The male Augrabies Flat Lizard (*Platysaurus broadleyi*) is vividly multi-coloured, making him attractive to females, but vulnerable to predators. The dentition is acrodont, having no sockets but are consolidated into the crest of the alveolar bone. The lizard is saxicolous (living among rocks).
Buenos Aires
Argentina
5-8 September 2018
www.worlddentalcongress.org
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Avoid the voids...

or minute the minutiae?

SADJ November 2017, Vol 72 no 10 p446

WG Evans

It may on occasion be observed that dentists tend to survey their world by looking through a telescope in reverse, so that the view becomes condensed and diminished. That is a perfectly understandable result of the prime need for careful attention to be paid to the minutiae ...dentistry deals with the minute, and the philosophy is readily transferred to everyday life! Perhaps we do not always see the broader picture, the wide view, and may even resort to “nit-picking”!!

As the precision of advanced and often computerized technology takes over more and more of the tasks in dentistry so the appreciation of the considerable importance of minutiae escalates and is respected. The margins of a crown or inlay are closely, nay, minutely, inspected and the criteria for acceptance are high. A lower premolar rotated at five degrees out of alignment is not readily accepted at the conclusion of orthodontic treatment. Extractions demand the most meticulous attention to atraumatic detail if the objective of minimal alveolar damage is required to enhance the success of implants, which themselves must be precisely positioned. Dental materials do not escape the interrogation and their chemical and physical properties are meticulously inspected. Minuting the minutiae is relevant indeed. All to the considerable benefit of the patient.. and perhaps adding considerable demands on the dentist.

All these challenges may be described as “voids” in meeting the requirements set in contemporary Dentistry. A void is generally understood to be an emptiness, a space.. but the word used as a verb may also imply to dismiss or to expel. This issue of the SADJ, the last for the year, includes two papers which may exemplify voids in the dental context. Consider the first: when dealing with restorative materials, the presence of voids in the final structure is of considerable clinical relevance, even with voids of minute dimensions. Accumulatively their effect is detrimental to longevity of the restoration and may even lead to further damage to the tooth. The paper most importantly draws attention to the manufacturing process and to the clinical handling of the material in the endeavours to minimize these untoward outcomes. Avoiding the voids becomes a central objective.

A second paper emphasizes just how detrimental it may be to dismiss consideration of ergonomic principles in Dentistry. The issue of Occupational Health is inextricably involved in how we practice, how we arrange our instruments and equipment, how we actually operate. Many ills are the result of voiding – or dismissing- this aspect of “ the dentist looking after the dentist.” Whilst the more obvious consideration involves the physical aspects of practice, a recent paper emphasizes that ergonomics is in fact much more than ensuring good postures to avoid musculoskeletal problems. Successful application of proper principles may help to ensure a whole raft of benefits.. high productivity, sustained good health, enhanced satisfaction. The authors relate a series of reasons for the early retirement of dentists.. leading that list are musculoskeletal disorders at 29,5%, with the next most frequent reason being cardiovascular disease at 21,2%.

Avoiding the Voids in Dentistry appears to be a sound objective!! If we are successful in this perhaps we can look forward to a state of what the Danish have termed “HYGGE” a state of convivial and comfortable atmosphere. Latterly the Scots have extended the philosophy.. and there is another delightful word to be appreciated ...CÓSAGOCH. This is taken to mean “snug, sheltered or cosy”.

Those are desirable objectives for the Holiday Season, whatever the weather.. and our readers are all wished the most Cósagoch and Hygge holidays!

But to revert to the theme.. another interpretation of Cósacogh is given as “a wee nook or hole such as very small creatures may live in” (Mark Wringe). And so we are back to voids.. an empty space just waiting for bacterial invasion or for structural deficiency.

Lets avoid the voids!

Reference:

Bill Evans: Managing editor, E-mail:bill.evans@wits.ac.za
SADA Dental & Oral Health Congress & Exhibition 2018

SADA Dental & Oral Health Congress & Exhibition
Date: 12-14 October 2018
Venue: Sun Times Square Arena & Conference Center, Pretoria, RSA

The SADA Congress and Exhibition is undergoing a revamp – you may call it a face lift. I have looked at the history of this premier event and have decided to reposition it effectively in the mind of our profession. The first thing you will notice is that the name will be called the SADA DENTAL & ORAL HEALTH CONGRESS & EXHIBITION. This name I believe is descriptive of this event and encompassing of the full landscape in which we operate. The event will have its own identifying logo to be launched in December 2018. Of course, it remains the best Dental and Oral Health event for:

- Inspiring Speakers
- Innovative Technology & Services
- A Melting Pot of the Best Oral Health Talent the World has to Offer

About the SADA Dental & Oral Health Congress
We are celebrating this annual SADA Dental & Oral Health Congress - a premier event, and the largest of its kind on the African continent. Year on year, we have seen the tremendous growth of this world class event, as like-minded Oral Health Practitioners find value in meeting and sharing valuable insights.

This exciting three-day event is carefully crafted to provide you the very best research, tools, materials, techniques and methods to begin applying to your practices immediately. With attendance from all over Africa and the SADEC region the SADA Congress is seen as the most popular meeting ground for our profession; a place to exchange ideas, learn, share war stories and touch-base with the latest cutting-edge innovations in the industry.

The Plenary
A dynamic speaking schedule includes both local and international speakers, all experts in their fields. Delegates are encouraged to pick and choose their sessions based on their specific interests and specialities. Sessions are engaging and interactive allowing for Q&As and detailed local and international case studies.

Exhibition Space
In addition to the main plenary discussions, delegates can browse the exhibition hall and discover the latest instruments, equipment, new techniques and services available to them and their practices. In an industry that is evolving by the minute, this platform allows for a condensed, focused market place where you can see, try, and test in a convenient hands-on environment.

Workshops
Numerous workshops and breakaway sessions are included providing Dentists, and other practitioners the opportunity for hands-on learning and interaction, based on their clinical interest and specialist groups. Facilitated by subject matter experts, delegates are exposed to the very latest technology and learnings.

Networking
We are very proud to host some of Africa’s most revered practitioners and ensure the schedule throughout the three days allow for networking and good old-fashioned fun. From sophisticated cocktail events, luxurious lunches to our auspicious Awards Gala dinner, where we recognize outstanding talent and achievements in the industry, delegates are guaranteed to rub shoulders with the who’s who in Dental circles. Meet up with colleagues, alumni, and some of the worlds most talented practitioners, in an environment designed specifically for the oral health community.

Who should attend?
This event caters for every sphere of the Dentistry and Oral Health industry including private and public sector. We welcome Academia, students and all the related professions including; Community Dentists, Orthodontists, Periodontists, Prosthodontists, Maxillofacial & Oral Surgeons, General Dental Practitioners, Oral Hygienists, Dental Assistants, Practice Managers, Dental Therapists, Dental Technicians, Practice Support Staff, Dental Traders, Public and Private GDPs.

We promise you three days that will open your eyes to new aspects on Dentistry and inspire you with the opportunities the industry and our country has to offer. In addition to earning delegates between 20 to 30 CPD points, the Congress is guaranteed to have something for everyone, it and will leave you ready and better equipped for the year ahead.

Whoever said Dentists were boring has never been to the SADA Dental & Oral Health Congress & Exhibition, an event that will change your world.

I look forward to seeing you next year.

KC Makhubele
The prevalence of occupational health-related conditions among oral health practitioners in KwaZulu-Natal, South Africa.

ABSTRACT
Introduction: Oral health practitioners may be affected by occupational health-related conditions associated with their work environment. There is a lack of relevant data on the prevalence of these conditions among dentists, dental therapists and oral hygienists in KwaZulu-Natal.

Aim: To describe the burden of occupational health-related conditions among oral health practitioners in KwaZulu-Natal, South Africa.

Methods: This cross sectional study evaluated data obtained through a self-administered questionnaire that sought information on demographics, occupational health, psychosocial risk factors, work tasks and planning. Data was exported from QuestionPro and analysed in SPSS version 24. Frequencies and means with standard deviations were calculated for categorical and continuous variables respectively.

Results: Oral hygienists most frequently reported symptoms of musculoskeletal disorders affecting the neck (70%) and the hand (56.5%). Dentists reported the highest prevalence of shoulder pain (55.8%) and of percutaneous injuries (42.3%). The dentists, dental therapists and oral hygienists also reported latex allergy (10.4%) and percutaneous injuries (32.6%).

Conclusion: The prevalence of occupational health-related conditions reported by the oral health care workers indicate the need to raise awareness about occupational health and warrants the inclusion of these issues on education programs and dental curricula to ensure a healthy work environment.

Key words: Musculoskeletal disorders, percutaneous injury, allergy, dental amalgam, dental curriculum

INTRODUCTION
Occupational health aims at maintaining the physical, mental and social wellbeing of workers. Occupational related health conditions in dentistry are associated with risks and hazards, and lead to poor health outcomes, affecting the quality of life of the oral health practitioner. Occupational hazards refer to the risk or danger associated with working conditions, and are classified as chemical, biological, physical, psychological and ergonomic.

1. Chemical: Dentists, dental therapists and oral hygienists are exposed to many hazards that include, among others, inhalation of gases during general anaesthesia, latex allergies, allergies to monomers and inhalation of mercury vapour. Occupational exposure to mercury occurs when workers inhale
vapours and through dermal absorption. The use of this material is controversial as mercury is a hazard to the environment when discharged into waste. The environmental impact of amalgam was the concern of dentists investigating the material, although they favoured its continuous use.

3. Physical: Physical hazards include noise, vibration, radiation, ventilation, air quality and heat. Work related musculoskeletal disorders (MSD) refer to a range of inflammatory and degenerative disorders and diseases. These conditions may lead to pain and/or impairment of function and can affect the neck, arms, legs, back and hips. The affictions can be minor disorders or disabling, irreversible injuries which are often aggravated by work. The acute, painful type of MSD is caused by a sudden failure in muscle function. The chronic type presents as a lingering pain caused by permanent strain on the muscles, leading to dysfunction. Musculoskeletal disorders are an occupational health related condition that is costly in both time and money and which may result in decreased productivity or even loss of a career. The cost of MSD and carpal tunnel syndrome (CTS) is on the rise, warranting further workplace interventions. Of relevance is the fact that dentists do have a significant risk of disability due to MSD.

4. Psychological: includes job stressors, conflict, task demands and leadership.

5. Ergonomic: Ergonomic hazards refer to strains on the worker’s body that harm the musculoskeletal system due to improper design of workstation, equipment and surgery.

A healthy workplace is one where all workers collaborate to promote and maintain health, safety and well-being in a good physical work environment. Thus, a worker will not only be free of workplace injuries but concerns about psychosocial work issues are reduced.

Given the changing recognition that dental practitioners should work in environments that do not place unnecessary strain on their bodies and do not cause occupational health related issues, hence, this study was conducted to investigate the prevalence of occupational health-related conditions among dentists, dental therapists and oral hygienists in KwaZulu-Natal, South Africa.

The dental workforce involved with treating patients directly, in South Africa (SA), is comprised of dentists, dental therapists, and oral hygienists. For the purpose of this article, they will be referred to as oral health practitioners. Oral health practitioners provide oral health care services both in the public and private sectors in SA.

METHODS

This cross sectional, descriptive study was conducted in 2017. Ethical clearance was obtained from the Humanities & Social Sciences Research Ethics Committee at the University of KwaZulu-Natal-HSS/1490/015D. Participants were informed of the purpose and procedures in the study. Written consent was obtained from all participants and they were informed of their right to withdraw at any time from the study. Anonymity of participants was maintained throughout the study by assigning participant reference identity numbers instead of names.

A self-administered questionnaire was developed, comprising questions on demographic information, occupational health, psychosocial risk factors and work tasks and planning. The questionnaire was piloted among 10 practitioners and edited prior to use.

A complete list of all dentists, dental therapists and oral hygienists based in KwaZulu-Natal (KZN) was obtained from the Health Professions Council of South Africa (HPCSA). A link to the online questionnaire was emailed via QuestionPro to all practitioners on the respective registers. Following a poor initial response by the dentists to the online survey, an attempt was made to contact the dentists who were registered with the South African Dental Association (SADA). All practitioners were invited to participate in the study through email, telephone and in person contact visits through their practices.

The final study population consisted of dentists (n=400), dental therapists (n=172) and oral hygienists (n=115).

Data was exported from QuestionPro and analysed in SPSS version 24. Frequencies and means with standard deviations were calculated for categorical and continuous variables respectively. Chi square and the independent samples t-test were used for bivariate comparison of categorical and continuous variables respectively. The accepted level of significance was 0.05 (α=0.05).

RESULTS

Demographic details

A sample total of 353 (55.7%) of the total population of 687 individuals responded to the questionnaire, consisting of 150 (42.5%) males and 203 (57.5%) females. The demographic characteristics are summarised in Table 1. A post-graduate degree was the highest qualification for 24.6% of the respondents.

| Table 1: Demographic profile of participants (n=353) |
|-----------------|-----------------|-----------------|-----------------|------------------|
|                | Dentist (n=169) | Dental Therapist (n=138) | Oral Hygienist (n=46) | Total (n=353) |
| Sex            |                 |                         |                        |                 |
| Male (n,%)     | 90, 53.3%       | 57, 41.3%               | 3, 6.5%                | 150, 42.5%      |
| Female (n,%)   | 79, 46.7%       | 81, 58.7%               | 43, 93.5%              | 203, 57.5%      |
| Marital Status |                 |                         |                        |                 |
| Single (n,%)   | 67, 39.6%       | 66, 47.8%               | 15, 32.6%              | 148, 41.9%      |
| Married (n,%)  | 94, 56.6%       | 67, 48.6%               | 28, 60.9%              | 189, 53.5%      |
| Cohabiting (n,%) | 8, 4.7%     | 5, 3.6%                | 3, 6.5%                | 16, 4.5%        |

The response rates were 41% (n=169), 80% (n=138) and 40 % (n=46) for dentists, dental therapists and oral hygienists respectively.

Chemical Exposures

Ten percent of the participants reported an allergy to latex, presenting as itchiness (n=15), redness (n=8), rashes (n=5), blistering (n=4), and sinusitis symptoms (n=3), with the highest prevalence being among dental therapists (18%).
Seventy five percent of practitioners (n=265) do not use amalgam in preference to resin based restorative materials in clinical practice. Indeed, 191 (54.1%) oral health practitioners stated that they never use amalgam while 26.1% (n=92) sometimes use it, 5.7% (n=20) often use it and 1.1% (n=4) always use it. Seventy-two percent of the participants did not have an amalgam trap in their practices. Of those using amalgam, the waste was disposed through waste recycling (n=26), bin (n=23), water or fixer in a bottle (n=55), drain (n=14), sharps container (n=8) and collected by company (n=8).

Biological Exposures
The majority of respondents 304 (86.1%) used a facemask during their work and 117 (33.1%) made use of an N95 mask. Thirty eight percent of the oral health practitioner never use extraction ventilation in their surgeries while 18% sometimes use it.

When asked about the reasons for PCIs the following were indicated: needle stick injuries (n= 64), elevators during extractions (n=15), patient moved (n=9), eye splash (n=9), bites by patients (n=5), rotating burs (n=4) and scaler injury (n=2).

Physical exposures
Nearly 93% of practitioners work in awkward postures. Nearly 50% sometimes work with their hands above elbow height. Nearly 95%, at some stage during the working day, remain in the same posture for prolonged periods (Table 2).

It was the oral hygienists who most frequently reported symptoms of MSD, reporting a prevalence of 70% and 56.5% for neck and hand pain respectively. Dentists complained of the highest prevalence of shoulder pain (55.8%) and of percutaneous injuries (42.3%) (Table 3).

The participants had consulted medical practitioners in many instances. A variety of reasons for the ailsments had been offered.

For neck pain: muscle spasm (n= 24), muscle strain (n=17), posture (n=16), muscle stiffness (n=15), muscle tension (n= 15), poor cervical spondylosis (n=13), degeneration of discs (n=4), work related (n=4), fatigue (n=2), repetitive strain injury (n=2), pinched nerve (n=2), stress (n=2) and osteoarthritis (n=1), Twenty-six respondents (n= 26) did not seek medical attention, despite reporting discomfort.

For hand pain: carpal tunnel issues (n=20), pain and inflammation (n=14), fatigue (n=14), strain (n=12), arthritis (n = 10), tendinitis (n=7), stiffness (n=6), numbness (n= 6) and burning sensation (n=3). Thirty two sufferers did not seek medical attention.

For shoulder pain: muscle strain (n= 21), muscle spasm (n=16), posture related (n=13), stiffness (n=11), inflammation (n=9), fatigue (n=8), rotator cuff (n= 7), frozen shoulder (n= 4), stress (n= 4), repetitive strain injury (n=2), arthritis (n = 1), fibromyalgia (n = 1), spondylosis (n=1) and trigger points (n=1). Twenty nine respondents did not seek medical attention.

<table>
<thead>
<tr>
<th>Table 2: Occupational related exposures (n=353)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you stand for long periods?</td>
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<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>n %</td>
</tr>
<tr>
<td>Never</td>
</tr>
<tr>
<td>Sometimes</td>
</tr>
<tr>
<td>Often</td>
</tr>
<tr>
<td>Always</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3: Prevalence of occupational health-related conditions (n=353)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentist</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Neck pain</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>103</td>
</tr>
<tr>
<td>Hand pain</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>81</td>
</tr>
<tr>
<td>Shoulder pain</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>87</td>
</tr>
<tr>
<td>Illness related to mercury exposure</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>Allergy to latex</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>PCI</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>66</td>
</tr>
<tr>
<td>Other occupational health - related illnesses</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>22</td>
</tr>
</tbody>
</table>
Significantly more female dentists (55.2%) reported shoulder complaints as compared with their male counterparts (44.8%) (p=0.024). There was significant association between the number of years in practice and neck complaints (p = 0.013) with the frequency increasing with age.

Psychological exposures
There was a significant relationship among dental therapists between the deadlines relating to their daily tasks and neck pain (p=0.05) and hand and wrist pain (p=0.00). One third of the participants (n=116) (33.9%) confirmed they had the ability to influence the planning of their work tasks. Nearly 45% were always able to plan their daily tasks. Several (40.5%) perceived that they never have a heavy workload and rarely work over eight hours a day. (Table 4).

Ergonomic exposures
Bending and twisting the upper body while working was significantly associated with pain in the hands and wrists (p=0.05). Working in awkward postures was significantly associated with neck complaints (p=0.002), hand and wrist pain (p=0.015) and shoulder pain (p=0.001). Working in the same posture for prolonged periods was significantly associated with neck pain (p=0.027), neck complaints (p=0.003) and shoulder pain (p=0.02). For all participants, the data revealed significant relationships between gender and shoulder pain (p=0.05), the ability to determine daily tasks and hand pain (p=0.032), variation in clinical work and hand pain (p=0.013), bending and twisting and shoulder pain (p=0.01), awkward postures and neck complaint (p=0.001), awkward postures and hand and wrist complaints (p=0.045), awkward postures and shoulder complaints (p=0.001), same posture for prolonged periods and neck pain (p=0.0), same posture for prolonged periods and hand pain (p = 0) and same posture for prolonged periods and shoulder complaints (p=0.001).

The other occupational health related conditions reported were lower back pain, depression, airway infections, headache, dry eyes, recurrent colds and flu, irritable bowel syndrome, knee problems, fibromyalgia, tennis elbow and trigger finger.

DISCUSSION
This research set out to find data on the prevalence of occupational health-related conditions among oral health practitioners in KwaZulu-Natal, South Africa. Information on the prevalence of neck, shoulder and hand pain was obtained together with possible reasons for the experience. Data on allergy, use of amalgam, use of mask, posture, work habits and ventilation were also gathered. Nearly 74% of the sample were female. In another study conducted in KZN the male participants were more

<table>
<thead>
<tr>
<th>Question</th>
<th>Parameter</th>
<th>Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have influence in planning work tasks?</td>
<td>Frequency</td>
<td>23.0</td>
<td>127.0</td>
<td>87.0</td>
<td>116.0</td>
<td>353.0</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>6.5</td>
<td>36.0</td>
<td>24.6</td>
<td>32.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Can you influence the pace (speed) of your work?</td>
<td>Frequency</td>
<td>7.0</td>
<td>113.0</td>
<td>128.0</td>
<td>105.0</td>
<td>353.0</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>2.0</td>
<td>32.0</td>
<td>36.3</td>
<td>29.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Are you able to decide how your tasks are performed?</td>
<td>Frequency</td>
<td>6.0</td>
<td>70.0</td>
<td>119.0</td>
<td>158.0</td>
<td>353.0</td>
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<tr>
<td></td>
<td>Percent</td>
<td>1.7</td>
<td>19.8</td>
<td>33.7</td>
<td>44.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Can you determine the order of the tasks?</td>
<td>Frequency</td>
<td>18.0</td>
<td>88.0</td>
<td>149.0</td>
<td>98.0</td>
<td>353.0</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>5.1</td>
<td>24.9</td>
<td>42.2</td>
<td>27.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Can you determine the deadlines for your daily tasks?</td>
<td>Frequency</td>
<td>14.0</td>
<td>103.0</td>
<td>170.0</td>
<td>66.0</td>
<td>353.0</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>4.0</td>
<td>29.2</td>
<td>48.2</td>
<td>18.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Can you determine the time spent on each clinical task?</td>
<td>Frequency</td>
<td>19.0</td>
<td>110.0</td>
<td>166.0</td>
<td>58.0</td>
<td>353.0</td>
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<tr>
<td></td>
<td>Percent</td>
<td>5.4</td>
<td>31.2</td>
<td>47.0</td>
<td>16.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Do you solve day to day problems on your own?</td>
<td>Frequency</td>
<td>4.0</td>
<td>51.0</td>
<td>172.0</td>
<td>126.0</td>
<td>353.0</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>1.1</td>
<td>14.4</td>
<td>48.7</td>
<td>35.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Do you do the same task over and over again?</td>
<td>Frequency</td>
<td>20.0</td>
<td>88.0</td>
<td>159.0</td>
<td>86.0</td>
<td>353.0</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>5.7</td>
<td>24.9</td>
<td>45.0</td>
<td>24.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Are you allowed to be creative in your work?</td>
<td>Frequency</td>
<td>21.0</td>
<td>136.0</td>
<td>108.0</td>
<td>88.0</td>
<td>353.0</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>5.9</td>
<td>38.5</td>
<td>30.6</td>
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<td>37.4</td>
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n numerous than female (72.5%). In studies conducted among dental students in South African universities, the dominant gender was female in both Gauteng (74%) and in the Western Cape (65%). Female participation in a study on MSD prevalence conducted in SA was 34%. The data was different in the American study where 85% were male. Gender distribution showed 63% were female in a Brazilian study, in line with the results of this investigation. A quarter of the participants had a post graduate degree. The cohort of oral health practitioners was exercise conscious with almost 80 percent doing some form of exercise, in contrast to a report from the United Arab Emirates where more than half (61%) did not exercise regularly and 61% were male. Gender distribution in the profession in South Africa is changing with, 64% of dental graduates between 1985 and 2004 being male.The female to male ratios have also increased in South African universities.

Chemical exposures
The usage of dental amalgams is low among oral health practitioners in KZN and resin based restorative materials are preferred, hence the low prevalence of conditions due to amalgam use. The problem is with the method of disposal as the environmental factors are a cause for concern. A study conducted in Scotland emphasised that the urinary levels of mercury were four times higher in dentists than in the control subjects and the researchers suggested that safer handling, monitoring and disposal as the environmental factors are a cause for concern. The operator is exposed to mercury vapour which is absorbed by the skin and is inhaled, but these hazards can be avoided by proper handling. A 2006 study failed to find a correlation between blood levels and cytogenic damage in dentists exposed to mercury. Methyl mercury was detected in blood samples but this is not the type of mercury that is found in dental amalgam. Other sources of mercury may be more of a concern. Dietary consumption should not be overlooked. The current investigation found that 54.1% of participants never use dental amalgams while the others reported only rarely using the material as compared with the 62% of general dentists who reported using amalgams in a 2017 American study.

The prevalence of allergy to latex was 10.4%, similar to the 8% reported in an Indian study. Flemish dentists reported a 22.5% prevalence of dental allergies of which nearly half were latex related, also presenting as pruritus, urticaria, eczema and asthma. Dental staff and students are intensive users of gloves which places them at risk to latex allergies. The type of gloves used in training sensitises students to latex allergy symptoms. Low protein non-amebic gloves were found to reduce the exposure to the latex allergen and to decrease airborne allergens. Rubber latex allergens were investigated in a South African study which found that only 20% of gloves analysed had the allergen content below the recommended threshold amount. Another study conducted in South African dental schools revealed similar results and considered that latex allergens posed an allergic health risk. In 2009 a study concluded that despite a global position to refrain from using latex, the use continues in the South African setting.

Biological exposures
Percutaneous injuries were experienced by nearly 33% of the responding practitioners with dentists showing a prevalence of 43%. A prevalence of 36.8 % has been reported in Nigeria, of 42% in Romania and of 42% in the UAE. These levels places dental workers at risk of contracting HIV, Hepatitis B and Hepatitis C. The Hepatitis C virus is found in saliva and the danger is that no effective vaccination is available. The risks are greater if the source patient is positive. HIV found in the blood of patients poses minimal risk in dentistry when compared with Hepatitis. An oral health practitioner who is not vaccinated is at a higher risk of Hepatitis B virus infection, the exposure risk ranging from 0 to 30%, depending on the antigen level of the patient.

Dental workers are exposed to bacteria, fungi and viruses found in saliva of their patients. In this study 54% of oral health practitioners reported not wearing the N95 mask, placing them at risk of infection. The N95 mask is recommended as healthcare workers are prone to blood borne pathogens and the N95 achieves a "high level of protection" including against meningitis and pneumonia. The aerosol between the patient and the clinician is a mix of flora of the oral environment. It is filled to levels higher than normal standard amounts with aerobic and anaerobic bacteria. To prevent the oral health practitioners from inhaling this potentially dangerous mist, a proper air filtration system is required to reduce contaminants in the air and to remove bacteria from circulation. Other effective measures are high performance suction systems in conjunction with a dental dam and an ultra violet light lamp to disinfect the air. Extraction ventilation should be considered by practitioners who do not have this operating in their surgeries. In this study only 31.3% of practitioners always use extraction ventilation, placing themselves and others at risk.

Physical exposures
The prevalence of neck pain reported by participants in this study was 65.8% with the hygienists showing a higher rate of 70%. Dental hygienists in Australia also reported a high prevalence of neck pain (85%). An Indian study found a high prevalence of neck pain amongst dentists (83%), higher than the present investigation which at 66% was higher than that of a Polish study (47%). Similar results were reported in a Queensland, Brisbane study (86.2%), Andhra Pradesh, India (52%) and Brazil (57.5%). Hand pain reported for hygienists (60.1%) in Australia closely approximates the results obtained in the current study. Nearly 60 % of dentists in this study had experienced hand pain in the last 12 months and the results obtained were much higher than the 29% prevalence in Poland, which was similar to results for dentists in Andhra Pradesh, India (26%) and Jordanian dentists (39%). A prevalence of shoulder pain (55.8%) was reported among the dentists and 47.5% by the hygienists. The prevalence for hygienists differed markedly from that reported among Australian hygienists at 70%. Dentists in KZN suffered more from shoulder pain than did Polish (20%), Jordanian (39%) and Indian dentists (29%), but less than those reporting in Queensland, Brisbane (66.2%). It may be that younger, less experienced dentists have a higher prevalence of MSD. The causes of neck pain are prolonged static postures, high loads on the trapezius muscle and forward bending. The forward leaning posture weakens the muscles in the shoulder causing rounding and pain.
Back pain was not explored in this study but was reported as another occupational health-related condition. Back pain prevalence was at 47% in the Nigerian study. Australian hygienists reported a 68% prevalence. Lithuanian dentists appear particularly prone to back pain at a 91% prevalence, whilst a Jordanian study reported 56% of the participants suffered this problem.

Females in this study were more prone to MSD and this was also seen in a study in the UAE. This could be due to females reporting more freely or possibly that surgeries and equipment are not designed for women. It may be of interest that a 2015 study showed that government workers suffered more from MSD than did private dentists. This phenomenon was not investigated in this study.

Psychological exposures
Workload stress due to patients (42.2%) and long working hours (69.2%) has been reported. Working long hours was not an issue in the current investigation as only 9% of participants worked more than eight hours per day. Increase in MSD adds to the mental stress resulting in further strain. Stress levels rated by a group of dentists in Belgium on a VAS scale from 0 to 10 was 7 which indicated high stress levels. The practitioners in this study were in control of their workday as they could influence the pace of work, they could solve their day-to-day problems and were able to influence the tasks performed. Daily workloads and planning appointments can also assist in eliminating stress.

Ergonomic exposures
Neck position is critical in the prevention of MSD (65% prevalence of neck pain in this study). Forward head posture is common among dental workers as it improves visibility. This posture controls the muscles of the neck to support the head causing a tension neck syndrome, presenting symptoms, which include headache, pain in the neck, shoulders and inter-scapular muscles. The continuous contraction of these muscles leads to disc degeneration, rounding of the shoulders and rotator cuff impingement. It may have been ideal to have investigated the role of magnification loupes as their usage improves posture and thereby reduces neck pain as they prevent the practitioner from leaning forward. A recommendation from a study in 2007 was that loupes should be used from undergraduate level. The improved posture will decrease the occurrence of pain.

In considering MSD and the associated pain, it is evident that that training in ergonomics should be included in the under-graduate curriculum and included in continuous professional development. The authors of a paper which reported that only 30% of dentists and 23.2% of orthodontists had received some sort of ergonomics training, went on to recommend that dental students be taught intervention measures to reduce the prevalence of MSD.

Study limitations
The limitation of this study was that it was self-reported and thus information bias could have affected the results. Participants could have either under- or over-reported their symptoms. In addition there may have been an element of participation bias as participation was voluntary. Individuals who were well may not have participated and so the results may indicate a prevalence higher than is the true state of occupational health-related symptoms and disease in this population.

CONCLUSION
Occupational health-related conditions remain a problem in dentistry. MSD and PCI are preventable and with education and training, including CPD, the burden can be reduced. More research into the ergonomics of dental practice needs to be conducted and filtered down to oral health practitioners via CPD courses. Further research into the causes of MSD is required and a need for intervention studies in this area to help reduce the prevalence is needed. Mercury handling needs to be improved with a focus on disposal of amalgam waste. Research into newer dental materials and amalgam replacement material is indicated. Dental training and student supervision should include the prevention of occupational health-related conditions. More qualitative studies should be conducted into dental education and occupational health.

References
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Accuracy of acetate overlays in bite mark comparison: How accurate is an ideal bite pattern?

SADJ November 2017, Vol 72 no 10 p456 - p461
N Mohamed¹, V M Phillips²

ABSTRACT
Forensically, a bite mark on human skin is reliant on the matching of the alignment and position of the dentition of the perpetrator with the bruise pattern inflicted by the bite. If there is more than one suspect, the bite pattern of each suspect needs to be analysed. At least hypothetically, a bite delivered by a person who has had orthodontic treatment will result in a bruise pattern of an ideal arrangement of the teeth. If there are two suspects, both of whom have had orthodontic treatment, could that “ideal” alignment compromise identification of the perpetrator of the bite mark?

Aim: To determine the accuracy of an ideal bite pattern and whether an exact match could be obtained when comparing acetate overlays with bite patterns registered in wax of treated orthodontic cases.

Method: The biting patterns of upper and lower teeth of each of the study models were recorded in grey bite registration wax (Alminax®). Two examiners viewed the bite mark patterns and correlated them with the study models.

Result: In some cases an exact match between the teeth of the plaster model and the bite mark was not possible.

INTRODUCTION
General dental practitioners do not deal with forensic dentistry on a daily basis but their awareness should be raised regarding bite marks as these are often seen in cases of child and elder abuse. The dental practitioner should be able to make a clinical assessment of a suspected case of abuse and report the case to the police.

In many criminal cases the dentitions of suspects have been compared with bite marks left on the skin in order to determine whether the perpetrator in question could be held accountable for the crime.¹ The accuracy of the bruise patterns when compared with the biting patterns of the upper and lower teeth of a suspect has been questioned. A degree of concordance should be demonstrable between the bite marks left on an impression surface (the skin) and the dentition of a suspect.² There is, however, no consensus in the literature regarding the actual number of concordant features that are needed to implicate an individual as being the perpetrator.⁴ In principle as many concordant features as possible should be recorded when the comparisons are made.

It has been suggested that bite mark evidence should never be used to convict a suspect,³ despite the variations in caries experience, dental treatment received, environmental factors and wear-and-tear, that makes each the morphology of each dentition unique.⁵ Features such as crowding, asymmetry, missing or filled teeth, supernumerary teeth, diastemata and attrition as well as the combination of these features could result in a unique bite pattern.⁴

Despite that unique quality, how these features are recorded on the skin can produce bite marks that are so similar that one may be indistinguishable from another.⁵,⁶ Thus, inaccurate interpretation of a bite mark may lead to wrongful conviction of a suspect.⁵ At the very least, bite mark analysis could either exclude a suspect as the possible perpetrator or suggest that a degree of probability could exist that the suspect inflicted the bite mark.⁷

Cases with obvious irregularities, such as tooth rotations that are unique to an individual, have been used as evidence in the conviction of a criminal, but in numerous cases the bite mark evidence has not been convincing due to a lack of accuracy in the correlation between the bruise patterns and the teeth of the suspect. When comparing the dental features, the positions of the teeth, inter-canine distance, shape of the arches and tooth sizes should be taken into consideration.⁵ The area of the tooth biting surfaces, tooth rotation and width, centric position and other unique characteristics, including absent teeth, should also be noted.¹,² These distinct features are easily

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correlated, but a perfect row of teeth may not produce enough evidence for a match.

The objective of orthodontic treatment is to arrange the upper and lower dentition of a patient into a “normal” Class I occlusion for aesthetic as well as functional and health reasons. Young patients with malocclusions are subjected to long term mechanical adjustment of the dentition. Sometimes, extraction of pre-molar teeth is required to attain a Class I occlusion. The teeth are moved and rotated to attempt normal catenary alignment and thereby improve mastication, reduce interference food retention and subsequent periodontal disease.

Dental study models of orthodontic patients at the completion of their treatment show an almost perfect catenary curve of the maxillary and mandibular teeth. Some minor rotations can persist, especially of the mandibular incisors. The maxillary and mandibular incisors also vary in size (mesio-distally) and the relationship between the maxillary central and lateral incisors can be sufficiently peculiar to be used for identification. The variable nature of bite marks on the skin makes identification of a positive match difficult. The question, however, is “If an ideal bite is recorded, is it possible to obtain a 100% match between the teeth of the plaster model and the bite mark”?

AIM
The aim of this study was to determine whether it is possible to accurately match the teeth of a sample of orthodontic plaster study models and an ideal bite mark registered in wax, using the acetate overlay technique.

MATERIALS AND METHODS
A cross-sectional, comparative study was carried out. Plaster of Paris study models of the upper and lower teeth of 26 dentate young adults who had completed their orthodontic treatment were used. The models were obtained by random selection from the database of the Orthodontic Department database at the Dental Faculty of the University of the Western Cape. All models had to have fully-erupted permanent teeth. This was purely a records-based (archival) study. No names or personal details of the patients were available. Models were identified only by means of a number (Figure 1). Patient confidentiality was therefore preserved.

To create an ideal bite pattern for each individual, the biting patterns of the upper and lower teeth of each of the study models were recorded in grey bite registration wax (Alminax®) to create an accurate impression of the biting patterns of the upper and lower teeth. The wax was heated with a flame to soften it and placed on a firm flat surface; then the teeth of each study model were pressed into the wax to record the bite pattern (Figure 2).

The method of bite mark comparison routinely used by author VMP is to trace the bite pattern of each jaw on plastic foil and to then superimpose the tracing over the actual bite mark. Thus the wax biting patterns of the upper

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Figure 1: Plaster of Paris study model with allocated case number.

Figure 2: Wax bite patterns of the upper and lower teeth of case No 3818 (Coded U).

Figure 3: The superimposed tracing on plastic foil on the wax bite pattern.
and lower teeth of each of the cases were traced onto plastic transparent foil using a fine permanent marker pen (Figure 3). Alphabetical characters from A to Z were assigned to the tracings. The list of alphabetical labels and the correlating case numbers were kept separately so that blind comparisons could be made (Table 1).

Two examiners independently analysed the cases and tried to identify matched pairs of the transparency tracings and the wax bite patterns. This was undertaken in the following manner:

The first analysis was to match the tracings of both the upper and lower jaws simultaneously with the upper and lower wax bite patterns. The wax bite patterns for each case were arranged on a table surface. Tracings of the upper and lower bite patterns, A to Z, were severally superimposed on each wax pattern until a match was obtained. This matched pair was then eliminated from the analysis. The results obtained by each examiner were recorded.

The second analysis was to identify matches of the upper teeth only and then matches of the lower teeth only. A similar method of matching was used. The results of each examiner were recorded.

The third analysis (Tables 5 to 7) examined the section of the dental arch spanning from the first premolar on the left side to the first premolar on the right side in the upper and lower arches. (In many of the cases of bite marks on the skin the pattern of bruises is inflicted by the upper and lower anterior teeth and rarely extends beyond the 2nd premolars.)

This meant that a maximum of eight concordant features could be obtained for each of the upper and for each of the lower arches. Each researcher performed the matching process for the maxilla and mandible together and then for each arch separately. The number of concordant features for each jaw were recorded as follows:

- 8 concordant features—definite match
- 7 concordant features—highly probable match
- 6 concordant features—possible match
- 5 concordant features—no match

Concordant features were noted if there was a match in the following between the transparency overlay and the wax bite pattern:
- the pattern of tooth distribution
- the spatial alignment of the teeth
- the shape of the arch—teeth had to fall within the dental arch
- the width of the incisal edges of the teeth
- angulation of teeth/ incisal edges of teeth

RESULTS

**First analysis:** When the upper and lower wax biting patterns were superimposed with the tracings of both dental arches, both examiners were able to match every case accurately i.e. 100% match (Table 2).

**Second analysis:** When each of the tracings were independently superimposed on the wax bite patterns of the mandibular and maxillary dentitions the degree of accuracy was found to be less accurate (Table 3).

**Third analysis:** Using the anterior 16 teeth (1st premolar to 1st premolar) of the upper and lower jaws separately, the tracings of each case were superimposed over these teeth to obtain a pattern match. The findings are reflected in Tables 4 to 7. In those Tables, the case numbers are shown in the first column. The tracings are labelled A to Z. The second column shows the exact match (eight concordant features) of the tracings with the bite patterns. The third column shows tracings where eight possible concordant features were matched. The fourth column shows those tracings where seven concordant features between the tracings and the bite patterns were obtained. The fifth column shows those cases where six concordant features were obtained. The sixth column shows those cases with five or less concordant features.

The first column in Table 4 demonstrates a high degree of accuracy in matching the cases. The third column shows two tracings (A & B) where eight possible concordant features were matched.

The third column in Table 5 shows four tracings (G, EG and G) where eight possible concordant features were matched.

The third column in Table 6 shows three tracings (LX, and X) where eight possible concordant features were matched.

The third column in Table 7 shows that for case No. 1783 tracing G has eight possible concordant features. Similarly for case 3766 the tracings G, L and M have eight possible concordant features. Case 3818 has eight possible concordant features with B, P and S; Case 3949 has eight possible concordant features with E, K and S; Case 4474 has eight possible concordant features with S and Case 4614 has eight possible concordant features with O and P.

DISCUSSION

The bite mark patterns recorded in the wax were ideal and accurate replications of the bite patterns of each of the study models were obtained. The tracings onto the plastic overlays of each of the biting patterns of the upper and lower teeth of the cases were systematically and sequentially superimposed over each wax bite pattern and the number of concordant features recorded.

It was clear from the results that when the mandible and maxilla were examined together as a single entity, the tracings could easily be matched to the wax bite patterns. This was repeated on more than one occasion with the same result. Both examiners scored a 100% match each time. When both arches were viewed together, these

| Table 2: The results of the analysis of the bite patterns of the upper and lower jaws together by each examiner (n=26) |
|-------------------|-------------------|
| Examiner          | Maxilla + Mandible|
| NM                | 26/26             |
| VMP               | 26/26             |

| Table 3: The results of the analysis of the bite patterns of the upper and lower jaws independently by each examiner (n=26) |
|-------------------|-------------------|
| Examiner          | Maxilla           | Mandible         |
| NM                | 24/26             | 23/26            |
| VMP               | 23/26             | 22/26            |
### Table 4: Results of the third analysis of the bite patterns of the maxillary teeth [14 to 24] by examiner NM.

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### Table 5: Results of the third analysis of the bite patterns of the mandibular teeth [34 to 44] by examiner NM.

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Table 7: Results of the third analysis of the bite patterns of the mandibular teeth [34 to 44] by examiner VMP.

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ideal bite patterns were thus unique enough to be able to identify an exact match, even when the teeth were perfectly aligned. When the arches were examined independently of each other, the maxillary arches were more easily matched than were the mandibular arches, but it was more difficult to identify an exact match.

The variability between the examiners could be attributed to the fact that Examiner NM is a general dentist and Examiner VMP is a forensic pathologist. Taking the variability of bite marks into consideration, the pathologist was therefore more inclined to be more lenient in his assessment. Examiner NM tended to be stricter in assessing the possibility of a match. Despite this, it was clear that both examiners found that more than one tracing could be matched to a wax bite when the maxillary and mandibular arches were viewed independently of each other.

This study shows that even in the ideal situation where the bite mark patterns in the wax are a perfect replication of the dental arches of the maxilla and the mandible, there are several of the biting patterns that are so similar that an absolute match is not possible.

A bite mark on human skin is often seen as only bruises and analysis requires that the teeth of the perpetrator be matched with those bruises. Often there are imperfections in the bruise patterns due to abrasion of the skin during the infliction of the bite. The malleability and distortion of the human tissues also contribute to distorted representations and hence inaccuracies in matching with the perpetrator’s teeth.

**CONCLUSION**

This study emphasized that even under ideal circumstances where the impression of each tooth was recorded accurately; an exact match between the acetate overlay and the teeth of the plaster model is not possible in some cases e.g. where more than one “perpetrator’s” bite pattern was very similar. In clinical situations where the examination of a bite mark in human skin often takes place long after the infliction thereof, the appearance of bite marks are variable depending on the degree of force applied and the movement of the victim.

The bite mark on skin usually consists of a pattern of bruises or puncture wounds, and is far less accurate for identification purposes. The latest literature confirms the inaccuracy of bite marks and suggests that it cannot be used as primary identification data to implicate a perpetrator of a bite mark.

There were several duplicate matches where more than one set of models could have made the impression in the wax. The plaster of Paris study models of patients who had undergone orthodontic treatment had very similar dental arch morphology. This added to the argument that if a bite mark were inflicted by a person who had an ideal dental arch and there were two or more suspects who had undergone orthodontic treatment, it would be difficult to accurately match their bite patterns with the bite mark.

Caution should therefore be exercised when analysing bite marks especially where the alleged perpetrator has a “perfect set of teeth”. There should be a move away from using this as a definitive means of identification of perpetrators of abuse, assault or murder.

**References**

2. Pretty, IA. The barriers to achieving an evidence base for bite mark analysis. Forensic Science International 2006; 159S: S110- S120.
A pilot study investigating the presence of voids in bulk fill flowable composites.

ABSTRACT
Objective: To investigate the presence of voids in bulk fill flowable composites.
Methods: This study investigated two well-known bulk-fill flowable composites, Smart Dentin Replacement (SDR) (Dentsply/Caulk, Milford, Germany) and Filtek bulk fill flowable (FBF) (3M ESPE, Minnesota, USA). Three ampules of each material were randomly selected. The ampules were subjected to 3D Micro-CT (General Electric Phoenix V|Tome|x L240) reconstruction in order to assess the presence of any voids within the ampules.
Results: Voids were present in all the ampules. The total void percentage for each group of three ampules was found to be SDR : 1.147 % and FBF : 0.0424 %. There was a significant difference between the volume of voids for SDR and FBF, p-value=0.003924.
Conclusion: Voids were found in the randomly selected samples of bulk-fill flowable composites. This is undesirable and manufacturers should be urged to ensure that no voids are present, or at least are minimized in the ampules of material.
Keywords: Voids, bulk fill flowable composite, 3D Micro-CT reconstruction, Displacement vector fields.

INTRODUCTION
The presence of voids between incremental layers of composite material has an adverse effect on the flexural strength of the restoration. Manufacturers of bulk fill flowable composites advocate that these materials be placed in a single layer of a thickness of 4mm. This technique appeals to many clinicians, as not only is the restoration being placed faster compared with incremental packing, but the risks for the entrapment of impurities and voids are also reduced.2

The manufacturers’ instructions for both composite and traditional flowable composites recommend that when an incremental layering technique is used, the layers should be of 2mm thickness. Investigations on the volumetric change of bulk fill flowable composites (Smart Dentin Replacement (SDR), Filtek bulk fill flowable (FBF), Venus bulk fill (VBF) compared with universal composites have resulted in similar percentages of volumetric shrinkage.3,4 Voids can be included inadvertently in the material by the manufacturer or by the clinician during restoration placement,5,6 and have been a concern since the hand-mixed chemically cured composites.7 At that stage, voids were assessed by visualisation of sections of 300µm. thickness under a stereomicroscope. The limitation of that study was that only twenty-five percent of the surface could be assessed as this was all that was visible. A mathematical equation was then used to estimate the total number and percentage of voids in the sample as a whole, which suggested that void sizes ranged between 10 and 175µm. The conclusion was that the number of small voids, between 10 and 40µm, increased during the spatulation of chemically cured composites. Contemporary studies reported the percentage of voids in paste systems as ranging from less than 1% to 2-3%.

ACRONYMS
FBF: Filtek bulk fill flowable
SDR: Smart Dentin Replacement

DEFINITIONS
Void: Bubble / porosity that is present in a dental material.
Void volume: Total volume (in mm3) of voids present in the sample of dental material.
Void percentage: Total void fraction present in the sample expressed as a percentage in relation to the total volume of the dental material.
Displacement vector fields: The direction of volumetric shrinkage that takes place within a tooth that was restored with a resin composite.

REFERENCES
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Voids in glass ionomers were assessed using only one sample of each material and visualisation of 40 µm thick sections under a stereomicroscope. Three randomly selected areas (64.75 mm²) were assessed in each sample, under 117.6 magnification.

A limitation of the methodologies of these studies was that the whole sample was not assessed and thereafter, the “total assessment of voids” had to be mathematically predicted.

With the development of the 3D Micro-CT (high-resolution micro-computed tomography) the whole sample could be assessed, thereby overcoming the limitations of the mathematical estimation of other techniques. The effectiveness and accuracy of the 3D reconstruction has been established as a non-destructive and accurate visualisation technique for marginal adaptation and volumetric change. 3D Micro-CT reconstruction has also previously been applied successfully in the assessment of voids in glass ionomer.

The incorporation of voids into a restoration may be due to the technique of condensing and smearing the material into the cavity by the clinician. It has been shown that the higher the viscosity of the composites the more difficult it becomes to condense it into the prepared cavity. This is mainly due to the physical properties of the material i.e. it may be too thick, sticky or dry and thus be more resistant to accurate adaption to the prepared cavity.

The clinician may attempt to reduce the incorporation of voids through careful condensation and by avoiding smearing of the composite against the walls of a cavity preparation.

The short- and long-term effects of the presence of voids in materials are varied and depend on the volume, number and location of the voids. Voids present in the material as produced by the manufacturer have been shown reduce load-bearing capacity in the oral environment. The compressive strength of single paste composites has been reduced with a resultant lower compressive fatigue limit. This is directly due to internal stresses, which are concentrated around the voids. Earlier two-paste and single-paste composites were shown in the long term to demonstrate a decreased resistance to wear if the voids were to be exposed to the occlusal surface. A decreased micro-tensile bond strength and marginal discoloration with microleakage has been observed, irrespective of whether the voids were within the adhesive layer or within the composite. Voids located at the tooth-restoration interface could be mistaken as secondary caries due to the radiolucency of the defect. An in vitro study showed that bacteria accumulate in voids and an SEM analysis of three-year-old resin restorations indicated bacterial collection in the exposed surface pores of the restorations.

It was postulated by McCabe (1987) that if the manufacturers were to provide void-free two paste- and single-paste composites the longevity of the restoration exposed to continuous compressive fatigue will be increased. The prevention of void inclusion by the clinician is equally as important as receiving a void-free material from the manufacturer. The high viscosity and stickiness of the packable composites can pose a risk for void inclusion into the restoration by the manufacturer or by the clinician during 2 mm incremental layering condensation. The advent of bulk-fill flowable composites offers a potential solution as many clinicians place these materials in 4 mm increments as recommended by the manufacturer.

The present study aimed to provide an assessment of the presence of voids in bulk-fill flowable composites and an overview of the literature on voids in dental composites.

**MATERIALS AND METHODS**

**Materials:**
This investigation evaluated two bulk-fill flowable composites and compared the volumes of voids present in three ampules of the materials. The SDR and FBF material ampules were selected due to their popularity on the local dental market.

**Material test groups:**
1. Filtek bulk fill flowable (FBF) (Universal Shade) (3M ESPE, Minnesota, USA, Lot 4861U).
2. Smart Dentin Replacement (SDR) (Universal Shade) (Dentsply/Caulk, Milford, Germany, Lot 0625).

**3D Micro-CT scan and reconstruction:**
3D Micro-CT scans were completed with a General Electric VTomex L240 system. The ampule scans were done using 120kV and 160 µA for X-ray generation at 20 µm voxel size. Data analysis was performed in Volume Graphics VGStudioMax 3.0. The procedure applied to scan the ampules was devised specifically for this application according to the requirements, which involved measuring the volumetric porosity in the ampules and the total volume of dental material in the ampules.

The voids within the unused ampules were detected by the algorithm “VGDefX”, as a defect analysis function with a relative deviation value of -2.

**Statistical analysis:**
In order to perform the statistical analysis for the differences of the means on a relatively small sample size of three ampules per material group, it was essential to produce a variance stabilising transformation of the variables. For the purpose of this investigation an “arcsine transformation” was applied to the Volume of the voids / Volume of the ampule to produce the Y-values, calculated with the formula: Y = 2arcsin√p, where p is a proportion (Table 1).

### Table 1: Arcsine transformation values (Y-values) of SDR and FBF

<table>
<thead>
<tr>
<th>Material</th>
<th>Total volume of material in the ampule (mm³)</th>
<th>Total volume of voids in the ampule (mm³)</th>
<th>Percentage of voids per volume of ampule (%)</th>
<th>Y-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBF 1</td>
<td>145.2551</td>
<td>0.011359995</td>
<td>0.007821</td>
<td>0.017687</td>
</tr>
<tr>
<td>FBF 2</td>
<td>145.4908</td>
<td>0.005192015</td>
<td>0.034948</td>
<td>0.037150</td>
</tr>
<tr>
<td>FBF 3</td>
<td>144.0886</td>
<td>0.000144004</td>
<td>0.000100</td>
<td>0.001999</td>
</tr>
<tr>
<td>SDR 1</td>
<td>173.6663</td>
<td>0.503001008</td>
<td>0.289637</td>
<td>0.107688</td>
</tr>
<tr>
<td>SDR 2</td>
<td>173.7022</td>
<td>0.977768001</td>
<td>0.562899</td>
<td>0.150194</td>
</tr>
<tr>
<td>SDR 3</td>
<td>170.9816</td>
<td>0.506905</td>
<td>0.296468</td>
<td>0.108952</td>
</tr>
</tbody>
</table>
## RESULTS

The 3D Micro-CT reconstruction was used as a non-destructive method for the investigation of the material within the bulk-fill flowable composite ampules. The 3D Micro-CT could accurately determine the volume of individual voids and the sum of all the voids in mm³ (Figure 1. Table 1, 2).

Each of the randomly selected ampules had varying volumes of material. The percentage of the voids per volume of material in the ampules was calculated mathematically, using the formula: Volume Percent = 100 x Volume of voids / Volume of ampule.

The spread and the differences in location of the Y-values for the SDR and the FBF ampules of the arcsine transformation values (Y-values) are represented in Figure 2. The t-test of significance of differences of the means indicated a significant difference: t=-5.9827, df=4, p-value=0.003924 between the material groups SDR and FBF.

The advantage of the transformed variables was that the confidence limits could be calculated with the samples pooled within the SDR and FBF groups for variance calculations based on df=4. The confidence limits represented in Table 2 were obtained using the transformed variables and mean values of the percentage of voids within the ampule at a 95% confidence limit.

The randomly selected samples from SDR and FBF reviewed in this study showed that there were fewer voids in total for the SDR (34 voids) test group compared with the FBF (46 voids) test group. The total volume of voids in percentage for the three ampules from each manufacturer were however greater for SDR (1.147 %) in relation to FBF (0.0424 %). The smallest, largest and total volume of voids per ampule was represented in relation to the volume of the material inside the ampule Table 3, Figure 3.

### DISCUSSION

The clinical relevance of the voids in relation to the longevity of the restoration and the post-operative complications are the most important considerations that the clinician should take into account. Early single-paste systems that were light-cured had a mean void size of >0.8µm where water sorption occurred into the void. Voids in the final restoration affected the solubility as well as the colour of the dental restoration due to the water sorption. Inherently, single-paste light activated composites were shown to contain voids that were close to the percentage found in the SDR and FBF ampules. The single-paste light activated composites had voids present to a percentage of 0.05-1.5% per volume.

The presence of voids within composites result in differences in internal stress development. The stress development varies according to the location of the void in the restoration. In the event...
that the void is located at the restoration/tooth interface, the volumetric shrinkage will have a negative effect in the immediate area of the void due to the stress development\(^{16}\) around it, resulting in an increased susceptibility for adhesive failure of the restoration.\(^{19}\) This stress development is due to the force distribution within the material as a result of the volumetric shrinkage of the material on the void.\(^{16}\)

Besides the stresses generated within the materials, by volumetric shrinkage and voids, the restorations are subjected to occlusal forces that could lead to the formation of cracks during loading. The crack formation has been found to be initiated and potentiated at areas where the voids are incorporated into the composite restorations.\(^{10,20}\)

In addition, the voids incorporated in the ampoules during manufacturing pose a threat to the longevity and shelf life of the material. Voids can cause oxygen inhibition on the surrounding material in the ampoule.\(^{27,28}\) The risk of inhibition is subject to the volume of voids present. In the case of SDR and FBF, the percentage of voids to material was small. However, due to the void inducing oxygen inhibition?\(^{27,28}\) and the fact that resin in replaced by air, a slower volumetric shrinkage could occur. The combination of the voids and oxygen exposure during restoration placement has been found to be a contributing factor to a decreased strain on the adhesive layer.\(^{27}\) It was postulated that in the cement used for inlays, where only thin layers of up to 200µm are used, there might be positive effects to having voids. The rationale was that voids reduce the adhesive and cohesive failure significantly as they may serve as a free surface of \(1\text{mm}^2/\text{mm}^3\).\(^ {27}\) Post-operative dentine sensitivity and micro-leakage at the marginal interface of the cement if voids were present was not considered when the that conclusion was reached. An \textit{in vitro} study on pre-molars with GV Black Class II preparations, reached the conclusion that 16 of the 35 restorations had voids in the gingival wall within the adhesive or within the composite, compared with no voids at the axial walls.\(^{24}\) The location of the void incorporation is important since a review of the literature has shown that, especially for composite restorations, the presence of voids at the tooth/restoration interface and within the material itself poses problems. A micro-leakage study with SDR indicated that most of the prepared specimens were found to have voids under stereomicroscope evaluation to have voids in the material.\(^{29}\) There is scope for extensive research on voids in composites, in particular bulk-fill composites that are packed in 4mm increments.

**CONCLUSION**

Based on the negative clinical effects that could ensue due to void inclusions in composite materials, the manufacturers should investigate filling the syringes of bulk fill flowable composites under vacuum. This technique has proven to be successful in eliminating void inclusion in composites.\(^{5}\)

**References**

Fragmentary tooth root development: biological and forensic dental implications

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ABSTRACT
Recent findings indicate that there could be continued root development after the successful surgical removal of an impacted tooth. The paper provides a brief review of normal root development, emphasizing the chain of reciprocal epithelial–ectomesenchymal interactions which regulate all aspects of this process.

Mineralized dental structures are not an absolute requirement for tooth root development, but residual fragments of Hertwig’s epithelial root sheath (HERS), together with the associated ectomesenchymal cells, will enable continued growth. The findings presented in this paper have significant implications in forensic odontology, dental litigation and for routine and elective tooth extractions.

INTRODUCTION
In 2015, during the routine forensic identification of a mutilated corpse, a peri-apical radiograph revealed a sizeable residual root in the 38 area (Figure 1). The ante-mortem records supplied by an orthodontist consisted of a panoramic radiograph, taken of the deceased in December of 2009 (Figure 2).

A maxillo-facial surgeon subsequently used this very radiograph four months later in March 2010 during surgery to remove the wisdom teeth for elective orthodontic purposes.

Figure 1: Post-mortem peri-apical radiograph showing a residual root fragment in the 38 area. The lamina dura and periodontal ligament space extend around the entire root surface.

Figure 2: Ante-mortem panoramic radiograph showing the third molar (38) in Demirjian’s stage F of development. Taken in December 2009.

ACRONYMS
DPSCs: dental pulp stem cells
ERK: extra-cellular signal-related kinases
FGF2: fibroblast growth factor
HERS: Hertwig’s epithelial root sheath
MAPK: mitogen-activated protein kinases
PDLSCs: periodontal ligament stem cells
PTHrP-PPR: parathyroid hormone-related protein receptor
SCAP: stem cells from the root apical papilla
Sirt6: Sirtuin-6
TGF-β: Transforming Growth Factor beta

The ante-mortem panoramic radiograph clearly shows the root formation of the tooth 38 as Demirjian’s stage F with root length as great as the crown length (Figure 2).

The peri-apical radiograph taken during the post-mortem investigation was inconsistent with this ante-mortem record as it revealed a horizontally positioned residual root with a closed apex in the 38 area and both the lamina dura and periodontal ligament space were not only present but extended around the entire root surface (Figure 1). Unfortunately, there were no post-extraction radiographs available, nor documented records

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indicating whether any of the roots had fractured during the extraction procedure. However, it would not have been possible for the 38 to have completed root development as seen in Figure 1 in the four months between the taking of the panoramic radiograph and the extraction of the wisdom tooth. The presence of the developed root created a forensic dilemma, as it constituted an apparently inexplicable discrepancy despite there being several other concordant dental features between the ante-mortem and post-mortem radiographs. However, the body was later positively identified by fingerprints as that of the orthodontic patient. The confirmation of identity by non-dental means implied that a residual root fragment had continued developing after the extraction of the tooth.

The hypotheses proposed: Remnants of the apical aspect of Hertwig’s epithelial root sheath (HERS) and the associated ectomesenchymal cells remained behind, leading to continued formation of the root.

REVIEW OF TOOTH ROOT DEVELOPMENT

Tooth development is initiated and regulated by a cascade of reciprocal interactions between the dental epithelium and the associated ectomesenchyme. The earliest sign of tooth development is regarded as a thickening of the odontogenic epithelium, wherein resides the initiating capacity to form teeth. As the dental ectomesenchyme condenses, this anlage is shifted to the underlying ectomesenchyme derived from the neural crest. Thereafter the reciprocal signalling between epithelial and ectomesenchymal cells continues through the characteristic bud, cap and bell stages of crown formation. This interaction is mediated through multiple pathways and a variety of different transcription factors. Details on the precise molecules involved are however beyond the scope of this article.

While the molecular and cellular mechanisms of early tooth development and crown morphogenesis have been extensively studied, less is known about the molecular mechanisms controlling tooth root formation. However, great progress has been made over the last ten years in this field. Root formation follows the completion of crown formation with the inner and outer enamel epithelium of the enamel organ forming a continuum at the cervical loop that extends apically as a thin sheath. This structure is known as Hertwig’s epithelial root sheath (HERS). Morphologically, HERS forms a structural boundary between two dental ectomesenchymal tissues derived from neural crest cells, namely: the dental papilla and the dental follicle. HERS signals the ectomesenchymal cells of the dental papilla to differentiate into odontoblasts. The secretion of Laminin 5 and TGF-β by HERS seems to be crucial in this process. Laminin 5 appears to induce migration, growth and differentiation of the ectomesenchymal cells while TGF-β is believed to induce the differentiation of these cells into odontoblasts. TGFβ1 induces early odontoblast differentiation through the Smad signalling pathway whereas Nfic signalling modulates late odontoblast differentiation and mineralization. These newly differentiated odontoblasts then secrete predentine that will become mineralized root dentine. The epithelial component (i.e. HERS) is therefore crucial in initiating root formation and is responsible for guiding and determining the size, shape and number of roots. Any disturbance in HERS can result in irregularities in root development. If the continuity of HERS is disrupted prematurely, the odontoblasts fail to differentiate with no subsequent dentin or cementum formation.

As soon as the odontoblasts have differentiated, HERS undergoes fragmentation through the degradation of E-cadherin, again under the influence of TGF-β1. Ectomesenchymal cells of the dental follicle then penetrate this bi-layer and deposit initial cementum. TGF-β1 signalling from HERS is responsible for inducing cementoblast differentiation. Some authors have postulated a different origin of cementoblasts where HERS cells themselves undergo epithelial-ectomesenchymal transformation and directly differentiate into cementoblasts. TGF-β1 and FGF2 have been proposed as factors stimulating this epithelial-ectomesenchymal transformation of HERS cells through a MAPK/ERK-dependent signalling pathway. Further support for this theory is that HERS has shown expression of cementoblast markers. However, this remains a controversial issue with recent evidence confirming the mesenchymal origin of cementoblasts.

Current research suggests that there may be other systems and factors influencing root formation. Loss of the parathyroid hormone-related protein receptor (PTHrP-PPR) signalling in dental mesenchymal cells has been shown to alter the morphology of the roots and dysregulate cementum formation. Deletion of Sirtuin-6 (Sirt6) in mice exhibited stunted development of tooth roots as well a delay in tooth eruption.

HYPOTHESIS REGARDING INDEPENDENT TOOTH ROOT FORMATION

In 1989, Thomas and Kollar demonstrated that HERS could induce odontoblast differentiation from the dental papilla. It is however important to note that this could take place only in papillae in which a certain degree of commitment already existed. Therefore, the dental papilla must have been exposed to signalling factors from HERS in order to be able to differentiate into odontoblasts. Based on this, had the apical aspect of HERS and the associated ectomesenchymal cells of the dental papilla and follicle been left intact in the case illustrated in this paper, that could account for the continued development of the tooth root.

The role of pre-programmed cells, as seen in stem cell studies, supports this hypothesis. Many investigators have used stem cells from dental tissues in the attempt to reconstruct a tooth that has normal physiological function. A 2006 study on miniature pigs used stem cells from the root apical papilla (SCAP) and periodontal ligament (PDLSCs) to construct a functional tooth root to which an artificial dental crown was fixed. The constructed root was successfully formed and functional, although the compressive strength of the bio-root was less than that of natural swine root dentin. SCAP can easily be isolated from the apical aspect of wisdom teeth in humans and show a greater tissue regeneration potential than do dental pulp stem cells (DPSCs). In the case presented, it is proposed that pre-programmed cells, SCAP and HERS, remained behind after the surgical procedure and retained the potential for continued root formation. The presence of a distinct periodontal ligament on the peri-apical radiograph
surrounding the root (Figure 1) indicates that dental follicle cells must also have been present in order for this structure to develop.

Regenerative endodontic therapy for the treatment of immature non-vital teeth has similarly illustrated the functional advantages of viable HERS and SCAP in promoting further root formation and thickening of root dentin walls.26 In a recent study by Nazzal and Duggal on regenerative endodontics, the authors stress that although root development does occur, there is variability in the degree of success of these techniques. They continue by stating that preservation of structures like HERS will have a significant impact on the success of these treatments.23 The cascade of signalling events associated with the apical aspect of the developing tooth have not been completely elucidated.24 However, based on the available experimental data, we can hypothesize that a tooth root can continue to develop in the presence or absence of mineralized dental tissue. The presence of HERS with associated ectomesenchymal cells of the pulp and follicle remains crucial in order to maintain the epithelial-ectomesenchymal signalling cascade.

**CLINICAL IMPLICATIONS**

The dental identification of mutilated, decomposed and burned bodies relies on the comparison of ante-mortem and post-mortem dental records. An analysis of concordant features present may serve to either confirm or reject the identification of the mortal remains. This comparison involves all structures present in the dento-facial complex and can include: dental restorations, implant structures, tooth anatomy, sinus anatomy, dental anomalies, pathological lesions and any other recognisable features. The comparison of concordant features can be made with the aid of dental models, radiographs, constructed odontograms and hand written notes. Explicable discrepancies, as seen when radiographic angulations differ, are regularly observed and understood. However, the presence of a residual root, after the “complete” extraction of a particular tooth is more problematic. An undocumented residual root would constitute an inexplicable discrepancy and lead to a dental mis-match. The residual root in this case could only have been the result of continued root formation after the extraction of the tooth, which was at Demirjian’s stage “F” root at the time of surgery. A thorough search of the literature was done and to the best of our knowledge, this is the first documented case of a residual root developing from residual tooth structures or cellular remains left behind during surgery. Forensic odontologists should be alerted to the fact that ante-mortem and post-mortem discrepancies of this nature are possible and explicable.

The discovery of a residual root after the removal of wisdom teeth by a maxillo-facial surgeon under general anaesthetic could most certainly lead to litigation by the unhappy patient if he/she is not informed of the possible complications. The findings of this paper will assist the defendant in cases of this nature, especially where due caution had been applied. The dental practitioner should carefully consider the forensic implications following routine extractions, elective extractions for orthodontic purposes and the surgical removal of impacted teeth. The importance of post-operative imaging to confirm complete extraction should be considered.

**CONCLUSION**

The evidence provided in the forensic case and consideration of the developmental biology, support the hypotheses that root formation could conceivably occur as long as pre-programmed cells for root formation are present, regardless of the presence or absence of mineralized dental tissues.

**ACKNOWLEDGEMENTS**

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**References**


INTRODUCTION
On a regular basis, dental practitioners have to make decisions regarding their care of their patients. Previously, dentists did this almost instinctively, drawing upon personal resources such as clinical experience, training, colleagues’ opinions, social media and past successes…and failures. Today it is expected that good clinical practice be based on the best and most currently available evidence, obtained by critical appraisal of scientific research and literature, books, journals, internet publications, and participation at continuous education programmes. This has led to an explosion in research, not all of which is scientifically sound or ethically acceptable. Evidence based dentistry (EBD) evolved as a means of evaluating the science and rigour of research (the focus of the next chapter in this series), while numerous codes of conduct have been developed to try to ensure ethical standards. Clinical research aims to “develop generalizable knowledge that will improve health, advance treatment modalities, and / or increase understanding of human biology”. To achieve these goals the investigations often rely on study participants, who may be put at risk of harm. If fifty people were asked what makes clinical research ethical, there would probably be as many different answers. The most common response is usually the essentiality of informed consent, yet Emmanuel et al. argue that this agreement alone is not sufficient. They proposed that seven requirements need to be met to ensure ethical integrity. These are: Value, (enhancement of health or knowledge); Scientific validity; Fair subject selection; Favourable risk: benefit ratio; Independent review; Informed consent; and Respect for enrolled subjects.

HISTORICAL EXAMPLES OF UNETHICAL RESEARCH IN DENTISTRY
Gustaffson et al. conducted a cariology study that spanned over more than ten years, from 1945-1953. Their aim was to determine the relationship between diet, frequency of sugar intake and dental caries. Different groups of mentally-deficient children were fed sweets, carbohydrates, chocolates and toffees in varying amounts, for a five year period. Some benefitted from the inclusion of vitamin and mineral supplements, while others did not. Results showed a definite correlation between the type of sugar, the frequency of consumption, the amount and time of day when it was ingested and the prevalence of dental caries. Whilst the results are instructive, the use of a defenceless and uninformed sample of children exceeds the bounds of ethical practice.

In the 1940s, state officials in Massachusetts implemented fluoridation studies surreptitiously at two schools for mentally retarded children. Minors were give radioactive fluoride isotopes without their assent or consent of their parents. Although it is now widely accepted that fluoride plays a beneficial role in preventing caries, this was unknown at the time of the investigation. Not only were vulnerable children, who lacked the capacity to understand or object, unwittingly exposed to fluoride, but parents were not consulted or asked for permission to allow the participation of their child. In addition, the researchers carried out the intervention without knowing or considering the possible systemic side effects. It is concerning, that eighty years later Colgate conducted several studies to investigate the efficacy of their recently launched Sugar-acid neutraliser toothpaste. Two of these were carried out on Chinese scholars and spanned a six month period. The children were divided into three groups. The first group received fluoride and arginine toothpaste, the second received a fluoridated toothpaste and a placebo group received toothpaste with neither fluoride nor arginine. This resulted in 298 participants being deprived of effective fluoride toothpaste which is considered the gold standard in oral hygiene. A key principle in ethics in research is that it should never include a placebo group when there is an effective product available. The company encountered international obloquy for what was considered to be an unethical study.

Friedman reported on the millions of third molar teeth that have been “prophylactically extracted” in order
to prevent possible later complications. This has led to numerous patients being subject to unnecessary surgical procedures, with associated pain, discomfort, swelling, bleeding, bruising and even worse, temporary or permanent paraesthesia of the tongue, lip or cheeks as a consequence of nerve injury.\textsuperscript{7} This practice of wisdom tooth removal was based on specious and unsound studies, which were thus automatically also unethical.\textsuperscript{8}

The American Dental Association (ADA) has strongly condemned the many studies in which patients had sound amalgam restorations removed and replaced with other plastic fillings in order to ‘remove their bodies of toxic mercury’. The ADA comment that when such treatment is performed solely at the recommendation of the dentist, it is improper and unethical.\textsuperscript{9} Some of these papers reported on studies which subjected patients to additional blood tests before and after removal of the amalgam. The authors then attempted to justify findings that did not support their contentions by stating that “During initial exposure to mercury (i.e. on amalgam placement) the body hosts an immune response to try deal with the initial exposure to mercury (i.e. on amalgam placement) the body hosts an immune response to try deal with the toxicity and many test values will be high. However after prolonged exposure the systemic challenge decreases and so some tests show a decline. During this time the patient will experience chronic conditions which could even include DNA damage and cancer.”

These examples raise the question of whether it is ethically sound to make use of data that was obtained in an unethical manner.

**OPINIONS**

A number of dental colleagues from all sectors, with widely differing experiences were asked the following question: “Do you think it is ethically acceptable to re-use data or information gained from unethically conducted studies?”

1. My gut tells me No. But I guess if the information is already out there and I use it but disclose in my publication that it was unethically obtained, that will be OK.
2. Yes, the harm has already been done, we can’t change that, so why waste the material if it can help others for the future?
3. No, it will make others think it’s Ok to do unethical research if the results end up being useful to lots of people.
4. No, I don’t want readers to think I agree with this type of study. It may also give others ideas and they may try to copy and do similar unethical investigations and also get away with it.
5. No. That’s a tough one. Then you could get a “friend” to do your unethical research and you later come and use the data.
6. No. If the information was obtained unethically then it can’t be used. But a lot of knowledge we use today is based on previous unethical studies, so perhaps God in his wisdom allowed these to happen before we became more ethically conscious.
7. Yes. It may not have been ethical, but the results are still valid. I know certain countries do lots of unethical studies, but this gives us a wealth of information.
8. Yes. How ethical is it to take a dog and put it down just to see how an implant will behave in the mouth, yet this is the norm?
9. Yes. So wear a denture or nothing if you want to be ethical and don’t come asking for restorations or implants if you lose your teeth.
10. No, because it was unethical in the first place, so, how can you be ethical to use it yourself? It’s like accepting stolen goods, as long as you didn’t steal them.
11. Yes. There were a lot of old unethical studies but they were all good for science. But sadly not good for ethics, but we learnt a lot from them regardless.
12. Of course not. No. It is unacceptable.
13. Isn’t that what the Nazis did – it may not be ethical but it is still valid data.
14. I will definitely use the data because it is still valuable information if it was scientifically done. Despite being unethical.
15. No. Most definitely no. If you know it was unethical there is no way you must use it. If you are unaware of this then it is alright.
16. Yes. Is it ethical to waste information that has already been gained at such a high cost?

**DISCUSSION**

Not only do ethical issues generate widely diverse opinions between respondents, but many battled to even formulate a definite personal stance. This informal survey amongst a random sample of dental colleagues revealed the ambiguities and uncertainties associated with medical ethics as was evidenced by the many “Yes buts, maybes, only ifs,” with very few definitive “Aye or Nay” responses. The Declaration of Helsinki\textsuperscript{11} clearly requires that any research not conducted according to its provisions should not be published.\textsuperscript{12} However, this creates the impression that the issue is “black-and-white”, when quite clearly it has emerged that there are various shades of grey in between. If you attempt to resolve this uncertainty by evaluating the research in terms of the requirements set out in the Nuremburg Code for Ethical Clinical Research, it would clearly not be acceptable. The Code specifies that it is the investigator’s responsibility to gain voluntary informed consent from all study participants, the investigator must guarantee the scientific soundness of the study design, avoid inflicting any unnecessary harm or suffering, assess the risks versus the benefits, make provision for ongoing health care after completion of the study, and ensure that subjects are aware of their rights, and have the means to withdraw from the study at any time.\textsuperscript{13} It could be argued that this policy was established as a blueprint to guide future research, and the debate is over re-use of data that has already been collected. As such the “new” researchers have no control (or liability?) over any of the above stipulations.

Perhaps publishers also need to assume some of the responsibilities in the endeavour to prevent unethical research by having stricter submission requirements. Instead of merely refusing to publish contentious clinical studies, the editors could insist that papers contain a section on ethical methodology that is as detailed as is the scientific description. In this the researchers would be required to “display evidence that they had given explicit and careful consideration to all ethical issues. This would give the journal more standing than their refusal to publish, and would help build up a body of expertise in dealing with ethically complex research settings”.\textsuperscript{12} The editors
would still reserve the final right to refuse publication of any research deemed to be unethical. Here again they may need to make value judgements based on the “reasonable man” rule, and the principles of beneficence, non-maleficence, autonomy and justice.14

CONCLUSION

There is no correct answer to this debate, although it seems that many people are of the opinion that the data should not be wasted no matter how grievously it was obtained. One recommendation may be to first establish whether the investigation was scientifically sound and that the data produced is valid. Thereafter it may be used but with a strongly worded covering statement to the effect that: “The researchers acknowledge that the original study is unacceptable by currently-held ethical standards. They do not condone this investigation but after interrogation of the results found the data to be of high quality, reliable and valid. As such, the merits and strong points of the paper were re-used and quoted in the follow up research”. To paraphrase the common idiom, do not discard something of potential value in your fervour to be rid of something useless or deplorable associated with it... the “baby and the bath water” conundrum.

References
Maxillo-facial radiology case 156

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CJ Nortjé

A 69-year old female, referred by her general practitioner, presented with the complaint of a burning sensation in her oral cavity. The upper jaw was edentulous. The patient herself and the oral mucosa appeared healthy and there was no obvious cause for the burning sensation. A routine pantomograph revealed marginal resorption of the alveolar crests, suggestive of an underlying periodontitis. Two years later she presented with a non-healing socket after a mobile 34 had been extracted three months previously. Figure 1 is a cropped pantomograph at the stage when she originally presented and Figure 2 was recorded when she presented for the second time. What are the important radiological features and what is your provisional diagnosis?

INTERPRETATION
The cropped pantomograph (Fig.1) shows marginal resorption of the alveolar crests while Figure 2 shows a nonspecific area of rarefaction in the canine-premolar region (red arrow) without evidence of sclerosis at the margins of the lesion. Figures 3&4 are radiographs of the resected specimen showing the changes more clearly. Permeative changes, lack of marginal sclerosis (yellow arrow) and absence of periosteal reaction indicate a malignant process but do not confirm a specific disease. The “geographic area” results from total destruction of the buccal half of the mandible (blue arrow). A histological examination confirmed the diagnosis of a primary intraosseous carcinoma.

Figures 5, 6&7 are from a similar case in a 70 year old edentulous female patient, the diagnosis in her instance being a clear cell odontogenic carcinoma. Figure 5 shows radioluencies of varying size with an irregular outline, Figure 6 shows destruction of the buccal part of the mandible while Figure 7 shows a moth-eaten appearance and lack of marginal sclerosis. Figure 8 is a CT scan of another case showing a very destructive lesion involving the body and ramius of the right mandible. Bony flecks are discernible within the lesion.

Most carcinomas found inside the jaws have originated from the squamous epithelium covering the alveolar ridge, the gingiva or the floor of the mouth. Primary intraosseous carcinoma of the jaw is a very rare tumour. It is classified by the WHO as an odontogenic carcinoma which is a squamous cell carcinoma arising within the jaw, having no initial contact with the oral mucosa and presumably developing from residues of the odontogenic epithelium. The tumour occurs mainly in adults in the sixth to seventh decades, male-to-female ratio is 3:1, and the growth is usually situated in the posterior mandible. The lesion may be asymptomatic or painful and may mimic localized periodontal disease. Of practical importance is that mobility of the teeth or non-healing of an extraction socket could well be the first clinical signs of odontogenic carcinoma. Paraesthesia and “floating” teeth may be evident and some teeth may have exfoliated spontaneously. One of the earliest and most characteristic signs of malignancy is the lack of a well-defined border with, or most frequently without, marginal sclerosis.

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


The presence or absence of the interproximal papilla is of great concern to periodontists, restorative dentists, and to the patients. The loss of papilla can lead to cosmetic deformities (so-called “black triangle disease”), phonetic problems (space allows passage for the air or saliva), and lateral food impaction. Open gingival embrasures, also called “black triangles,” are often the result of attachment loss in the interproximal area, or may be due to surgical trauma, and are rather common at implant-supported crowns. Micro-surgical techniques have improved the aesthetic outcomes of periodontal/mucogingival interventions. However, the reconstruction of a missing papilla to close an open gingival embrasure remains among the most challenging and unpredictable surgical scenarios, due to anatomical and access restrictions. Thus, other treatment options are often proposed to close an open gingival embrasure, for example, orthodontics or restorative; however, these are rather time-consuming and/or costly procedures. Promising results were described in terms of deficient papilla augmentation in recent reports including a few patient cases, with hyaluronan (HY) application as injectable filler for reconstruction of interproximal papillae at implant-supported crowns and between teeth.

HY is an important component of the extracellular matrix and is responsible for tissue resilience and volume due to its high hygroscopicity. Products containing HY are widely used in cosmetic medicine as facial fillers, for example, to reduce wrinkles or restore lost skin volume that often occurs with age due to – among other reasons – a decrease in the HY content of the skin. In dentistry, HY is used primarily due to its bacteriostatic, fungistatic, anti-inflammatory, anti-edematous, osteoinductive and pro-angiogenetic properties. In this context, a minimally invasive, simple, relatively inexpensive non-surgical technique for reconstruction of interdental papillae by HY injection appears as an attractive treatment approach. Bertl and colleagues (2017) reported on a randomized controlled clinical trial, with six months follow-up, that sought to assess the effect of local HY injections to augment deficient interproximal papillae at implant-supported crowns in the anterior maxilla.

MATERIALS AND METHODS
The dental records of implant patients were screened for eligibility based on the following inclusion criteria: (i) ≥ 18 years of age, (ii) implant restoration finalized > six months ago and (iii) at least one deficient papilla in the anterior maxilla (first premolar to first premolar) between a natural tooth and an implant-supported crown. The following clinical exclusion criteria were applied: (i) no contact point, (ii) inadequate plaque control (i.e., full-mouth plaque score > 20%), (iii) probing depth (PD) > 5 mm, or buccal gingival recession (GR) > 3 mm, or < 2 mm keratinized tissue (KT) at the adjacent tooth/implant and (iv) systemic disorders (e.g., uncontrolled diabetes, malignancy) or regular intake of medications (e.g., steroids), affecting connective tissue metabolism. Oral and written informed consent was obtained from all participants prior to any intervention.

The test substance consisted of a commercially available HY product (Hyadent Barrier Gel); one ml of the gel contains 16 mg cross-linked Na-hyaluronate and 2 mg Na-hyaluronate. The control substance (placebo) consisted of physiological saline solution.

Patients who were included were allocated to either the test or control group according to a pre-defined randomization list and if the patient had two deficient papillae, either at the other site of the same implant-supported crown or at different implant-supported crowns in the anterior maxilla, both were allocated to the same treatment group (i.e., test or control); however, only one was chosen to be included in the analysis, by coin toss at baseline. Test and control substances were contained in identical and masked syringes to assure that patients were blinded to the treatment. However, due to the different consistency...
of the test and control substance (i.e., gel vs. fluid, respectively), the operator giving the injections could not be considered as blinded.

After administration of a local anesthesia gel, the injection of the test or control substance was performed using a pressure syringe for standardized dose delivery (0.06 ml per “click”) with a 30-gauge needle and a three-step technique was applied as per the manufacturer’s recommendation: (i) creation of a reservoir in the mucosa immediately above the mucogingival junction (total amount - 0.18 ml), (ii) injection into the attached gingiva/mucosa just below the base of the deficient papilla (total amount - 0.12 ml), and (iii) injection 2–3 mm apically to the tip of the deficient papilla (total amount - 0.06 ml). The whole injection session was repeated once four weeks later.

Any discomfort during and within the first week after injection was recorded using a visual analogue scale (VAS) ranging from 0 (no pain) to 100 (worst pain).

Evaluation appointments were made before injection (baseline) and three and six months after the second injection. All parameters were assessed by a single blinded examiner, who was unaware of treatment group allocation, and the clinical measurements were recorded with a periodontal probe and rounded to the nearest half mm.

The following parameters were assessed at baseline:
- Width of keratinized tissue (KT): distance (in mm) from the gingival margin to the mucogingival junction at the mid-facial aspect of the adjacent tooth/implant.
- Gingival phenotype: a periodontal probe was placed in the sulcus at the mid-facial aspect of the adjacent tooth/implant, and if the periodontal probe was visible through the gingiva, the gingival phenotype was judged as “thin,” or otherwise as “thick.”
- Tissue texture and colour: gingival/mucosal tissue texture and colour of interproximal tissue (i.e., of the papilla) until the mid-facial aspect of the adjacent tooth/implant, and if the periodontal probe was visible through the gingiva, the gingival phenotype was judged as “thin,” or otherwise as “thick.”
- Texture and colour of interproximal tissue (i.e., of the papilla) until the mid-facial aspect of the adjacent tooth/implant, and if the periodontal probe was visible through the gingiva, the gingival phenotype was judged as “thin,” or otherwise as “thick.”
- Modified papilla index score (MPIS) Score 0 – no papilla is present; score 1 – less than half of the height of the papilla is present; score 2 – half or more of the height of the papilla is present, but not all the way to the contact point of the teeth; score 3 – the papilla fills up the entire proximal space; score 4 – the papilla is hyperplastic and excess tissue is present.
- PT-CP: distance (in mm) between the papilla tip (PT) and the contact point (CP)
- PD and clinical attachment level (CAL) (in mm), bleeding on probing (BoP), and plaque (both in %): measurements were taken at the mesial and distal aspects of the deficient papilla, both from the buccal and palatal side (i.e. four sites).
- Area of the “black triangle” (in mm²)
- Esthetic appearance: the patient and the examiner evaluated the esthetic appearance of the region of the deficient papilla including that of the neighboring tooth and implant-supported crown by means of a VAS ranging from 0 to 100 (0 = no defect/best imaginable appearance, 100 = worst imaginable defect/appearance).

The following parameter was judged after three months:
- Mucosal volume gain apically to the deficient papilla

The following parameter was assessed at baseline and after six months:
- Radiographic alveolar bone level at the implant next to the injection site (mm): Sample size calculation

**RESULTS**

Twenty-two patients (11 per group) were allocated to either the test or control group. One patient of the control group had to be excluded shortly after the first injection, due to fracture and renewal of the adjacent implant-supported crown. Finally, 21 participants (12 female, 9 male; mean age 30 ± 6.4 years) received the allocated treatment and completed the follow-up period of six months. Thirteen papillae were between the central and lateral incisor, seven between the lateral incisor and the canine, and one between the canine and the first premolar; 14 implants were at position 12/22, four at position 13/23, and three at position 11.

Injection of test and control substance did not cause any noticeable increase in papilla volume immediately after injection. Also, injection of test and control substance caused similar level of discomfort values, at both time points (VAS: 50–60, on average). During the first week after injection, almost no discomfort was reported in the control group (mean VAS ≤ 5), while low-to-moderate discomfort remained in the test group (mean VAS < 30). The difference between test and control groups in discomfort during the first week post-injection was statistically significant (p < 0.05) regarding the first and borderline significant regarding the second injection.

In the test group (HY group), adverse effects most likely triggered by the injection were reported in three patients. Two patients experienced severe pain and swelling of the lip after the second injection. In another patient, a painless granuloma of approximately six mm in diameter was observed above the mucogingival junction after the first injection; it persisted for >four weeks, but it was not detectable at the three-month check-up. No adverse effects were observed in the control group.

All included deficient papillae presented with a MPIS of 2 and none of them changed after treatment, that is, all remained at score 2. No significant differences in any of the clinical periodontal parameters (i.e., PD, CAL, plaque) were observed between the groups at any time point or within the groups over time. BoP was significantly higher in the control group compared with the test group at baseline and presented a significant increase in the test group from baseline to three months. No differences in the “black triangle” area were observed between groups at any observation time or within groups over time. Some minimal reduction of the “black triangle” could be detected only in a very few cases in the test group. Any recorded volume changes in the area of the attached gingiva adjacent to the deficient papilla after three months were minimal, and there were no significant differences between the test and control group. Finally, alveolar bone height at the implant site adjacent to the injection site remained basically stable for the six-month study period;
No single case showed a > 0.5 mm difference between baseline and six months.

No significant differences in terms of aesthetic appearance between the test and control group at any time point or within the groups over time were observed by the patients or the examiner. A slight, but insignificant, improvement over time was reported by the patients in both groups. In general, the esthetic appearance of the deficient papilla was judged as acceptable by the patients and the examiner (VAS values on average <30) at all time points.

CONCLUSIONS
The researchers concluded that Injection of hyaluronan (HY) adjacent to maxillary anterior implant-supported crowns did not result in any clinically conspicuous volume augmentation of deficient papillae.

IMPLICATIONS FOR PRACTICE
The benefits of HY experienced in other clinical applications have not been observed for the management of deficient papillae.

Reference

2. Short (6-mm) dental implants versus sinus floor elevation and placement of longer (≥10-mm) dental implants: a randomized controlled trial with a three-year follow-up.


Endosseous dental implants have become a predictable treatment option for applicable patients. The success rate of dental implants is associated with bone quality and quantity. Most implant failures occur in the maxillary molar region with poor bone quality. Other factors that may cause failure and difficulty in implant placement in the posterior maxilla are limited visibility, reduced interarch space and sinus pneumatization due to post-extraction bone resorption.

Short implants (<10 mm) were introduced recently as a new approach to simplify implant placement in compromised alveolar bone and to prevent possible damage to vital structures. The edentulous posterior maxilla is often characterized by reduced bone volume, due to severe post-extraction alveolar crest resorption coupled with age-linked sinus pneumatization. This anatomic limitation is a problem that can affect osseointegration and the fabrication of a functional and esthetic implant-supported restoration, dictating the need for reconstructive osseous surgery in order to restore a sufficient bone for implant insertion. Different bone augmentation techniques have been introduced to overcome this problem. Among these, maxillary sinus floor elevation has become the more reliable, commonly used procedure to increase bone height in the posterior maxilla. Although maxillary sinus floor elevation can be successfully employed to regenerate bone and allow the placement of implants of standard length recent studies have pointed out that this surgical intervention increases treatment duration, cost and is prone to complications such as graft failure and/or postoperative sinusitis.

The placement of short (<10-mm) dental implants represents a viable, minimally invasive alternative treatment solution for the prosthetic restoration of the posterior maxilla with limited amount of bone. The use of short implants requires no sinus floor elevation, reduces the risk of complications, treatment time and costs. Bechara and colleagues (2017) reported on a three-year follow-up randomized clinical trial that sought to evaluate whether short (6-mm) dental implants placed in the posterior atrophic maxilla are a viable alternative to sinus floor elevation and placement of longer (≥10-mm) fixtures. The primary outcomes of the study were implant survival, stability, marginal bone loss, and complications associated with the two treatment options; secondary outcomes included treatment time and cost and patient satisfaction.

MATERIALS AND METHODS
The inclusion criteria for this trial were as follows:
1. (partial edentulism in the posterior atrophic maxilla;
2. post-extraction or healed sites (at least four months after extraction) with residual bone height ≥4 mm and width ≥5 mm under the maxillary sinus;
3. one to four adjacent implants required;
4. dentition in the posterior mandible for occlusal contacts;
5. age ≥18; and
6. ability to sign an informed consent form. Patient eligibility in terms of bone dimensions was determined on orthopantomography (OPT) and cone beam computed tomography (CBCT) scans.

ACRONYMS

| CBCT | cone beam computed tomography |
| FPDs | fixed partial dentures |
| ISQ | Implant stability Quotient |
| MBL | mean marginal bone loss |
| OPT | orthopantomography |
| RFA | resonance frequency analysis |
| SCs | single crowns |
In this prospective, randomized, controlled study, patients were randomly assigned either to receive one to four short (6-mm) implants (test group) or to undergo augmentation procedures and simultaneous placement of one to four standard-length (≥10-mm) implants (control group). Within the same group, patients could undergo bilateral treatment (i.e., short implants in the right and left posterior maxilla or bilateral maxillary sinus augmentation and placement of standard-length implants). Randomization was performed prior to surgery by opening a sequentially numbered sealed envelope corresponding to the patient recruitment number. In both groups of patients, dental implants featuring a tapered design with strong self-cutting threads (AnyRidge Implants) were used. These implants have an internal hexagon combined with a 5-mm-deep conical connection (10°), providing a tight seal and high mechanical strength, with built-in platform switching designed to maintain crestal bone and to increase soft tissue volume. The implants feature a novel nanostructured calcium-incorporated surface. In the control group, the augmentation procedures consisted of the insertion of collagenated porcine particulate bone graft (OsteoBiol GenOs) in a lateral window below the lifted membrane, with simultaneous implant placement. The test group (short implants) included both fresh post-extraction sockets and healed sites (defined as sites with at least four months of undisturbed healing after tooth extraction). In fresh post-extraction sockets, a flapless approach was used. The failing teeth were extracted asatraumatically as possible. In healed sites, a midcrestal incision was made, connected to two releasing incisions, and then a full-thickness flap was raised. In both fresh post-extraction sockets and healed sites, the surgeon placed short (6-mm) implants, being free to choose from the available implant diameters (4–8 mm) according to clinical indications and his preferences. All fixtures were placed at the bone crest level.

In the control group (standard-length implants in augmented sites), the maxillary sinuses were augmented using the lateral approach. After crestal incision and flap elevation, a lateral window was outlined and moved internally. After careful elevation of the Schneiderian membrane, the sinus cavity was partially filled with a collagenated porcine particulate bone graft; then, one to four 10-, 11.5-, 13-, or 15-mm fixtures were then surgically inserted. The operator was free to choose appropriate implant diameters (4–8 mm) on the basis of clinical indications and his preferences. Finally, the sinus cavity was completely packed and overfilled with bone graft particles, and the lateral window was covered with a pericardium porcine resorbable collagen membrane (Osteobiol Evolution).

In both groups, all implants were placed using a manual ratchet and then exposed to evaluate primary stability with a resonance frequency analysis (RFA) instrument. Implant stability quotient values were measured from the four sites (mesial, distal, buccal, and lingual sites) for each implant. An average value was calculated from the four measurements, rounded to a whole number, and regarded as the final Implant Stability Quotient (ISQ) value of the implant. A submerged healing protocol was selected for implants with an ISQ <60, whereas a non-submerged healing protocol (with placement of healing abutments) was selected in implants with an ISQ ≥60. The mucoperiosteal flaps were repositioned and sutured over the cover screws (submerged healing) or around the healing abutments (non-submerged healing) using resorbable sutures.

After surgical procedures, all patients were prescribed oral antibiotics, 500 mg amoxicillin plus clavulanic acid (Augmentin), every 8 h (three times per day) for six days. Postoperative pain was controlled with 600 mg ibuprofen every 12 h for two days. Detailed instructions on oral hygiene were provided; chlorhexidine 0.2% mouth rinse (OralB) twice a day and a soft diet were recommended for two weeks. Patients were recalled and checked three days, 10 days (suture removal), and one month postoperatively; they were not allowed to wear removable dentures up to one month postoperatively.

All implants were left unloaded to allow osseointegration over a period of four months; then, where necessary, the implants were uncovered and the cover screws were replaced with healing abutments. Impressions were taken, and provisional acrylic resin restorations, consisting of cemented or screw-retained single crowns (SCs) and fixed partial dentures (FPDs), were provided. The provisional remained in situ for four months, after which definitive restorations were provided. The definitive restorations comprised single crowns (SCs) and fixed partial dentures (FPDs). All definitive restorations were ceramometallic, screwed or cemented with temporary zinc oxide–eugenol cement. An accurate control of occlusion was performed, and protrusion and laterotrusion were evaluated on the articulator and intra-orally. Maintenance care was given every six months. All patients were included in an annual recall program.

At each annual inspection, an experienced, calibrated, independent examiner performed a careful clinical examination of the fixtures, peri-implant tissues, and prostheses. The primary outcome measures were implant survival, stability, marginal bone loss, and complications. All implant losses were considered as failures. Implant mobility in the absence of signs of infection, persistent/recurrent infections (with pain, suppuration, bone loss), progressive marginal bone loss caused by mechanical overload, and implant fracture were indications for implant failure. Implant losses were divided into “early” (before the connection of the prosthetic abutment) and “late” (after the connection of the prosthetic abutment) failures.
Resonance frequency analysis was employed to measure implant stability with a dedicated instrument. For each implant, ISQ values were measured from the four sites (mesial, distal, buccal, and palatal sites). The mean of all measurements was rounded to a whole number and regarded as the final ISQ of the implant. Afterward, the abutments were repositioned and installed on the implants, so that the prostheses could be re-inserted. ISQ values were obtained after implant insertion, at the delivery of the final restoration, and at the 1- and 3-year follow-up examinations.

Orthopantomographies were taken of each patient at baseline (immediately after implant insertion), delivery of the final restoration, and one and three years after implant placement. Radiographs were digitized, and saved in a dedicated folder. Peri-implant marginal bone levels were then measured using dedicated software. Marginal bone levels were measured on the mesial and distal sides of each implant and were compared at baseline, one and three year follow-ups.

Complications were biological and/or prosthetic. Biological complications included intraoperative complications (intraoperative bleeding), immediate postoperative complications (pain and swelling after surgery, acute sinus infection), late postoperative complications (chronic sinus infection, partial or complete graft failure), and problems in the function caused by an infectious process affecting the peri-implant tissues (peri-implant mucositis or peri-implantitis). The threshold to define peri-implantitis was set at a probing pocket depth ≥6 mm with bleeding on probing/suppuration and peri-implant bone loss >3.0 mm. Prosthetic complications included failures or complications of prefabricated implant components (abutment loosening and abutment fracture) and superstructure-related failures (such as fracture of the metallic framework of the restoration, decementation/loss of retention, and ceramic fracture/chipping).

The evaluation of complications included identification of any complications that had affected the restorations over the three-year follow-up period. The secondary outcomes were treatment time and cost and patient satisfaction.

Patient satisfaction with both treatments (short implants and sinus floor elevation with placement of longer implants) was assessed. All patients were asked to give their perception of the received therapy by completing a questionnaire that dealt with function, esthetics, cleaning of the implant-supported restorations, satisfaction, and cost.

RESULTS
Fifty-three patients (19 males and 34 females) aged between 21 and 76 years (mean age: 48.1 ± 15.1 years, median: 48, 95% CI: 44.0–52.1) were included in this study. Among these, 15 (28.3%) were smokers. According to the study design, the patients were randomly divided into two groups: 33 patients (10 males and 23 females) aged between 21 and 76 years (mean age: 47.5 ± 16.2 years, median: 48, 95% CI: 42.0–53.0) were assigned to the test group (short implants without sinus floor elevation), and 20 patients (9 males, 11 females) aged between 28 and 75 years (mean age: 49.2 ± 13.4, median: 47.5, 95% CI: 43.0–55.0) were assigned to the control group (sinus floor elevation with standard-length implants). Baseline demographics (gender, age, smoking habits, history of periodontal disease) did not reveal significant differences between the two groups. Twenty-one of the 53 enrolled patients had multiple indications for implant treatment (13 patients received two implants, two patients received three implants, four patients received four implants, and two received five implants), so a total of 90 implants were installed. Forty-five implants were finally inserted in each group of patients.

In the test group, 33 patients received 45 implants whilst in the control group, 20 patients received 45 implants. In the test group, 36 implants were inserted in healed sites (at least four months after teeth extraction) of 25 patients, whereas nine implants were inserted in the extraction sockets (immediate implant placement) of eight patients. Among the test implants placed in healed sites, 24 (15 patients) were placed in ridges with a residual height of four mm, whereas 12 (10 patients) were placed in healed ridges with a residual height of five to six mm; among the control implants, 25 (10 patients) were placed in healed ridges with a residual height of four mm, whereas 20 (10 patients) were placed in healed ridges with a residual height of five to six mm. In the test group, the most frequent indication was the restoration of single tooth gaps (24 implants were placed to support SCs); the least frequent indication was the restoration of partially edentulous patients with FPDs (21 implants were placed to support 11 FPDs). Conversely, in the control group, 21 implants were placed to support SCs, and 24 implants were inserted to restore partially edentulous patients (12 FPDs). There was a significant difference in the distribution of the implants between the two groups with respect to implant diameter (implant diameter was narrower in the control group than in the test group, P < 0.0001); there were no significant differences in the distribution of implants between the two groups with respect to implant position and type of supported restoration.

Over the three year period after surgery, only two implant failures occurred, both in the same patient (control group). These failures occurred two months after surgery (before connection of the prosthetic abutment) and were classified as “early failures”: they were caused by chronic sinus infection with loss of integration/implant stability.

No further implant failures were observed in the control group after the delivery of prosthetic restorations. No implant failures occurred in the test group. Overall, one-year survival rates of 97.8% (implant-based) and 98.2% (patient-based) were found. In the test group, the implant survival rate was 100% at the implant (45/45) and patient (33/33) levels; in the control group, the survival rates were 95.6% (43/45) at the implant level and 95.0% (19/20) at the patient level. There were no significant differences in the one-year implant survival rate between the groups at both the implant level (P = 0.49) and patient level (P = 0.38). One 76-year-old male patient in the test group (one implant) died two and a half years after implant placement and was consequently lost to follow-up: this patient was considered a dropout and was excluded from the study. No other patients dropped out of this study, so 52 patients were available for the three-year follow-up examination. Overall, three year survival rates of 97.8% (implant-based) and 98.1% (patient-based) were reported. The test group had a 100% implant survival rate at both the implant level
(44/44) and patient level (32/32); the control group had a 95.6% survival rate (43/45) at the implant level and a 95.0% survival rate (19/20) at the patient level. There were no significant differences between the two groups at the three-year follow-up at both the implant level ($P = 0.49$) and patient level ($P = 0.38$).

The mean ISQ values of the test and control groups did not differ at placement (test 68.2 vs. control 67.8, $P = 0.1$), at delivery of the final restoration (test 69.5 vs. control 69.4, $P = 0.9$), and after one year (test 71.0 vs. control 71.5, $P = 0.1$); however, at three years, the control group had a significantly higher mean ISQ than the test group (72.4 vs. 71.6, $P = 0.004$).

Overall, a mean marginal bone loss (MBL) values of $0.18 \pm 0.09$ mm (median: 0.15, range: 0–0.41) and $0.24 \pm 0.11$ mm (median: 0.23, range: 0–0.5) were found at the one and three-year follow-up evaluations, respectively. Minimal bone changes around implants were observed with time; however, this difference was significant ($P < 0.0001$). Mean MBL was significantly higher in the control group than in the test group, both at one year (0.14 mm vs. 0.21 mm, $P = 0.006$) and at three years (0.20 mm vs. 0.27 mm, $P = 0.01$). With respect to the short implant subtypes, the MBL of implants placed in the post-extraction socket was significantly lower than that of control implants, both at one year ($P = 0.03$) and at three years ($P = 0.02$). MBL of implants placed in healed ridges with 3–4 mm of residual bone was significantly lower than that of control implants, both at one year ($P = 0.003$) and at three years ($P = 0.005$); however, in the five- to six-mm subtype, mean MBL did not differ from the values for the control group at one year ($P = 0.5$) and three years ($P = 0.6$). Finally, with respect to the short implants, there were no statistically significant differences in MBL between the different subtypes at one year ($P = 0.2$) and three years ($P = 0.12$).

No complications were reported for the test group. In the control group, 19 biological complications occurred: three were intraoperative (intraoperative bleeding) and 16 were immediately postoperative (one patient experienced pain and swelling after surgery, and 14 patients experienced swelling alone); finally, one patient experienced a late postoperative complication (chronic sinus infection with complete graft loss) which led to the loss of two implants. Significant differences were reported between the two groups with respect to intraoperative bleeding ($P = 0.049$) and swelling after surgery ($P < 0.0001$). Peri-implant mucositis or peri-implantitis was not reported. All implant-supported restorations were free from prosthetic complications; no mechanical or technical complications were reported over the three-year period.

In the test group (short implants), the mean time needed for placement of one single implant was 19.1 ± 7.1 min (median: 15, 25th–75th percentile: 15–20 min), whereas in the control group (sinus floor elevation with longer implants), the mean time needed was 32.2 ± 8.5 min (median: 30; 25th–75th percentile: 25–35 min). The sinus floor elevation procedure almost doubled the time needed for the intervention. The difference between the two groups was statistically significant ($P < 0.0001$).

The cost of both treatment modalities was calculated for one single implant limited to the surgery (without prosthetic treatment). The cost for the placement of one single implant in the short implant group was 700 euros (EUR), whereas in the longer implant group, the mean cost was 1322 ± 490 EUR. The sinus floor elevation procedure almost doubled the price for the intervention. The difference between the two groups was statistically significant ($P < 0.0001$).

There were no significant differences between the two groups with respect to satisfaction with function ($P = 0.7$), aesthetic outcome ($P = 0.5$), cleaning the implant-supported restorations ($P = 0.6$) and overall satisfaction with the treatment ($P = 0.7$). Perception of the cost of the therapy significantly favoured the test group ($P = 0.03$).

**CONCLUSIONS**

In the present randomized clinical trial, both short (6-mm) dental implants and longer (≥10-mm) dental implants in combination with sinus floor elevation provided good results up to three years after loading; however, with 6-mm short implants, the treatment was faster and less expensive. Further, long-term randomized controlled trials on larger samples of patients are needed to confirm these results.

**IMPLICATIONS FOR PRACTICE**

The results of this trial suggest a significant benefit for patients having the short implants in terms of length of treatment and cost. Patient satisfaction and implant survival was high with both groups.

**Reference**

CPD Questionnaire

This edition is accredited for a total of 3 CEUs: 1 ethical plus 2 general CEUs

GENERAL

A pilot study investigating the presence of voids in bulk fill flowable composites (p 462)

1. Identify the INCORRECT statement:
   3-D high resolution micro computed tomography (3D Micro -CT) has been shown to be:
   a. A useful tool for assessing marginal adaptation
   b. Non destructive
   c. Accurate
   d. An inappropriate technology for assessing the presence of voids
   e. A useful tool for assessing volumetric changes

2. Identify the INCORRECT statement:
   Voids present in the material as produced by the manufacturer have been shown to:
   a. reduce load-bearing capacity in the oral environment.
   b. reduce the compressive strength of single paste composites
   c. enhance the compressive fatigue limit.
   d. result in internal stress around the voids

3. Restoring the cavity using 2mm incremental layering condensation of the material poses a risk of including voids in the restoration.
   a. True
   b. False

4. It has been shown that filling the syringes of bulk fill flowable composites under vacuum does not reduce the incidence of voids in the material.
   a. True
   b. False

Fragmentary tooth root development: biological and forensic dental implications. (p 466)

5. According to the ante-mortem panoramic radiograph the root formation of tooth 38 was in which stage according to Demirjian’s classification
   a. Stage B
   b. Stage C
   c. Stage D
   d. Stage E
   e. Stage F

6. Hertwig’s epithelial root sheath (HERS) forms a structural boundary between:
   a. the dental papilla and the dental follicle
   b. the dental papilla and the enamel organ
   c. the enamel organ and the dental papilla
   d. the enamel organ and the dental follicle

7. If the continuity of Hertwig’s epithelial root sheath (HERS) is disrupted prematurely, the following cells fail to differentiate:
   a. Ameloblasts
   b. Odontoblasts
   c. Osteoblasts
   d. Osteoclasts

8. Hertwig’s epithelial root sheath (HERS) is not essential in initiating root formation and determining the number of roots.
   a. True
   b. False

9. In the 2006 study on miniature pigs the authors were unable to reconstruct a functional tooth root.
   a. True.
   b. False

Accuracy of acetate overlays in bite mark comparison: How accurate is an ideal bite pattern? (p456)

10. Identify the CORRECT statement.
    The degree of concordance which should be demonstrable between the bite marks left on an impression surface (the skin) and the dentition of a suspect must, for a conviction, be at least:
    a. Eight features
    b. Six Features
    c. Twenty two features
    d. As many as possible (there is no consensus in the literature).

11. When comparing the dental features, the positions of the teeth, inter-canine distance, shape of the arches, tooth sizes, the area of the tooth biting surfaces, tooth rotation and width, centric position and other unique characteristics, including absent teeth, should be noted.
    a. True
    b. False

12. Under ideal circumstances where the impression of each tooth was recorded accurately, an exact match is always possible.
    a. True
    b. False

The prevalence of occupational health-related conditions among oral health practitioners in KwaZulu-Natal, South Africa. (p448)

13. In Dentistry, the risks or dangers associated with working conditions are classified as Chemical, Biological, Physical, Psychological and Ergonomic.
    a. True
    b. False
14. 46% of oral health practitioners reported wearing the N95 mask.
   a. True
   b. False

15. Forward head posture is common among dental workers as it improves visibility, but results in a tension neck syndrome.
   a. True
   b. False

Maxillo-facial and Oral Radiography 156 (p 473)

16. Carcinoma is the second most common malignancy of the oral cavity.
   a. True
   b. False

17. In carcinoma of the jaws the lamina dura of the involved teeth is totally destroyed?
   a. True
   b. False

Clinical Windows (p 474)

18. In the Bertl et al trial, no significant differences were noted in terms of aesthetic appearance between the test and control group at any time point.
   a. True
   b. False

19. In the Bechara et al trial, overall survival rates between the test and control groups were similar.
   a. True
   b. False

20. In the Bechara et al trial, patients who received short implants reported significantly better patient satisfaction scores than patients with longer implants.
   a. True
   b. False

ETHICAL
Part 15. Secondary use of unethically obtained data: (p 470)

21. Identify the CORRECT statement.
   It has been proposed by Emmanuel et al that there are seven requirements which must be satisfied to ensure ethical integrity of a project. Which of the following correctly lists those seven requirements?

22. The paper demonstrates that all professionals have clear, unambiguous and accepted opinions on what constitutes Professional Ethics
   a. True
   b. False

23. According to the American Dental Association, It is unethical for a dentist to recommend to a patient that sound amalgam restorations be replaced by composites.
   a. True
   b. False

24. Good clinical practice should be based on the most widely held beliefs.
   a. True
   b. False

25. Mentally retarded children are good subjects for clinical research as they are readily available in a controlled environment.
   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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