence of early childhood caries in developed countries is between 1% and 2% while the prevalence in less developed countries is 70%. In developing countries, communities are disadvantaged and the people are from a much lower socio-economic background. The current study showed that in the permanent dentition in 12 year olds, 62% of teeth are affected while in 15-year olds, almost 81% of the dentition is affected which is almost twice the national figure.

AIM

To investigate the burden of dental caries in the Western Cape and to compare those findings with the data reported in the last National Children’s Oral Health Survey of 1999-2002.

OBJECTIVES

- To discuss the National Children’s Oral Health Survey of 1999-2002
- To analyze the caries experience and severity recorded in the most recent caries surveillance data of the Department of Health in the Western Cape (2011 to 2015) among 6- and 12-year old children
- To compare the results of the Departmental survey with those of the current study.

MATERIAL AND METHODS

The first part of this article will focus on results obtained from the last National Oral Health Survey conducted in 1999-2002 by the National Department of Health to determine the oral health status of adults and children (6-, 12-, and 15-years of age) in the five major metropolitan areas of South Africa. Secondly, the paper will focus on the most recent surveillance data for dental caries in the Western Cape obtained in 2015. These data are being collected on an on-going basis to evaluate a fissure sealant roll-out for 6 year olds and 12 year olds in targeted provincial schools throughout the province. The examiners were all standardized according to the guidelines provided by the WHO Oral Health Surveys, Basic Methods methodology (4th Edition) in the understanding of the precise criteria for the identification of each caries status and treatment need code. A formal calibration exercise was not carried out, as it was not feasible to do so for all the dentists employed in the public sector throughout the province. The Department of Health is responsible for the Oral Health preventive and treatment services for schools in lower socio-economic areas. At each school a random sample of 20 six year olds and 20 twelve year olds who met the age criteria was selected from names on the class lists. If there were less than 20 children who qualified in terms of age, all the qualifying children were examined. The subjects were examined at the school, using a portable dental chair and a portable dental light, a WHO probe and a plane mirror.

The caries status and treatment needs were recorded on a modified WHO Oral Health Surveys data collection form. A total of 3427 learners were examined from 194 schools and the programme is on-going. The data were analyzed using a custom software program for measuring oral health surveys and, using Microsoft Excel, the results were calculated and presented according to the WHO guidelines.


The last National Oral Health Survey which was conducted in 2002 reported that more than 82% of 6 year old children in the Western Cape have experienced dental caries and 75% of the children in this age category remained untreated. The Western Cape had the second highest levels of dental caries the country (Figure 1). The caries experience in the Western Cape was 22% higher than the national mean which was 60%. The province with the highest caries experience was Northern Cape with 84%. Other provinces had caries experience around the 52% - 68% levels except for Limpopo which recorded the lowest prevalence of 37%. The national percentage for untreated caries was 55%, which is 20% less than the figure recorded for the Western Cape.
Results

Caries experience among 12-year-olds in the Western Cape was 62% (national mean: 37%) and the percentage of untreated caries was 52% (Figure 2), making the province that with the highest caries experience, while Northern Cape and Eastern Cape recorded figures of 47% and 49% respectively. Limpopo had the lowest caries experience of 16%. The national percentage for untreated caries in 12-year-olds was 22% less than the result for the Western Cape (Figure 2).

Severity of dental caries was measured by the dmft-score in primary teeth (Figure 3). The dmft-score for 6-year-olds in the Western Cape of 5.5 was almost double the national mean of 2.87. Within the Western Cape, the d-component (3.81) contributed to 70% of the dmft-score, the m-component (1.57) contributed 29% and the f-component was only 2% of the dmft-score. Similar cumulative proportions of dmft were found in other provinces except for Gauteng where the f-component contributed 14%.

The DMFT-score for 12-year-olds in the Western Cape of 1.97 was double the national mean of 1 (Figure 4). Within the Western Cape, the D-component (1.39) contributed 70% of the DMFT-score, the M-component (0.39) contributed 20% and the F-component (0.19) was 10% of the total DMFT-score. None of the other provinces had similar cumulative proportions of the different components for DMFT. In Limpopo, the M-component was 0.09. Gauteng had the highest F-component among all provinces with F = 0.34 accounting for 14% of the DMFT-score.

Western Cape surveillance data: 2011 – 2015

Caries experience for the province for 6-year-olds was 84% while untreated caries recorded a level of 74%. This means that three quarters of all 6-year-olds had active caries which was untreated (Figure 5). The Overberg district and the West Coast showed the highest caries experience in the province with 94% and 92% respectively. Central Karoo had the lowest caries experience in the province with 77%. Untreated caries remained slightly lower than caries experience for all the districts except for the West Coast where untreated caries was almost as high as caries experience.

Caries experience among 12 year-olds was at 67% and untreated caries reached 62% (Figure 6). The Overberg sub-district and the Cape Winelands had shown the highest caries experience in the province with 87% and 78% respectively. Central Karoo had the lowest caries experience in the province with 43%. The high levels of caries experience were mostly due to untreated caries.

The dmft-score for 6 year-olds in the Western Cape was 6.2 (Figure 7). In the Cape Winelands and Overberg the numbers of missing teeth were almost half of the numbers of those teeth being affected by caries. In the West Coast district each child had on average one tooth missing and five teeth with active caries.
The DMFT-score for 12 year-olds was 2.4 with the Overberg district having the highest mean DMFT-score in the province and Central Karoo the lowest (DMFT = 1). The severity of caries among 12-year-olds in the Western Cape was more than double the national mean in 2002 (Figure 8).

When comparing with findings for caries severity among 6 year-olds in the National Survey of 2002 and the current surveillance data, it was found that the mean dmft had increased from 5.5 to 6.2. Student’s t test showed that this increase is statistically significant (p = 0.039).

Similarly, the caries severity among 12-year-olds in the National Survey of 2002, measured as the mean DMFT, increased from 2.0 to 2.5, a statistically significant change (p = 0.024).

**DISCUSSION**

The findings from the current surveillance data in the Western Cape related to caries experience, shows that untreated caries and caries severity among age groups 6- and 12 year-olds, have remained high between 2002 and 2015. The caries experience in the Western Cape for 6-year-olds during the period 2011-2015 was 84% compared with 82% in 2002. Only 16% of 6-year-olds in the Western Cape are caries free. This figure is far below the goal of 50% recommended by the National Department of Health which was proposed for 2000.25 Similarly, caries experience in 12 year-olds has increased from 62% in 2003 to 67% in 2015.

Untreated caries in 6 year-olds dropped 1% from 75% in 2003 to 74% in 2015. However in the 12 year-olds, untreated caries increased from 52% in 2002 to 62% in 2015. A similar trend was observed between 1988 and 2002 by Van Wyk when the previous two National oral health surveys for South Africa were compared.25 This observation emphasizes that the majority of dental caries among young children remains untreated. The finding raises serious concern since untreated dental caries progresses towards complications such as irreversible pulpitis, pulpal necrosis, dental abscess and facial cellulitis, which in some cases can be very severe.26 Most of these are associated with excruciating pain, limited jaw opening and reduced quality of life. All of these can be prevented by daily tooth brushing with fluoridated toothpaste, reduced sugar intake and an annual dental examination.

Among 6-year-olds, caries severity increased between 2002 and 2015 by 13%, from dmft 5.5 to 6.2, whilst a 20% increase was recorded amongst 12 year-olds, from DMFT of 2 to 2.5. A positive observation is that caries severity in 12-year-olds in the Western Cape remains below the WHO global goal of less than 3 (by 2000).27 However, it is above the RSA national goal of 1.5 as set by the Department of Health.20 Similar DMFT-scores of 2.14 – 2.5 among the “Coloured” population group were found by Ayo-Yusuf in 2007.28
The increase in caries experience and severity can be explained by the continued consumption of a high sugar diet as well as a limited access to basic oral health care services. The high rate of urbanization in the Western Cape also might have contributed to the high unmet treatment need, as the number of dental clinics and oral health professionals has not increased at the same rate as population growth. Good access to basic oral health care is essential in planning future strategies such as the National Development Plan, Health Care 2030 and National Health Insurance.

Poor oral health will contribute to general health problems and it is for this reason that the high prevalence of early childhood caries should be a serious concern to the country. Aspects of life such as growth, cognitive and general development, interferences with sleep, poor appetite, poor school behaviour, eating patterns and negative self-esteem may be affected. Dental disease in children leads to lost school time due to absenteeism and has been shown to decrease academic performance. Oral health programmes to promote good oral health in the school setting and at clinics are very limited in the province, and such programmes that are there, may not be well managed.

CONCLUSION

Given the persistently high levels of caries among children recorded in the period from 2002 to 2015, the current prevention strategies are clearly failing. Although oral disease does not contribute to high mortality rates, the effect on morbidity is a cogent issue and many people who seek health care in the public sector require urgent dental treatment. The burden of oral disease will worsen over time and will continue to result in more hospital admissions with dental sepsis if the current limited access to basic oral health care is not addressed by health managers. Promoting oral health among children is not solely the responsibility of oral health professionals. Others, such as nurses, home based carers, social workers, community health workers and clinical associates can also be utilized to provide oral health instruction and education to patients. Training of these individuals can be provided by oral health professionals with the ultimate goal of equipping patients to manage self-care.

Oral health care must be regarded as a right that each person can enjoy and therefore it is crucial for decision makers to implement existing health strategies to prevent oral disease and promote good oral health.

RECOMMENDATIONS

An oral health strategy needs to be implemented that focuses on promoting good oral health and preventing oral disease, notably dental caries. This requires a shift towards a preventive approach instead of a predominantly emergency service of dental extractions. All main public dental clinics (where a dentist is present each day of the week) should at least be able to offer the basic oral health package. The following recommendations are made:

Antenatal clinics and Road to Health booklet

The general health of children is monitored closely during the first five years though timeous immunizations. At the same time, growth development is charted on the “Road to Health Booklet”. The oral health section in the booklet which includes charting for dental caries, should be completed by an oral hygienist, a dental therapist or a dental practitioner. However, due to a serious shortage of oral health professionals in the public sector, the oral health section in the booklet most commonly is simply not completed. Other health workers such as nurses or community health workers should be allowed to complete the section on oral health and the necessary training should be offered to them to perform early dental screening of children.

Promotion of good oral health habits

Strategies that focus on Mother and Child Care should focus on the oral hygiene of mother and child, infant feeding practices and diet of mother and child. The deleterious effect of adding sugar to a feeding bottle should be emphasized.

Immunization schedule

Exposure to oral health education during different immunization appointments may influence behaviour in order to promote good oral health. Interventions can be initiated at the following time frames:

- Time frame 1: From 9 months to age 18 months
- Time frame 2: From 19 months to age 6 years

The necessary training should be offered to nurses to perform early dental screening of children who are attending immunization clinics.

Training workshops for Early Childhood Development Centres

A comprehensive crèche training programme should be implemented in both registered and non-registered ECD (Early Childhood Development) facilities in the rural areas as has been done in the Cape Winelands District Municipal area.

Life skills in primary schools

Closer cooperation with the Department of Basic Education should be encouraged to increase the exposure of oral health education that children receive during their school years. Children can be introduced to good oral habits e.g. daily tooth brushing with fluoridated toothpaste as part of the official Life Skills curriculum.

Supervised daily tooth brushing programmes

Introduce daily supervised tooth brushing programmes at schools and early childhood centres. The foundation phase (Grade R, 1 and 2 learners) should be targeted. The integrated school health team and the community health workers can assist with supervision and in some cases a community volunteer can also play this role.

Selected pit and fissure sealant programmes

The combined effect of tooth brushing and fissure sealant placement is more effective than one regimen alone. Smooth surfaces and fissures of teeth should be protected against decay. Schools that are on the national nutrition programme should be targeted.

The targeted age groups for selective pit and fissure sealant programme are 6 - 7 year-olds (grade R and 1) to seal the first permanent molars and 11 – 12 year-olds (grade 6 and 7) to seal the second permanent molars.
Household visits by ward-based health teams

Community Health Workers (CHW) also known as Community Based Carers should be offering oral health instructions (OHI) and oral health education (OHE) to parents when households are visited. Concurrent with instructions and education on oral health, CHW’s should also disseminate tooth brushes and fluoridated tooth paste meant for the pre-school children of that particular household.

Information management

Information on dental services in the public sector needs to be investigated to evaluate the quality of oral health programmes and whether these services adhere to national and provincial policy recommendations.

References

ABSTRACT

Introduction: Research has confirmed that the replacement of defective restorations is the most commonly performed procedure in general practice. Any defect or sign of secondary caries often led to the complete replacement of a dental restoration. The repair or refurbishment of defective dental amalgam restorations is now considered best practice over replacements.

Aims and objectives: To investigate the use and repair of dental amalgam restorations as practised in South Africa.

Methods: Three hundred and twenty-four dentists participated in an electronic cross sectional survey to gather biological data and information on the management of defective amalgam restorations. Analyses included Analysis of Variance (Anova) tests, Chi-square tests, paired t tests and Friedman’s test (p-value of <0.05) (SAS Institute Inc., Cary, NC, USA).

Results: Most dentists (n=62%) reported almost never using dental amalgam and an almost equal number (n=63%) repaired defective amalgam restorations. Resin composite was the most popular material for the repair (n=62%) and replacement (n=78%) of defective amalgam restorations. Dentists in this study relied on their clinical experience to derive their repair techniques.

Conclusions: Dental amalgam was no longer a preferred material for the restoration of posterior teeth in South Africa. Resin composite was the most widely used to repair or replace defective amalgam restorations. Dentists practised the repair of defective restorations.

INTRODUCTION

Dental caries is the most common chronic disease worldwide, affecting nearly all adults and is the “primary cause of oral pain and tooth loss”. Although there has been a widespread decline in the prevalence of caries in permanent teeth in high-income countries, there are reports of a growing burden of dental caries for adults in low and middle income countries. This is attributed to increasing urbanisation and changes in dietary habits and living conditions.

In recent years, there has been a trend in caries management away from the operative model towards a more preventive approach – minimum intervention dentistry. This includes strategies that curb the disease process and conserve tooth structure. Traditional curative treatment of dental caries has dominated in countries such the United States of America, although in some regions such as Scandinavia, a more preventative approach has been adopted. Once sound tooth structure is destroyed through the caries process, there is an ongoing lifelong cycle of repair and maintenance.

A wide variety of dental restorative materials exists today. The principal material types for direct restorations include dental amalgam, composites, glass ionomers and resin ionomers. The use of dental amalgam for the restoration of posterior teeth has decreased because of the need for a more aesthetic material as well as concerns regarding its safety; however, it remains an effective restorative material.

Extensive research has been conducted over the years to investigate the longevity of direct restorations, specifically comparisons between the longevity of dental amalgam and posterior resin composite restorations. Studies conducted by Manhart et al. and Opdam et al. found that newer resin composite restorations have an improved longevity. However, a Cochrane Review published in 2014 concluded that the failure rate for composite restorations was twice that of amalgam restorations. Despite this, increasing concern over aesthetics, the recent Minamata Convention on Mercury and advances in adhesive dentistry have globally decreased the acceptance of dental amalgam among dentists and patients alike.
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Hurst surmised that the failure rate of composite restorations could be four times that of amalgam restorations in a patient with a high caries experience. If dental amalgam were no longer available as a restorative material, populations with high caries rates could therefore be disadvantaged. The most recent data records dental amalgam being used by 85.8% of dentists in South Africa. In these situations, extending the longevity of defective dental amalgam restorations with a repair or refurbishment may be an excellent alternative for increasing the longevity of the restoration and ultimately, the tooth.

This paper reports on the use of dental amalgam as a restorative material in South Africa in light of the Minamata Convention recommendations and the management of defective amalgam restorations.

MATERIALS AND METHODS

An electronic cross-sectional quantitative survey using Survey Monkey was distributed to all members of the South African Dental Association (SADA). The study population consisted of 3,076 general practice dentists. Responses were collected for three months and reminders were emailed at 14 day intervals for two months.

The questionnaire consisted of closed and open-ended questions. It elicited information on age, gender, years of experience in practice and highest qualification achieved. The questionnaire also gathered information regarding the practices of the dentists in their management of defective dental amalgam restorations. The questionnaire was adapted from research conducted by Moncada et al. and Dental PBRN.

STATISTICAL ANALYSES

The Survey Monkey program collected responses and automatically prepared an Excel spreadsheet. The frequency distributions of all the demographic variables, dental practice profile, continuing professional development, selection of restorative materials and attitudes to repair and replacements of defective amalgam restorations were computed.

Results are presented as frequency distributions and mean scores. For the Analysis of Variance (Anova) tests, Chi-square tests and paired t tests, a p-value of <0.05 was considered as statistically significant.

In questions for which more than one response could be selected, the Friedman’s test was used to determine these differences. The data analyses and re codings were carried out using statistical software SAS (SAS Institute Inc., Cary, NC, USA).

Ethical considerations
Each participant was asked to complete an online informed consent form. Ethics approval was received from the Senate Research Committee of the University of the Western Cape (Project registration: 11/1/46).

RESULTS

Initially 388 dentists responded to the online survey. However, six respondents did not agree to participate in the study and an additional seven respondents agreed but did not answer any of the survey questions. The application of the exclusion criteria resulted in a final sample of 324 general dental practitioners currently employed as dentists in the private sector.

Demographics

More than three quarter (78%) of the respondents were younger than 55 years old, with females accounting for just over a third (36%). More than two thirds (67.7%) had a BChD degree as their highest qualification, and just over a quarter (26.7%) held a postgraduate diploma.

55% were self employed in solo practices and 41% had at least 21 years in private practice. One third were not contracted to medical aid or third party funders.

Choice of dental restorative material

Most dentists (57%) reported that they almost always discussed the choice of dental material with the patient and only 11% almost never did. Amalgam was almost never used as a restorative material by 62% of respondents while only a small group (7%) reported almost always using amalgam as a restorative material.

Repair of defective dental amalgam restorations

Almost two-thirds (63%) reported repairing defective dental amalgam restorations in their practice. Of the 37% who did not repair, 81 respondents provided reasons when asked. Most of the respondents (72%) felt there was a lack of predictability in the process. This was the major factor in their decision not to repair defective dental amalgam restorations followed by the absence of an established technique (26%), lack of supporting evidence (20%) and the absence of a professional code or fee for the procedure (8.6%).

AMALGAM REPAIR TECHNIQUE USED

Table 1 shows the amalgam repair techniques employed by respondents.

<table>
<thead>
<tr>
<th>Techniques</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a bur to create mechanical retention</td>
<td>189</td>
<td>77</td>
</tr>
<tr>
<td>Apply silica coating to the amalgam prior to bonding</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Apply silane coating to the amalgam prior to bonding</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Apply total-etch dentine-bonding system</td>
<td>120</td>
<td>49</td>
</tr>
<tr>
<td>Apply self-etch dentine-bonding system</td>
<td>53</td>
<td>21.5</td>
</tr>
<tr>
<td>Apply glass ionomer as a dentine bonding system</td>
<td>79</td>
<td>32.1</td>
</tr>
<tr>
<td>Place a pin-retained restoration</td>
<td>81</td>
<td>33</td>
</tr>
</tbody>
</table>

Origin of technique used

Respondents were asked to indicate where and from whom they had learnt their repair technique. They could select more than one appropriate answer. Using the frequency of individual items chosen, more than two-thirds (68%) of the participants developed their technique through their own clinical experience, while only 27% learnt it through attending a continuing professional development course or lecture (Figure 1).

Pairwise comparisons confirmed that undergraduate dental school was chosen significantly more than attending a CPD course or lecture, reading a journal
article, learning from the Internet or learning from a fellow colleague (p<0.0001) but was chosen significantly less than the clinical experience of the respondents.

**Restorative material of choice for repairing a defective dental amalgam restoration**

Resin-based composites were chosen significantly more often than all the other dental restorative materials when replacing a defective dental amalgam restoration (Figure 2). From the pairwise comparisons conducted, it may be seen that resin modified glass ionomer was chosen significantly less than resin-based composite but significantly more than silorane based composite, flowable composite and compomers when a restorative material was selected to repair a defective dental amalgam restoration.

**Restorative material of choice for replacing a defective dental amalgam restoration**

Using the frequencies of the most popular single treatment option as in Figure 3, it is evident that resin-based composites were the material of choice when replacing a defective amalgam restoration (78%). The treatment choice of a crown was also popular, with 58% of the participants choosing this treatment option. When pairwise comparisons were completed, resin-based composites were chosen significantly more often than all the other possible treatment choices for replacing a defective dental amalgam restoration (p<0.0001).

**DISCUSSION**

In South Africa in 2014, a total of 5 824 dentists were registered with the Health Professions Association of South Africa (HPCSA),23 of whom 3 607 were members of the South African Dental Association (SADA). Despite being reminded of their participation fortnightly for two months, there was a low response rate of 10.7% for the quantitative online survey. A better response would certainly have offered greater confidence in the study. However, this is consistent with other studies that had used the same study population and similar electronic survey methods.24,25

The sample included approximately one third female participants. A study of the gender distribution among dental graduates between 2000 and 2005 reported a two fold increase in the number of female graduates.26 Previous research conducted in South Africa also noted differences in the working patterns of male and female dentists. A 1997 study found the percentage of male dentists working in private practice was 70% to 89.7%.27 However, the percentage of female dentists practising more than 35 hours per week has dropped from 86% to 34%, while the working patterns of male dentists remain unchanged.27 Only 19% of female dentists were the primary breadwinners, indicating that many female dentists were able to work part-time.27 In addition, a greater percentage of female than male dentists worked for a salary in government clinics and at academic institutions.27 The present study focused on dentists in private practice and if these working patterns have remained unchanged from 1997, and this may have influenced the study population.

**Management practices of defective dental amalgam restorations by South African dentists**

The findings of the present study were in line with global trends, revealing a decline in amalgam use, with only 7% of participating dentists using it as a restorative material in South Africa. Despite this, dentists in this study advocated its use due to the excellent lifespan and durability, and a significant number believed it should remain available for clinical use. This is in stark contrast to the 99.7% of dentists who were using dental amalgam in 1990 and the 85.8% in 2003.28 It should be noted that the 2003 study conducted by Du Preez et al. had only 177 respondents as opposed to 324 in this study. The dramatic decline may be due to the increasing perception that the material is outdated and increasing awareness of patients of the possible harmful effects of dental amalgam.

Approximately 72% of amalgam restorative treatment is performed to replace existing restorations and the two primary reasons are recurrent caries and faulty margins.21 Just a decade ago, dental amalgam was the material of choice in South Africa.28 Given that the longevity of
dental amalgam restorations varies between 7 years and 20 years, it is anticipated that South African dentists will be treating more patients with defective dental amalgam restorations in the near future.\(^{29}\)

Recent studies have confirmed that the repair of defective dental restorations is a clinically viable option to extend the longevity of a restoration without compromising tooth structure or incurring huge costs as in the case of indirect restorations.\(^{20,30}\) Data from the self-administered questionnaires revealed that the majority of dentists routinely repair defective dental amalgam restorations.

While no consensus has been reached on a repair technique, recent research has clearly outlined successful and appropriate techniques.\(^{30-36}\) The successful repair of a defective restoration is dependent on the formation of a durable bond between the original restoration and the repair material. Macro-mechanical retention is achieved by creating retention features in the restoration or roughening the surface with a coarse diamond bur and micro-mechanical retention is achieved with the use of etching or the use of air abrasion.\(^{35}\) In the present study, a large percentage of the dentists indicated that they would use a bur to create mechanical retention and an almost equal number indicated that they would use a dentine bonding agent to prepare the substrate.\(^{33}\) Although phosphoric acid has no effect on the surface characteristics of composites, ceramics and metals, research has shown that it has a favourable effect on retention rates following a repair because of a cleansing action.\(^{36}\) Thus, dentists who participated in this study were practising according to current available evidence. However, the most recent recommended protocol for the repair of restorations advocates the use of hydrofluoric acid or the use of air abrasion instead of phosphoric acid.\(^{35}\)

Once the decision has been taken to repair a restoration, the focus shifts to the selection of a suitable dental restorative material for the repair. In the present study, more than one half of the dentists reported discussing the choice of dental material with patients even though it is possible that most patients would not understand the scientific rationale.

Consistent with the decrease in amalgam usage worldwide and the findings from the National Dental Practice-Based Research Network,\(^{36}\) resin composite was the restorative material of choice when repairing a defective dental amalgam restoration. However, similar to the findings of Gordan et al.,\(^{36}\) a very small number of dentists were confident in the use of amalgam to repair an existing defective dental amalgam restoration. A concern for aesthetics and the perception of a lack of adequate bond strength between dental amalgam and composite could explain these results even though laboratory studies have confirmed favourable bond strengths are attainable.\(^{37-39}\)

Approximately two thirds of dentists revealed that they had developed their repair technique through their own clinical experience. This behaviour could be explained by two possible opinions. Firstly, clinicians often assume that a treatment is successful based on positive outcomes reported for a number of treated patients. Secondly, the perception that the treatment ‘works in my hands’ is often seen by general dentists as better evidence that the treatment is clinically viable and acceptable as opposed to data from ‘artificial clinical trial settings’. While dentists are bombarded with information from dental company representatives, critical evaluation of the scientific information is often not undertaken. This delays the incorporation of evidence-based dentistry into general dental practice.

This lack of knowledge or competence in the technique potentially means patients are not offered a treatment procedure that has been shown to require less anaesthetic and to promise the conservation of more tooth structure.\(^{40}\) Furthermore, the lack of adequate knowledge and skills among South African dentists on how to repair defective restorations may adversely affect health outcomes for an entire population. Until now, the main focus of dentists was to ensure the longevity of the dental restoration. However, in an attempt to break the ‘restorative cycle’, Opdam proposes that “it is more important to preserve the underlying tooth and the functionality of the dentition as a whole”.\(^{40}\) Failure of a restoration results in its replacement with a larger restoration, possibly root canal treatment resulting in more complications and eventual extraction of the offending tooth.\(^{45}\) Consequences of dental disease - including the loss of teeth - range from pain, impaired eating, interferences in sleeping and speaking, loss of productivity and depressed general health.\(^{5}\) This suggests that the indiscriminate replacement of defective restorations raises issues of ethics and quality of care.

While the dentist is responsible for providing appropriate dental care, the responsibility to encourage the implementation of suitable dental care is shared between dental schools and professional organisations.\(^{43}\) Dental schools should ensure that their curriculum is based on evidence-based practice. Dentists should be taught how to access sound resources of evidenced-based dentistry and how to incorporate these guidelines into clinical practice. An important part of teaching dental students is to think critically and includes making them aware of conflicting evidence or the absence of evidence. The fact that dentists have adapted their own ‘repair technique’ may imply that dental schools in South Africa have not yet formally included repair techniques into their curricula, as have the UK, USA and European schools where the repair of direct restorations is taught.\(^{44,45}\) Gilmore et al. stated that “the adoption of evidence-based practice by dentists has been slow”.\(^{49}\) The present study suggests that South African dentists are no different and raises concern regarding the practice of evidence-based dentistry and the competencies of acquiring, maintaining and applying evidence-based knowledge.

**CONCLUSIONS**

The present study provides important insights into restorative treatment practices of South African dentists as there is limited data in this field. South African dentists have significantly decreased their use of dental amalgam as a restorative material in favour of resin composites. In addition, dentists in this study were in favour of repairing defective dental amalgam restorations. However, there was much variation in the clinical repair technique used. The lack of knowledge regarding best practice in the management of defective dental amalgam restorations is a cause of concern. It may be helpful for future research
to interrogate the teaching practices on the repair of dental restorations. Appropriate continuing professional activities should be arranged for practising dentists so that ultimately patients may benefit.

Conflicts of Interest: None declared

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References


Functional Appliances – a review and presentation of four cases.

INTRODUCTION
Orthodontic treatment is aimed at improving facial and dental appearances as well as enhancing the relationships of the teeth and skeletal bases to each other. As orthodontic treatment is becoming more accessible, parents and caregivers are requesting attention for their children at an earlier age. The goal of early treatment is to correct existing or developing skeletal, dentoalveolar and muscular imbalances.

There are a number of modalities available for managing Class II malocclusions. Some of the more common options include extra-oral traction appliances, arch expansion appliances, extraction procedures, functional jaw orthopaedic appliances and orthognathic surgery. The treatment approach adopted will depend on the growth status of the patient. Treatments that have the ability to alter a patient’s facial growth exert their effect, either accelerating or limiting, on the skeletal structures of the craniofacial region.

The concept of functional jaw orthopaedics or advancement of the mandible is not new to dentistry. As cited by Graber4, Norman Kingsley was the first to use forward posturing of the mandible by “jumping the bite”. He developed a maxillary vulcanite plate that guided the mandible into a forward position during mandibular closure.

In 1902, Pierre Robin introduced the plastic monobloc as a passive positioning device. This appliance influenced the muscular activity by a change in the spatial relationship of the jaws. It was specifically designed to act on the maxillary and the mandibular arches simultaneously with the intention of expanding the upper and lower arches to bring the mandible forward.5 Since then, numerous appliances have been designed and developed with the intention to advance and reposition the mandible.

There has also been a gradual evolution in the way functional jaw orthopaedics is used in a contemporary orthodontic practice, especially with regard to appliance selection, the timing of intervention and the urgency and need for “orthopaedic” correction. These functional appliances were developed to correct the aberrant muscle environment – the jaw-to-jaw relationship – and as a result restore facial balance by improving function.6

The timing of early treatment is pivotal in the modification of facial growth. Ball et al. conducted a study in 2011 with the intention to establish the relationship of mandibular growth to the stages of cervical vertebral maturation. They found that peak mandibular growth velocity occurred most frequently during stage four. This stage is defined by concavities at the lower borders of C2, C3, and C4 with the bodies of both C3 and C4 being horizontally rectangular in shape. Ball et al. found the average number of years spent in this stage to be 3.79 years and the average amount of mandibular growth occurring during stage four to be 9.40mm.1

In an attempt to demonstrate the potential benefit of early functional treatment, four cases treated at the Oral and Dental Hospital of the University of Pretoria are presented.

CASE REPORT 1
A 10-year-old female patient (Figures 1a-h) presented with the complaint that her teeth were crooked and that she found it difficult to chew. The patient requested an improvement in her appearance, wanting her teeth to be straight and an improvement in her function so that she could eat and chew more effectively.

Clinically the patient presented with a Class II Division One malocclusion on a moderate Class II skeletal base with mandibular retrognathia. The patient was in the transitional dentition stage of dental development with permanent incisors and molars present together with the primary molars and canines.

In occlusion the overbite was 7/10ths (70%) and the overjet was 10mm. The molar relationship was Class II bilaterally. The cephalometric tracing confirmed that the patient had a moderate Class II skeletal base relationship with an ANB of 9° and the mandibular plane angle of 20.7°. The upper incisors were slightly proclined at 23° with the lower incisors retroclined at 22° (norm values; 22° and 25°). The interincisal angle was 125°.

This patient was treated with a Twin Block appliance2 which essentially consists of upper and lower removable bite planes which meet on an incline when the patient occludes, producing a protrusion of the lower jaw. Initially
a 2x4 appliance was used for three months to level and align the anterior maxillary segment. This was followed by the placement of removable Twin Block appliances and the patient was instructed on the wear and care of the appliance.

The Twin Block appliances were trimmed as the succedaneous teeth erupted and the buccal blocks were trimmed posteriorly to allow for the eruption of the first molars. The appliances were worn full time for 20.5 months followed by night time wear only for another eight months (Figures 2a-h).

Following this period of treatment, the antero-posterior correction of the buccal segments was achieved, the upper incisors had been retroclined by 8°, the lower incisors proclined by 8° and the ANB angle was reduced by 4.5°. Superimposition of cephalometric tracings revealed mandibular changes in a horizontal and vertical direction, with a favourable increase in lower anterior face height of 3.5mm (Figure 3).

CASE REPORT 2

A 14-year-old male (Figures 4a-h) presented with a concern about the appearance of his upper front teeth. He presented with a Class II Division Two incisor relationship on a skeletal Class II base with a retrognathic mandible. He had a full complement of teeth with moderate crowding of the upper labial segment.
In occlusion the overbite was 8/10ths (80%) and the overjet was 5mm. The buccal segment relationship was a full unit Class II bilaterally. The cephalometric tracing confirmed that the patient had a skeletal Class II base relationship with an ANB of 6°. The mandibular plane angle was 23°. The upper incisors were retroclined at 17° with the lower incisors at a correct inclination at 25°. The interincisal angle was 132°.

Treatment involved correcting the Class II skeletal relationship with a Twin Block appliance. Removable Twin Block appliances were fitted and instructions were given on wear and care of the appliances. The patient was monitored and the bite blocks were trimmed posteriorly to allow for molar eruption. After 6.5 months of full time wear the patient was instructed to wear the appliance at night only as a retentive measure. Interim results were reassuring and there has been a change in mandibular position (Figures 5a-h). Treatment is ongoing and the patient will be evaluated for the placement of full fixed appliances in three months.

CASE REPORT 3

A 14-year-old male (Figures 6a-h) presented with a complaint that his “top teeth are too far forward.” He presented with a Class II Division One incisal relationship on a Class II skeletal base with mandibular retrognathia. He had a full complement of teeth with mild crowding of the upper arch and severe crowding of the lower arch. In occlusion the overbite was 8/10ths and the overjet was 10 mm. The buccal segment relationship was a full unit Class II bilaterally. The cephalometric tracing confirmed that the patient had a skeletal Class II base relationship with an ANB angle of 6°. The mandibular plane angle was 25°. The upper incisors were proclined at 35° with the lower incisors showing a compensatory proclination of 29°. The inter-incisal angle was 113°.

The aim of treatment was to achieve sagittal correction with the Mandibular Anterior Repositioning Appliance (MARA) appliance. Fixed orthodontic appliances were bonded in the upper and lower arches from second molar to second molar after extraction of the upper and lower first premolars (14, 24, 34 & 44). Thirteen months after bonding the MARA was placed to advance the mandible by 4mm on the left and 5mm on the right. During follow-up appointments, the lower jaw was advanced incrementally and asymmetrically to achieve an edge-to-edge bite with coincidental midlines. After seven months, TMJ radiographs were taken to confirm that the condyles were centred in the fossae and subsequently the MARA elbows were removed. Two
weeks later, the remaining components of the MARA were removed. Final detailing was done to produce a mutually protected functional occlusion. Total treatment time was 27 months (Figures 7a-h).

Cephalometric analysis revealed that the sagittal correction occurred due to an anterior repositioning of B point with no evidence of maxillary restraint. The upper labial segment was normalized at 22°, the lower retroclined to 20° and an interincisal angle of 138° was achieved (Figure 8).

CASE REPORT 4
A 13-year-old female (Figures 9a-h) presented with a complaint that her teeth were ‘crooked’. She had a Class II Division Two incisor relationship on a skeletal Class II base with a retrognathic mandible. A full complement of teeth was present with moderate crowding of the upper and lower labial segments. In occlusion the overbite was 8/10ths and the overjet was 3 mm. The buccal segment relationship was Class II bilaterally. The cephalometric tracing confirmed that the patient had a skeletal Class II base relationship with an ANB of 6°. The mandibular plane angle was 30°. The upper incisors were retroclined at 7° as were the lower incisors at 17°. The interincisal angle was 151°.

Treatment involved correcting the Class II skeletal relationship with a MARA appliance. Fixed orthodontic appliances were bonded in the upper arch 4-4 and the lower arch 5-5. Two weeks later the MARA appliance was added to advance the mandible by 3mm on the left and 4mm on the right. During follow-up appointments, the
lower jaw was further advanced in increments of 1-2mm. to achieve an edge-to-edge bite. After 13 months, TMJ radiographs were taken to confirm that the condyles were centred in the fossae and subsequently MARA elbows were removed from the left and right sides. The remaining components of the MARA were removed after a fortnight and final detailing was done to produce a mutually protected functional occlusion. Total treatment time was 22.5 months (Figures 10a-h).

Cephalometric analysis revealed correction of the upper incisor inclination to 24°, the lowers to 26° and the interincisal angle was reduced to 127°. The ANB angle had improved by a reduction of 3° with evidence of an increase in mandibular length by 2.5 mm (Figure 11).

**DISCUSSION**

The Clark Twin Block appliance (Figure 12) that has been used in two of the cases presented here is a modern, highly successful functional appliance modelled after the Schwarz double plate. This appliance was developed more than 30 years ago by William Clark, and is composed of maxillary and mandibular removable
acrylic components that fit tightly against the teeth, alveolus and adjacent supporting structures. Treatment with the appliance includes occlusal guide planes, selective grinding of the acrylic, guided eruption and a midpalatal jackscrew to allow for three-dimensional control.

An impeding factor to the success of this treatment modality is patient cooperation and compliance. It is essential that the appliances are worn all night and for most of the day. The latter may be onerous with regard to speech and communication at school. Fortunately the two cases presented were successfully treated without any incident.

To alleviate the abovementioned restrictions to Class II corrective therapy, the Mandibular Anterior Repositioning Appliance (MARA) (Figures 13a & 13b) can be employed. Although not as bulky, it can be considered to be a fixed Twin Block, in that it is cemented to the molar teeth and also repositions the lower jaw forward upon closing. The appliance fits around the upper and lower first molars and has two buccally positioned vertical surfaces which contact to keep the lower jaw forward. By holding the lower jaw forward over a sufficiently long period, growth and/or remodelling of the jaws and migration of the teeth can result in a permanent change in the bite from Class II to Class I.

Functional jaw orthopaedic appliances have a common denominator. All induce a forward mandibular posturing as part of the overall treatment effect, that is, working towards achieving a Class I occlusion during the pivotal growth period.

Controversy exists around the optimal timing for treatment of children with Class II malocclusions. After a comprehensive clinical examination aided by the necessary diagnostic records, the clinician should identify the components that make unique an individual patient’s malocclusion. Once this has been established, the appropriate appliance can be selected that would best manage the problem.

There are two general strategies prevailing today regarding the timing of treatment for Class II malocclusion. The first calls for intervention during the pre-adolescent years (ages 8-11) with limited goals that include correction of the molar distocclusion, improvement of the overjet/overbite relationship and incisor alignment. This so-called “early treatment” is usually followed by a more definitive intervention during adolescence (ages 12-15), which is designed to finish and detail the occlusion. The second major approach to the timing of Class II treatment is not to intervene early and to accomplish the entire correction during the adolescent years.

Those advocating early treatment believe that the tissues of the craniofacial complex may be more adaptive at a younger age, and pre-adolescent patients may be more compliant than teenagers.

In their investigation of the influences of a fixed functional appliance, Ghislanzoni et al. evaluated the treatment and post-treatment dento-skeletal effects induced by the MARA in the treatment of Class II malocclusion. From this controlled clinical study it was concluded that when compared with matched untreated Class II controls, the cases treated by the MARA showed favourable skeletal changes (mandibular elongation, maxillary growth restriction, ANB decrease, dental-arch changes, overjet and overbite decrease and correction of molar relationship) that were maintained at an average 1-year post-treatment observation. Furthermore lower incisor proclination is limited, probably as a result of the concurrent use of fixed appliance treatment with MARA.

O’Brien et al. conducted a study to evaluate the effectiveness of early orthodontic treatment with the twin-block appliance for the treatment of Class II Division 1 malocclusion. They found that twin-block treatment when a child is 8 to 9 years old has no advantages over treatment started at an average age of 12.4 years.

In another study, Tulloch et al. found that two-phase treatment, started before adolescence in the mixed dentition, might be no more clinically effective than single-phase treatment started during adolescence in the early permanent dentition.

It is evident from this that the optimal timing for treatment of children with Class II malocclusions still remains controversial. Four cases have been presented in the endeavour to demonstrate and support the effectiveness of functional jaw orthopaedics with both the removable (Twin block) and fixed (MARA), functional appliances, as applied in the Department of Orthodontics at the University of Pretoria.

**CONCLUSION**

Several appliances can be used in the functional treatment of Class II malocclusions. After a comprehensive clinical examination aided by the necessary diagnostic records, the clinician should identify the components that make unique an individual patient’s malocclusion. Once this has been established, the appropriate appliance can be selected that would best manage the problem.

Successful orthodontic treatment is evaluated in terms of facial balance, aesthetic harmony and functional stability. The four cases presented offer confirmation that functional jaw orthopaedics can be beneficial. Patients in their pubertal growth should be given an opportunity for early aesthetic improvement with orthopaedic correction.
The authors wish to thank Prof. P. Botha and Drs. P. Ferreira and B. van Niekerk for supervising the treatment of these patients.

References

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ABSTRACT
Radicular cysts most commonly occur in men in the third to fifth decades of life, presenting in the maxillary anterior region. They are of frequent occurrence but are usually asymptomatic and are often a serendipitous discovery when routine radiographs are taken. These cysts may present as multiple lesions affecting a number of teeth. Although the cysts usually heal after endodontic therapy alone, larger lesions may need additional treatment. When surgical enucleation in combination with endodontics is the treatment of choice, there is a possibility of inadvertent injury to adjacent teeth or structures. This case highlights an unusual presentation of symptomatic multilocular radicular cysts in the mandible of a female, subsequent endodontic treatment of the involved teeth and surgical enucleation of the cysts. Management of radicular cysts is case dependent and decisions should be based on medical and dental histories, the size and location of the cysts, and consideration of associated structures.

Key words: radicular cysts, multilocular, endodontic treatment

INTRODUCTION
Radicular cysts are amongst the most common cystic lesions of the jaw. They develop as a result of inflammatory processes within the root canal system of a tooth, leading to pulpal necrosis. Dental caries is the usual causative culprit. The cystic lining of the lesion arises from the epithelial cell rests of Malassez within the periodontal ligament. Most frequently radicular cysts are found at the apices of involved teeth, but may also occur along the roots in relation to lateral and accessory root canals. Radicular cysts account for about 52% to 68% of all the cysts found in the human jaw; they most commonly affect men in the third to fifth decades of life and usually present in the maxillary anterior region. According to Shear et al., they are usually asymptomatic and present with no visible extra-oral swellings.

In most instances, radicular cysts are periapical lesions ranging from 0.5 to 1.5 cm in size, although, rarely, larger radicular cysts have been reported. Treatment options are determined by the size, extent and location of the lesion. Currently the standard approach is a conservative non-surgical phase which includes endodontic treatment, active non-surgical decompression, aspiration-irrigation, and the use of calcium hydroxide as an intra-canal medication. Although small radicular lesions can frequently heal with endodontic therapy alone, larger lesions may need additional treatment. In these larger lesions or in multiple radicular cystic lesions, surgical enucleation, marsupialisation or decompression in combination with endodontics, are the treatments of choice. The incidence of cystic lesions appears to be increasing in South Africa, and clinicians may be required to perform endodontic treatment on multiple teeth.

This case report highlights an unusual presentation and management of multiple radicular cysts, the subsequent root treatments of the involved teeth and surgical enucleation of the cysts.

CASE REPORT
History
A healthy female, 29-years of age, presented to the Charlotte Maxeke Hospital via referral from her local clinic. Relevant history included a motor vehicle accident in November of 1999 in which she had sustained multiple fractures and displacement of the following teeth: 11, 21, 24 and 45. As a result, the upper central incisors and left first premolar had been extracted at the local dental clinic (Figure 1).

In 2004 she noticed a swelling of the symphyseal area of the mandible and experienced a bad taste in her mouth. She returned to the local clinic where the dentist prescribed antibiotics, which apparently reduced the drainage of pus for a period of a few months.
In September 2014 she returned to the local clinic complaining of a similar swelling which was progressively enlarging. The bad taste in her mouth was also becoming more pervasive. During this appointment, the 31 was extracted.

Two weeks later the patient returned to the local clinic complaining that the same swelling was causing discomfort despite the removal of the lower left central incisor (31). She was referred to the Maxillo-facial department of the University of the Witwatersrand, Johannesburg.

Her main complaint described a slow growing lesion in her lower jaw that caused a low grade, constant dull ache, and she often experienced a bad taste in her mouth (Figures 1-2).

**Patient examination, diagnosis and management: (Figures 1-3)**

**Examination**

The patient presented with a skeletal and dental Class 3 malocclusion complicated by an anterior open bite.

Extra-oral examination revealed a soft swelling of the mandible in the symphyseal area, extending bilaterally to the submandibular area. The right submandibular lymph nodes were palpable.

Intra-oral examination showed that multiple teeth were missing (18,11,21,24,28,38,37,36,31,47) and retained roots of teeth 25, 45 and 48 were observed. The maxillary molars were over-erupted, as a result of missing lower posterior teeth. The patient had only five functional occluding pairs of teeth [(16, 46); (14, 44); (13, 43); (22, 32); (23, 33)]. Periodontal assessment found a plaque index of 25%, a bleeding index of 5%, but no probing depths of 4mm or more. Teeth 41, 43, 31 had Class 1 mobility according to Miller’s classification.12

Palpation revealed a bilateral fluctuant and tender buccal swelling extending from the 35 to the 46. A draining fistula was present on the midline region of the labial sulcus of the mandible, from which pus could be expressed (Figure 2).

Vitality tests were performed on all teeth, using the electrical pulp test, ethyl chloride and heated Gutta percha. Teeth 35,34,33,32,41,42,43,44,45,46 recorded negative responses and were confirmed non-vital. Tooth 41 was painful on vertical percussion.

**Radiographic assessment**

The radiographic assessment revealed large multilocular radiolucent lesions in the mandible extending from the region of the 36 to the 46. The lesions involved the apices of all mandibular teeth, excluding the 48. The radioluencies appeared well-circumscribed and a widening of the periodontal ligament space was noted on the 46, the root rest of the 45, on 44, 43, 42, 41 and 32. A radiolucency was also observed at the furcation region of the 46.

**Treatment Plan**

A multidisciplinary treatment conference was held which included input from clinicians representing endodontics, prosthodontics, maxillofacial surgery and orthodontics.

The following treatment plan was formulated:
1. Extraction of the 46 and the retained roots 25, 45 and 48.
2. Endodontic therapy of the 44, 43, 42, 41, 32, 33, 34 and 35.
3. A surgical phase which would include enucleation of the cysts and curettage of associated teeth.
4. Orthodontic correction of occlusal collapse after establishing healing of the cystic lesions.
5. Definitive oral rehabilitation with appropriate prosthodontics. Endodontically treated teeth were to be restored conservatively and if necessary with appropriate posts and crowns. The treatment of choice for the edentulous areas involved fixed implant-supported prostheses.
Endodontic Management

Endodontic treatment was performed on a single quadrant per visit under local anaesthesia (lignocaine, xylitol with adrenaline, 1.8ml ampule) and strict rubber dam isolation. The Zeiss microscope was used for magnification. Relevant teeth were accessed using a round tungsten carbide bur. After completely de-roofing the pulp chamber and identifying the orifice(s), an Endo Z bur was used to flare the axial walls in order to gain straight line access. The coronal flaring step was completed using a single stainless steel X-Gates bur (Dentsply Sirona). The necrotic pulp tissue was extirpated using small size 8 and 10 K-files. Patency was then achieved 1mm beyond the radiographic apex using a size 8 K-file. The sac-like cystic structures contained blood-filled serous exudate and some drainage was established after periapical instrumentation by virtue of patency. The canals were copiously irrigated with 1% sodium hypochlorite (NaOCl), RC Prep and with normal saline as a final rinse. Working length was established and was confirmed with a periapical radiograph and the ProPex Pixi Apex Locator (Dentsply Maillefer).

The ProTaper Next rotary system (Dentsply Sirona) was used to shape and clean the canals in the sequence advocated by the manufacturer. Irrigation was again carried out copiously using 1% NaOCl, instrumented with the assistance of RC Prep and a final saline rinse. The 33 was the only tooth which presented with a weeping canal after cleaning and shaping. It was treated by placing calcium hydroxide as intracanal medicament for 3 days using small size 8 and 10 K-files. Patency was then achieved 1mm beyond the apex for the following reasons: the extent of penetration debrides the apical area, establishes drainage, relieves pressure and thereby provides decompression of the periapical lesion.19-21 It has been surmised that if drainage from infected root canals ceases, fibroblasts begin to proliferate in the apical region and collagen is deposited. The proliferation of fibroblasts compresses the capillary network causing starvation and degeneration of the epithelial cells, which will ultimately be engulfed by the macrophages.19,20 According to Bender there is no scientifically-based evidence to support this assumption.21 However in the case presented, patency was indeed established to help eliminate micro-organisms and debris from the apical area.20,21 Furthermore, cyst resolution was also facilitated through the relief of cystic pressure.22

The significance of lesion size on healing has been researched in several studies.23,24 The treatment protocols implemented in these studies were dependent on the size and extent of the lesion and its relationship to adjacent teeth and structures. If the lesion was discreet in size, then most clinicians opted for a conservative treatment option by means of endodontic therapy.25,26 However other authors have stated that, in large or multiple connected lesions, endodontic treatment alone was not sufficient. Management should also include adjunctive techniques such as decompression, marsupialization or enucleation of the cyst.25,26,28

The treatment protocol at Maxillo-facial department of the University of the Witwatersrand, Johannesburg, for small radicular cysts, is endodontic treatment only and re-evaluation over time. However, larger lesions or multiple lesions may require a joint endodontic and surgical approach. To date, there are no established protocols for radicular cysts. The treatment of each lesion is dependent on its individual characteristics. The multidisciplinary management of this case is consistent with the literature reports on cases when patients were treated for multiple and large cysts.

DISCUSSION

Radicular cysts are inflammatory in nature and usually arise within a periapical granuloma resulting from the necrotic pulp of a permanent tooth.4,14 The current case is a rare presentation of large multiple cystic lesions occurring in the mandible of a 29-year old female patient as a consequence of trauma sustained to the lower jaw. Krishnamurthy et al. reported on a similar case of a radicular cyst masquerading as a multilocular radiolucency in the mandible, subsequent to trauma.15 However, the patient discussed in that study was a male in his early fifties. In 2012 Naspur et al. presented a rare case of a mandibular radicular cyst in a nine year old boy. The lesion demonstrated an unusual bilocular radiographic appearance along with expansion of the lingual cortex.16

The accumulation of dentinal and pulpal debris in the apical region is a common event in endodontic procedures and can cause blockage of root canals. This can be avoided by establishing initial apical patency, adequate irrigation and the filling technique.16,18 In this case study, patency was established 1mm beyond the apex for the following reasons: the extent of penetration debrides the apical area, establishes drainage, relieves pressure and thereby provides decompression of the periapical lesion.19,20 It has been surmised that if drainage from infected root canals ceases, fibroblasts begin to proliferate in the apical region and collagen is deposited. The proliferation of fibroblasts compresses the capillary network causing starvation and degeneration of the epithelial cells, which will ultimately be engulfed by the macrophages.19,20 According to Bender there is no scientifically-based evidence to support this assumption.21 However in the case presented, patency was indeed established to help eliminate micro-organisms and debris from the apical area.20,21 Furthermore, cyst resolution was also facilitated through the relief of cystic pressure.22

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CONCLUSION

This is a clinical case report of large multilocular radicular cysts treated successfully by endodontic therapy, and surgical enucleation and debridement of the associated cystic lesions. The patient was referred to a multidisciplinary team for definitive oral rehabilitation after healing was initiated.

References
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SADJ September 2017, Vol 72 no 8 383

CJ Nortjé

Below are two examples of the malignant tumour that most commonly may affect the maxillary sinuses. What are the important clinical and radiological features in these cases and what is your diagnosis? What is the importance of the maxillary sinuses for the dental practitioner?

INTERPRETATION

Figs. 1, 2, 3, 4, 5, and 6 present a clinical picture and radiographs of a fifty year old female patient with the main complaint of dental pain, loss of teeth, nasal obstruction and a numbness on the left side of the face. The cropped pantomograph (Fig. 2) shows opacification and destruction of the floor and posterior border of the sinus. The axial CT shows a large destructive necrotic tumour originating from the left maxillary sinus with destruction of the medial and inferior floor of the sinus. The tumour infiltrated the left nasal passage destroying the hard palate and expanding into the roof of the mouth. The tumour also infiltrated the soft palate posteriorly, destroying the pterygoid plate on the left. Massive necrotic metastatic lymphadenopathy is clearly present in the neck on the left side (red arrows). Fig. 3 shows an extensive tumour affecting the left side of the face and extending into the orbit. The Water’s view (Fig. 5) shows destruction of the medial, lateral and orbital walls of the maxillary sinus with the tumour infiltrating the nasal cavity and orbit. A T1 weighted coronal MR image (Fig. 6) show an expanded isointense homogeneous mass of the left antrum which has extended into the nasal cavity and ethmoid sinus. The palate is eroded and there is extension into the alveolar ridge. In both cases a histological diagnosis of a squamous carcinoma was made. Squamous carcinoma is the most common malignant neoplasm of nose and sinuses. Eighty percent of paranasal sinus carcinomas occur in the maxillary sinus. Men are affected twice as often as women. Facial or dental pains are very common early signs while nasal obstruction and epistaxis appear very late in the development of the lesion.

In conclusion, the importance of the maxillary sinus for the dental practitioner is that the image of the sinuses appears almost consistently in radiographs taken on a daily basis in a normal dental practice. The radiograph often reveals associated pathology which is often overlooked or not identified, with serious consequences to the patient. Furthermore a pathological lesion can affect both the oral cavity and the sinus. Lesions in one of these regions may cause problems in the other region. An abnormal opening can also develop between these cavities and pain can be referred from one region to the other.

Reference

INTRODUCTION

Absenteeism from work as a result of sickness places a tremendous financial burden on the economy of any country. In 2013, the Adcorp index revealed that 3.96 million South Africans were absent from work due to illness as compared with 700 000 in 2000. Not only did this result in billions of rand being lost on a yearly basis, but the increasing trend is a major concern for the future. Thus the question arose: “How sick do you have to be… to be sick?” In 1948, The World Health Organization (WHO) defined health in its broader sense as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.” It was initially widely acclaimed for its inclusion of physical, mental and social domains. However, since then it has been criticized by many because of its lack of operational value, ambiguity, and the problems created by use of the word “complete” in relation to wellbeing. Strict application of that unmeasurable criterion could categorise most people as unhealthy, or able to declare themselves “unwell” much of the time! It is also counterproductive in that it declares those with chronic conditions and disabilities as ill, and could inhibit people’s natural capacity to adapt and cope with physical, emotional and social challenges. At the same time, sickness has almost as many definitions as there are types of ailments, ranging from being affected by a physical or mental illness, to feeling unwell, poorly, ailing, indisposed, laid up, nauseous, ghoulish, morbid, intensely annoyed or merely bored. It can also be described from different viewpoints as a disease (medical perspective), sickness (society’s perspective) or illness (how the patient perceives his/her condition). These concepts represent different aspects of morbidity and need to be considered as separate entities. How then does a dentist decide when a patient is completely healthy, persevering with slight ailments, mildly sick, or so incapacitated as to warrant a medical certificate that excuses them from work?

1. LABOUR LAW

Before considering the legal aspects of sick leave, it is useful to be reminded of specific relevant South African legislature. The Basic Conditions of Employment Act applies to all employers and workers excluding: members of the National Defence Force, National Intelligence Agency, Secret Service, and unpaid charity volunteers. In addition, the regulation of working hours is not applicable to workers in senior management, sales staff who travel and regulate their own working hours, those who work less than 24 hours a month, those who earn above the amount stated in section 6 (3) of the Act, and workers engaged in emergency work. Employers may demand a medical certificate for workers who are absent for more than two consecutive days, or who are absent more than twice in an eight-week period. With regards to sick leave, workers may take the number of days they would normally work in a six-week period as leave. This excludes the first six months when a worker is entitled to only one day of paid sick leave for every 26 days worked. These provisions do not apply to workers who work less than 24 hours a month, those who earn above the amount stated in section 6 (3) of the Act, and workers engaged in emergency work.

2. HPCSA GUIDELINES ON WHAT SHOULD BE WRITTEN AND HOW

The HPCSA Booklet 14 sets out guidelines on the keeping of patient records and the issuing of documents. Clinicians are required to keep a record of the date, time and place of every consultation, the assessment of the patient’s condition at that visit, and the dates and times that the patient was booked off from work along with the relevant reasons.
Rule 16 pertains to the issuing of medical certificates. For the certificate to be legally valid it must adhere to certain requirements as laid out in the Basic Conditions of Employment Act. It must be issued by a medical practitioner who must state that based on his/her professional opinion, the employee is unable to perform duties because of the illness. It is not good enough to merely state that the practitioner “saw the patient” or “was informed by the patient”, as this does not clearly state that the clinician diagnosed the patient with any specific condition to warrant absence from work (“the actual diagnosis does not need to be disclosed in the certificate – see below”). The certificate must record: the name, address and qualification of the practitioner; the contact numbers and physical address; the practice registration number; the name of the patient; employment number of the patient (if applicable); date and time of the examination; whether the certificate is being issued as a result of personal observations by the practitioner during an examination, or as the result of information received from the patient, and which is based on acceptable medical grounds; a description of the illness, disorder or malady in layman’s words and with the informed consent of the patient; (**Note: With the introduction of the Protection of Personal Information Act [POPI] act, and doctor-patient privilege the patient does not have to consent to this information or to a revelation of the diagnosis. In this case the clinician can merely specify that he/she has examined the named patient, and that in his/her opinion based on the examination, the patient is unfit to work for the specified dates and times); whether the patient is totally indisposed for duty or whether able to perform less strenuous duties in the work situation; the exact period of recommended sick leave; the date of issuing the certificate of illness and clear information of their identity. Backdated certificates are acceptable if the practitioner stipulates that in their professional opinion the employee was unable to perform their normal duties during the backdated period.

Rule 15 states that when official documents are issued, including medical certificates, these must be signed by the authorised person followed by his/her initials and surname in printed or bold letters.5

[Note: The rules governing the retention of records will not be discussed in this paper as they are clearly stated in Booklet 14 of the HPCSA.]3

3. SPECIFIC DENTAL CONSIDERATIONS

While the legalities surrounding the issuing, format and contents of a medical certificate are clear, the decision on when they are justified and warranted is a far more difficult task. The clinician may be influenced by subjective views, personal opinions, emotional feelings, sentiments, his/her own attitudes towards sickness as well as an appraisal of the circumstances of each patient. In this regard, issues to be considered may include:

Patient socio-economic factors
- Transport time and costs incurred to get to their appointment.
- Can a person be granted sick leave when they accompany a child / minor / elderly / infirm or other dependant person to their appointment?

Dentist / practice related factors
- Waiting times (may be due to the dentist running late, practices where patients are seen as walk-ins as opposed to those who run on appointments, attendance at government clinics where patients have to arrive early to be put on that day’s list).
- Delayed appointments due to unforeseen emergencies with a previous patient.
- Procedures that take longer than anticipated (extraction with complications).
- Can a dentist sign for a family member, colleague, or patient based on a report from that person or some other third party without personally and physically examining the patient? Even when the third party is a colleague or other medical professional?
- What are the dentist’s duties to an employer when he/she suspects that a patient is returning for many unnecessary visits and requesting medical certificates to excuse him/her from work on each occasion?

Dentist’s value judgements
- Dentists may have to estimate the degree of pain the patient is experiencing or may experience after the treatment.
- Is sick leave warranted for associated morbidity without actual pain or illness? For example, swelling, malodour, numbness, bruising, or any other conditions that the patient may feel embarrassed about in their work environment.
- Bleeding after a procedure. How much time should be granted away from work for this? It is a question of how much bleeding is normal, when can it be anticipated to stop and how much discomfort it causes the patient.
- Sepsis post-operatively such as a dry socket. Here there would be a cause for retrospective sick leave as well as prospective. When should the dentist have been consulted and how much time is reasonable to be away from work?
- Can a dentist grant sick leave based on a telephonic conversation even if it does follow a scheduled appointment where the patient had been seen or treated? How long after that appointment can the dentist still entertain requests for sick leave without seeing the patient again?
- Should a patient be allowed sick leave for pain following an endodontic procedure, and if so, for how long?
- Is it permissible and reasonable to ask for sick leave when a patient has attended for prophylactic treatment or a routine consultation?
- Can a patient be given sick leave for time spent having cosmetic dentistry such as a bleaching procedure (and the subsequent sensitivity)?
- How does the clinician decide and determine how many days sick leave are justified for different conditions, as pain and morbidity are subjective and unmeasurable. Should it differ for a patient who had a simple extraction, one who had extraction with complications, for a patient who underwent a surgical extraction under local anaesthesia, under conscious sedation or under general anaesthesia? How do you calculate hospital admission times, theatre time, post-operative recovery and subsequent days off from work?
• How does the dentist determine if a patient is partially incapacitated or fully disabled by his/her dental condition in terms of his/her job requirements?

In many of these situations, the issuing of a medical certificate and number of days decided upon are based on both the professional diagnostic proficiency and experiential discretion of the clinicians as well as the extent of trust between themselves and their patients. However, it may be very difficult to question the legitimacy of a request when it is felt that the patient’s condition does not warrant sick leave. It can also be hard to refuse the subtle pressure from those who ask for this. How then do dentists refuse to issue a certificate without compromising those patients who do have a genuine malady, or souring the relationship they have with those whose veracity they have questioned?

A final consideration is that according to the Basic Conditions of Employment Act, sick leave cannot be granted for routine check-ups, examinations, tests, collecting medicines from a pharmacy, and visits to specialist medical practitioners. Where then does this leave dentistry which is striving to move away from being “treatment based” to focusing on prevention of disease? By not making provision for patients to have regular dental prophylaxis the law is in direct opposition to the WHO aims of Health Promotion. Should the dental fraternity be challenging these rulings?

CONCLUSION

The final decisions regarding issuing of medical certificates and amount of time requested rests on the discretion and professional opinion of the treating clinician. Considering the diverse range of dental conditions, treatment modalities, levels of patient tolerance and psychosocial factors involved, it is clear that there can be no concrete rules or directives. Each situation and decision needs to be guided by the “reasonable dentist / patient” rule. Perhaps two deciding questions to ask are “Can you justify your decision and the contents of the medical certificate if called upon to do so in a Court of Law?” And “Is it based on legal, professional, social and ethical considerations?” If the answer to both of these is affirmative, the dentist should feel at ease issuing the medical certificate.

References

Periodontal disease results from inflammation of the supporting structure of the teeth and in response to chronic infection caused by various periodontopathic bacteria. In the treatment of periodontally involved teeth, current concepts are based on mechanical scaling and root planing (SRP) to remove bacterial deposits, calculus, and cementum contaminated by bacteria and endotoxins. However, the efficacy of mechanical non-surgical debridement is limited in areas difficult to reach by instruments, e.g., furcation lesions or deep narrow intrabony defects. The subgingival application of antiseptic rinsing solutions, e.g., chlorhexidine digluconate or povidone-iodine, additionally to SRP, has shown significant improvements on clinical healing parameters. However, in progressive periodontal disease and residual deep periodontal pockets, antiseptic solutions seem not effective enough for bacterial elimination.

Photodynamic therapy (PDT) has emerged in recent years as a non-invasive therapeutic modality for the treatment of various infections by bacteria, fungi, and viruses. PDT can be applied topically into a periodontal pocket, avoiding overdoses and side effects associated with the systemic antimicrobial agent administration. It also minimizes the development of bacterial resistance. Photodynamic antimicrobial chemotherapy represents an alternate antibacterial, antifungal, and antiviral treatment against drug-resistant organisms. Applications of PDT in dentistry are growing rapidly. The technique is also used in the treatment of oral cancer, bacterial and fungal infections, and in the photodynamic diagnosis of the malignant transformation of oral lesions.

During the last decade, antimicrobial PDT has become an accepted therapy for biofilm-induced diseases in several medical disciplines. The therapy requires in the first instance that a photosensitizer binds to the target cells. Activation with light of a suitable wavelength results in the generation of singlet oxygen and reactive oxygen species, which are toxic to the target cells or microorganisms.

Tabenski and colleagues from Germany (2017) reported on a trial that sought to investigate the additional influence of antimicrobial (aPDT) vs. local application of minocycline microspheres following non-surgical periodontal therapy in deep periodontal pockets. The scientific rationale was to find an effective procedure to treat deep periodontal defects whilst avoiding the use of antibiotics or surgical interventions.

**MATERIALS AND METHODS**

For inclusion into this 12 month parallel randomized control trial, patients had to have good health; be ≥35 years old; have a minimum of 16 residual teeth; have untreated generalized moderate to severe chronic periodontitis with a minimum of four teeth having probing pocket depth (PPD) ≥6 mm, an approximal plaque index (API) ≤25% and a papillary bleeding index (PBI) ≤25%. Heavy smokers, those with uncontrolled medical conditions, or pregnant or those having aggressive periodontitis or having periodontal treatment during the last 3 months were excluded.

The study comprised three randomly selected groups of 18 patients each. Each patient was periodontally treated within one session. In all three groups, SRP was carried out using a sonic scaler and Gracey curettes. This was followed by a PDT in the test group (aPDT + SRP). The photosensitizer was based on phenothiazinium chloride. Activation was achieved through application of a laser
While for the SRP-alone group 18 patients could be recruited, for the aPDT + SRP and MC + SRP groups, only 15 patients could be followed over the study period. Thus, for symmetry reasons, only 45 patients (age range 54-57) were included for data analysis. The evaluations of the clinical and microbiological healing outcomes are based on only the four experimental teeth (PPD ≥6 mm) from each patient. After the six-month evaluation and in one patient each of the MC + SRP and SRP-alone groups, one experimental tooth was lost due to prosthetic reasons. During the entire study period, the researchers could not observe any signs of adverse reactions related either to aPDT or minocycline (MC) application.

With exception of the API, none of the other healing parameters (PBI, BOP, PPD, CAL) revealed any statistically significant differences between the three treatment groups at any time-point. During the periodontal maintenance, none of the 45 patients required subgingival re-instrumentation, which would have been performed according to the study protocol. Thus, the reported healing results describe the effects of the initial active treatment.

After completion of the pre-treatment phase, all patients showed an acceptable compliance with good oral hygiene at baseline. While in the MC + SRP group and in the SRP-alone group the API was below the threshold of 25%, in the aPDT + SRP group, a median API of 29% had to be accepted. However, the long-term parameter for good oral hygiene, the PBI, was by far below the threshold of 25% in all therapy groups. With regard to the API, the aPDT + SRP group showed significantly less plaque compared with the MC + SRP group after six weeks, three months, and six months. Twelve months after treatment, both the aPDT + SRP group and the SRP-alone group had significantly better oral hygiene status than the MC + SRP group. However, all patients could maintain relatively low plaque and gingivitis scores during the entire study period.

At baseline, in each group, the median percentage of BOP-positive experimental teeth was 100%. Compared with baseline, a statistically significant reduction of BOP-positive experimental teeth was found for each group during the 12-month period. No statistically significant differences could be found between the three treatment groups. After six weeks, 50% of the experimental teeth in the aPDT + SRP and MC + SRP groups as well as 75% of experimental teeth in the SRP-alone group still bled on probing. After three months, the percentage of BOP-positive experimental teeth was reduced to 50% in each group. At six months, bleeding was found in 25% of the experimental teeth in the aPDT + SRP group and in 50% of the experimental teeth in the MC + SRP and SRP-alone groups. After 12 months, BOP values increased again significantly in the aPDT + SRP and SRP-alone groups and remained stable in the MC + SRP group, considering that one experimental tooth each was lost in the MC + SRP and SRP-alone groups after the six-month examination (aPDT + SRP 75%, MC + SRP 33.3%, SRP-alone 66.7%).

There were no statistically significant differences between the three groups at baseline for PPD. During the 12-month study period, the three treatment modalities achieved statistically significant reductions in PPD at each follow-up compared to baseline. At no time-point and no examination interval, were any statistically significant differences found between the three groups.
At baseline, there were no significant differences in CAL between the three groups. Statistically significant CAL improvements were observed in each group during the 12-month study period with no statistically significant differences between the three groups at any examination time-point or interval.

The bacterial strain A.a. was detected only in very few sites with no clinical or statistical relevance. For T.d., T.f., and P.g. and for TBL and TML, the three groups showed a similar bacterial load at baseline. In the MC + SRP group, significantly less T.f. were found after 6 weeks compared to the aPDT + SRP group. After three months, the SRP-alone group revealed significantly less P.g. compared to the aPDT + SRP group. For all other bacterial species and time-points, no significant differences were found between the groups. The reduction of the bacterial load over time was statistically significant for P.g. in each group at each follow-up compared with baseline with the exception of the 12-month time-point in the SRP-alone group. For T.d., a statistically significant reduction could be detected in the aPDT + SRP group only after six months; in the MC + SRP group after six weeks, three months, and six months; and in the SRP-alone group at the three-, six- and 12-month examination time-point. The total bacterial load was significantly reduced in the aPDT + SRP group and the MC + SRP group after six weeks and 12 months and in the SRP-alone group at each follow-up. The total marker load was significantly reduced in the aPDT + SRP group six weeks and three months after treatment, in the SRP-alone group three and six months after treatment, and in the MC + SRP group at each examination time-point.

CONCLUSIONS

Within the limits of this clinical study, all three treatment modalities (aPDT + SRP, MC + SRP, SRP-alone) achieved statistically significant clinical and microbiological improvements over time in deep periodontal pockets (PPD ≥6 mm). However, the additional use of aPDT or minocycline failed to show any significant additional positive effects compared with SRP alone in deep periodontal pockets.

IMPLICATIONS FOR PRACTICE

This trial showed that the new interventions tested showed no additional benefit over the standard approach of SRP in patients with periodontitis. Clinicians should note that the small sample size may have masked the true treatment effects.

Reference


2. Effects of photodynamic therapy in periodontal treatment: A randomized, controlled clinical trial


Scaling and root planing (SRP) is the gold standard for reducing biofilm in nonsurgical management of periodontal disease. However, SRP is not able to remove all periodontal pathogenic bacteria, particularly those found within periodontal tissues or in deep periodontal pockets. As a result, bacterial recolonization occurs from the non-eliminated subgingival plaque or from other oral reservoirs. Photodynamic therapy (PDT) has been introduced as a noninvasive intervention which is based on the use of a photosensitizing agent that is activated by light of an adequate wavelength. In the presence of oxygen, this generates free radicals and singlet oxygen, which have been found to be toxic to bacteria. However, there is no agreement to date on the benefits of PDT as a co-adjutant to SRP. Segarra-Vidal and colleagues from Spain (2017) reported on a trial that sought to assess additional clinical, microbiological and biochemical effects of PDT in the initial management of chronic periodontitis. The null hypothesis was that PDT as a co-adjutant therapy would result in improved basic periodontal management.

ACRONYMS

PDT: Photodynamic therapy
SRP: Scaling and root planing

MATERIALS AND METHODS

Forty patients (12 men and 28 women) between 33 and 74 years of age (mean 55 ± 2) with chronic periodontitis took part in this study. Inclusion criteria for this trial was: four or more periodontal pockets with a probing depth ≥5 mm and bleeding on probing. Patients who had undergone periodontal, antibiotic, photosensitizing or anticoagulant treatment in the last three months, were smokers, had a Sliness and Löe plaque index of 2 for more than 30% of the teeth, were pregnant or breastfeeding, or were allergic to the components used in the treatments, were excluded. The patients were divided into two groups of 20 individuals according to the type of treatment prescribed. One group underwent basic periodontal treatment consisting of scaling and root planing (SRP group); the second group underwent this basic periodontal treatment plus photodynamic therapy (SRP + PDT group). A third group consisted of 20 systemically and periodonally
healthy individuals (control group) recruited during routine periodical checkups, who were monitored only once during the screening visit, at the same time as the other two groups.

A randomized, single-blind, controlled design was used. Simple randomization of the patients (1:1 allocation ratio) to the SRP or SRP + PDT group was carried out by staff external to the study using a computer-generated random number table. Blinding to the randomization was ensured using sealed and opaque envelopes numbered in sequence.

The calculated required sample size was 40 patients. This sample size was determined to provide 90% power in recognizing a significant difference in the clinical attachment level of 0.75 mm between groups, with a standard deviation of 1.5 (\( \alpha = 0.5 \)) and a 95% confidence interval (\( \alpha = 0.05 \)).

The protocol comprised eight visits for each patient with periodontal disease, distributed over a period of 175 days as shown in Figure 1.

A blinded examiner conducted a periodontal evaluation of the patients at six sites per tooth. In addition, four samples of gingival crevicular fluid were collected, always at the same locations (probing depth \( \geq 5 \) mm and bleeding on probing), during the screening visit and after five, 13, and 25 weeks. Samples were collected from the control group on a single occasion.

Both study groups underwent SRP with combined ultrasound and the use of Gracey and Columbia curettes under local anaesthesia at week 0 and 24 hours later. The randomization envelope was opened after SRP was completed (week 0 + 24 hr). Supporting periodontal treatment—consisting of SRP, with reinforcement of brushing techniques, including the use of interproximal hygiene measures—was performed at weeks 13 and 25.

In addition to SRP, the patients in the SRP + PDT group received co-adjuvant PDT using the Periowave® system. Methylene blue at a concentration of 0.005% was used as a photosensitizing agent and was applied following the instructions of the manufacturer using a blunt needle over the periodontal pocket. Diode laser irradiation (670 nm, 150 mW) was carried out with a flexible tip for 60 seconds in each periodontal pocket (depth \( \geq 5 \) mm). The treatment was applied at weeks one, five and 13.

All patients received instructions on proper toothbrushing. Reinforcement of these instructions was carried out during each visit.

Clinical parameters were recorded at six sites per tooth by a single calibrated examiner who was blinded to the type of treatment received by the patient. Clinical parameters for each patient were monitored in the following order:
1. gingival crevicular fluid;
2. plaque index;
3. probing depth;
4. clinical recession;
5. clinical attachment level;
6. bleeding on probing.

Comparison of the treatments was performed at critical sites, defined as sites at which the periodontal pocket measured \( \geq 5 \) mm in depth with bleeding on probing at the screening visit. The effective study sample, therefore, comprised 809 data points (381 corresponding to SRP and 428 to SRP + PDT).

Probing depth was measured in millimetres from the gingival margin to the depth of the periodontal pocket. Clinical recession in turn was measured in millimetres from the gingival margin to the cementoenamel junction. The clinical attachment level was measured in millimetres from the cementoenamel junction to the end of the pocket. Bleeding on probing was documented according to the absence or presence of bleeding 30 seconds after probing. Improvement in the clinical attachment level was regarded as the primary endpoint. Secondary endpoints were improvement in probing depth and reduction of bleeding on probing, clinical recession and the plaque index.

Microbiological and biochemical samples were taken before any subgingival instrumentation was carried out. Following the removal of supra-gingival plaque and calculus using periodontal curettes, gingival crevicular fluid samples were pooled during the screening visit and at weeks five, 13 and 25 from four experimental sites, namely, the deepest periodontal pocket in each quadrant (probing depth \( \geq 5 \) mm, accompanied by bleeding on the screening visit) was considered to be representative of the entire oral cavity. Samples for microbiological analysis were obtained by inserting a sterile number 30 paper endodontic tip (Dentsply®, Maillefer) into the bottom of the periodontal pocket for 10 seconds; a sterile Periopaper® strip (Oralflow®) was inserted for 30 seconds in the case of sampling for biochemical analysis. Samples containing blood or plaque were rejected. The gingival crevicular fluid volume was recorded using Periopaper® strips with a Periotron 8000® (Oralflow®). The samples were stored at \(-80^\circ\text{C}\) in sterile Eppendorf® tubes until processing.

For the healthy control group, a single sampling was performed in the groove between distal-vestibular teeth.

**Figure 1:** The protocol comprised eight visits for each patient with periodontal disease, distributed over a period of 175 days.
1.2 and 2.2 and mesio-vestibular teeth 1.6 and 2.6. Both samples were pooled and treated as described above.

Gene expression levels of the main bacteria implicated in chronic periodontitis (Aggregatibacter actinomycetemcomitans, Tannerella forsythia, Porphyromonas gingivalis, Treponema denticola, Prevotella intermedia and Campylobacter rectus) in gingival crevicular fluid using real-time polymerase chain reaction (RT-PCR) was determined. Commercial enzyme-linked immunosorbent assay (ELISA) kits were used for the determination of biochemical markers.

RESULTS

Thirty-seven patients (26 women and 11 men, with a mean age of 55 ± 2 years) completed the six month trial. At baseline, the clinical attachment level was 6.19 ± 1.42 mm in the SRP group and 6.47 ± 1.60 mm in the SRP + PDT group (p > .05). These values decreased over time, independent of the treatment received (4.19 ± 1.60 mm and 4.67 ± 1.83 mm for SRP and SRP + PDT, respectively; p > .05). Secondary clinical parameters improved in both groups, with the exception of clinical recession, which increased significantly in both groups. No significant differences were noted between treatments. At baseline, the mean gingival crevicular fluid volume in the SRP group was 0.62 ± 0.40 μl, compared with 0.55 ± 0.37 μl in the SRP + PDT group (p > .05). The corresponding mean volume in the healthy controls was significantly lower than that in the patients with periodontal disease (0.18 ± 0.05 μl; p < .001). The gingival crevicular fluid volume in the patients with periodontal disease decreased over time, with no significant differences between treatments and without reaching the control values at the end of the study.

Compared with the control group, the patients with periodontal disease showed increased bacterial burden corresponding to A. actinomycetemcomitans, P. gingivalis, T. forsythia, T. denticola, P. intermedia and C. rectus at the screening visit. Although SRP treatment alone did not alter the pathogenic burden of A. actinomycetemcomitans, the addition of PDT significantly lowered the abundance of this species (p < .001) to levels consistent with those of the healthy individuals. Both SRP and SRP + PDT were found to be effective at lowering the bacterial burden of P. gingivalis and T. forsythia to levels similar to those in the controls, without significant differences between treatments. Conversely, neither treatment modified the T. denticola, P. intermedia or C. rectus burden, which remained higher than that of the control group at the end of the study.

At baseline, pro-inflammatory cytokine (IL-1β, IL-6 and TNF-α) levels in the gingival crevicular fluid of the patients with periodontal disease were higher than those in the control group. Independent of the treatment received, the TNF-α and IL-1β concentrations decreased, reaching values similar to those in the controls, though there were no changes in IL-6, which remained at an elevated level at the end of treatment.

Regarding bone metabolic markers, by the end of the study, both treatments resulted in similar non-significant levels/ratios (p > .05).

CONCLUSIONS

The authors concluded that PDT did not provide additional benefits in terms of clinical attachment level or any secondary clinical outcome compared with the effects of SRP. Clinical improvement was consistent with a decrease in the concentrations of cytokines and biochemical markers. Based on the findings of this trial, the authors did not support the use of PDT as a co-adjuvant in the treatment of moderate-to-severe chronic periodontitis.

IMPLICATIONS FOR PRACTICE

This study adds to the weight of evidence that suggests that PDT is not useful in the treatment of moderate-to-severe periodontitis.

Reference

GENERAL

A comparison of radiation doses to selected vital organs in the maxillo-facial region using three different settings on the Galileos CBCT machine housed in the Wits Dental Hospital. (p 350)

1. The study found that the dose to the eyes from a full-mouth intraoral examination using conventional films was higher than that from the panoramic machine.
   a. True
   b. False

2. The study found that CBCT appeared to have a three to seven times lower risk compared with a panoramic examination.
   a. True
   b. False

3. The authors recommend the combined setting (mandibular and maxillary) be used at all times for optimal diagnostic quality when taking radiographs with the Galileos CBCT machine.
   a. True
   b. False

Candidiasis – has anything changed in the way we manage these patients? (p 355)

4. In a healthy mouth, the C. albicans organism occurs as mainly vegetative, oval to round, budding yeast cells, referred to as:
   a. blastocytes
   b. blastoconidia
   c. blastochromes
   d. blastoceres

5. Confirmation of the presence of Candida hyphae before routinely prescribing an antifungal agent is:
   a. not necessary
   b. only to support a firm diagnosis
   c. strongly recommended
   d. entirely optional

6. When candidiasis is diagnosed, the health professional has a duty to either attempt to establish a possible underlying systemic condition in patients or to refer the patient appropriately.
   a. True
   b. False

7. In elderly patients it may be warranted to prescribe systemic antifungal agents such as fluconazole oritraconazole if resolution is not achieved through the topical application of myconazole.
   a. True
   b. False

The burden of dental caries in the Western Cape and a recommended turn-around strategy. (p 360)

8. Almost 40% of carious lesions in 6 year-old-children within the Western Cape province are untreated.
   a. True
   b. False

9. The study showed that only 1 in 10 000 cases (0.0001%) of pre-school children in the Western Cape undergoing dental general anaesthetic received restorative treatment.
   a. True
   b. False

The use and repair of dental amalgam restorations as practised in South Africa. (p 366)

10. A Cochrane Review published in 2014 concluded that the failure rate for composite restorations was less than twice that of amalgam restorations.
    a. True
    b. False

11. Most of the respondents indicated that in applying a technique to repair amalgam restorations, they had learnt the procedure through:
    a. attending a continuing professional development course
    b. lectures at undergraduate dental school
    c. developing their technique through their own clinical experience,
    d. reading a journal article
    e. learning from a fellow practitioner

12. The most recent recommended protocol for the repair of restorations advocates the use of hydrofluoric acid or the use of air abrasion instead of phosphoric acid.
    a. True
    b. False

Functional Appliances – a review and presentation of four cases. (p 372)

13. Functional appliances were developed to compensate for an aberrant muscle environment and to guide the patient in adapting to functional deviations.
    a. True
    b. False

14. Which of the changes listed below as achieved by treatment with the MARA appliance was NOT found?
    a. Mandibular elongation and Maxillary growth restriction
    b. ANB decrease
    c. Retained centre line discrepancies
    d. Overjet and overbite decrease
    e. Correction of molar relationship
Radicular cyst: Atypical presentation and therapeutic dilemma (p 379)

15. Radicular cysts are found most frequently at the apices of involved teeth, and the cystic lining of the lesion arises from the epithelial cells of the adjacent gingiva.
   a. True
   b. False

16. Most clinicians reported in the study opted for a conservative treatment option by means of endodontic therapy if the lesion was discreet in size.
   a. True
   b. False

MaxilloFacial and Oral Radiology case 154 (p 383)

17. Facial numbness may be a symptom of squamous carcinoma of the maxillary sinus.
   a. True
   b. False

18. Squamous carcinoma is the most common malignant neoplasm of the maxillary sinus
   a. True
   b. False

Clinical windows (p 387)

19. In the Tabenski et al. trial, evidence for the continued use of scaling and root planing as the gold standard was not proven.
   a. True
   b. False

20. In the Segarra-Vidal et al. trial, gingival crevicular fluid volume in the patients with periodontal disease decreased over time, with no significant differences between treatments.
   a. True
   b. False

ETHICAL
Part 13. Issuing Medical Certificates (p 384)

21. Which of the following HPCSA requirements regarding the issuing of medical certificates is NOT correct? Clinicians are required to keep a record of:
   a. whether the patient was accompanied by a responsible adult
   b. the date, time and place of every consultation,
   c. the assessment of the patient’s condition at that visit;
   d. the dates and times that the patient was booked off from work along with the relevant reasons.
   a. True
   b. False

22. The HPCSA does NOT require that the actual diagnosis be disclosed in the Medical Certificate.
   a. True
   b. False

23. Backdated certificates are acceptable if the practitioner stipulates that in their professional opinion the employee was unable to perform their normal duties during the backdated period.
   a. True
   b. False

24. The author(s) state that by not making provision for patients to have regular dental prophylaxis the law is in direct opposition to the WHO aims of health promotion.
   a. True
   b. False

25. If the dentist considers that he/she could justify his/her decision and the contents of the medical certificate if called upon to do so in a court of law and is confident that the certificate was issued based on legal, professional, social and ethical considerations, then he/she should feel at ease about issuing a medical certificate.
   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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BUSINESS DIRECTORY < 395
Smalls Advertising Placement Procedure and Rules

- All smalls advertisements are restricted to a **maximum 100 words** per advertisement.
- All advertisement requests are required in writing, submit to ABayman@sada.co.za, with full contact details of the advertiser which should include:
  - the wording of the advertisement as you require it to be published;
  - the members professional number; (will not be published);
  - the members contact details (will not be published).
- Advertisement **lifespan is two weeks** from the date of upload.
- Advertisements to be **repeated follow the same process** as the original placement request.
- All advertisements which **exceed a word count of 100 words** will be forwarded to our publishers E-Doc for further processing as a potential advertisement to be placed in the SADJ electronically or as website advertising. E-Doc will contact you thereafter regarding your requirements.
- **SADA Members** may place advertisements at no cost providing their annual membership fees are either paid in full at the time of their request of a debit order request has been lodged.
- **Non-SADA Member** advertisers will be charged R25 per word for placement of their advertisements.
- Advertisement must be paid in full prior to uploading on the web platform.
- Invoice may be settled telephonically with the use of a credit card to prevent delay of placement.
- **Telephonically processed** payments will result in uploading of advertisement within **24 hours** of settlement.
- Advertiser remains liable for placement costs should payment be dishonoured and invoice remains unpaid.

**Contact details:**
Ann Bayman
South African Dental Association
Tel: 011 484 5288
E-mail: ABayman@sada.co.za