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The familiar chameleon, (Family Chamaeleonidae), that deliberate and slow moving reptile, that animal that intriguingly can alter body colour, that possesses an enormously long slender projectile tongue. There are some 156 species. Teeth: these are acrodont, i.e., attached to the edge of the jaw, so, Yes, a chameleon can deliver a bite, usually ineffectual. And there are atrophied venom glands, but only a harmless trace amount of venom is produced.

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South African Dental Association Educational Theme 2017
“Oral manifestations of infectious disease”

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World Oral Health Day celebrated at Zenzeleni Primary School in Alexandra

Dr Nosipho Mzobe (SADA Head of Education), Ms Nelisa Makubalo (SADA Events Administrator), are seen in the attached photographs when they visited the Zenzeleni Primary School in Alexandra today and handed out Colgate Sponsored gift packs to school children and supplied the school with SADA posters in celebration of World Oral Health Day. Dr Nosipho also spoke to the children educating them all about the importance of oral health.
Human papillomavirus infection of the oral cavity: what the dentist should know

SUMMARY
The incidence of human papilloma virus-induced oropharyngeal carcinoma is steadily rising globally and the observation has become widely publicised in recent times. Human papilloma virus (HPV) is therefore an important infectious oncogenic agent. The aim of this article is to highlight the modes of transmission in HPV-related oral and oropharyngeal lesions whilst explaining the morphological spectra of benign and malignant disease which are attributed to low-risk and high-risk subtypes respectively. These issues as well as the topic of vaccination against HPV are likely to be the concern of many dental patients. The oral health care worker is therefore expected to provide appropriate counselling and education when informing patients of the potential health risks posed by HPV.

INTRODUCTION
Human papillomavirus (HPV) infection is the most common sexually transmitted viral infection in the world.1 HPV infection is associated with several proliferative, wart-like lesions of the skin and mucosae. High risk HPV-types play a causative role in a significant number of anogenital carcinomas and oropharyngeal carcinomas (OPC's) as well as in carcinomas of sinonasal origin. Due to the common occurrence of benign HPV-induced oral lesions, it is important for the oral health care worker to have a sound knowledge of their clinical manifestations and roles in the health of a patient as well as the current protocol for prevention of infection.

HUMAN PAPILLOMAVIRUS
HPVs are small, double stranded DNA viruses that characteristically infect mucosal and cutaneous epithelium to induce a variety of proliferative lesions.2 More than 170 types of HPV have been identified and are classified as cutaneous or mucosal subtypes on the basis of their preferred site of infection. HPV was initially considered a variant of Polyomavirus but since 2004 has been regarded as a taxonomic family on its own, known as the Papillomaviridae.3 They are divided into five genera on the basis of their genetic composition. Most mucosal HPVs belong to the alpha genus while the beta, gamma, mu and nu genera are mostly associated with skin warts and papillomas.3 The link between HPV and carcinogenesis was first established by zur Hausen in 19774 for which he subsequently received the Nobel Prize in 2008.

Mucosal HPV-subtypes which are strongly associated with cancerous lesions are referred to as “high-risk” and include subtypes 16, 18, 31, 33, 34, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68 and 70.5 Low-risk mucosal types are present in benign warts and other non-cancerous epithelial lesions and include types 6, 11, 13, 32, 42, 43 and 44. The HPV genome consists of eight open reading frames (ORFs) that are divided into three parts. The early (E) region codes for seven proteins (E1-7) which are needed for viral DNA replication, while the late (L) region codes for two proteins (L1-2) required for viral structure. As the most conserved region of the genome, the configuration of the L1 protein is used for identification and classification of the virus.3 A new HPV type is only accepted if the DNA sequence of the L1 ORF differs more than 10% from other types. Differences of between 2-10% define a subtype of HPV and those less than 2% a variant of HPV.3

ACRONYMS
ARt: antiretroviral therapy
HPV: Human Papilloma Virus
MEH: Multifocal epithelial hyperplasia
OPC: oropharyngeal carcinoma
ORF: open reading frames

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2017 Theme Article: Oral manifestations of infectious disease
HPV INFECTION

The clinical features of HPV-associated lesions are dependent on the subtype of HPV as well as the site of infection. HPV infection usually occurs via direct contact and is thus frequently associated with sexual transmission in anogenital lesions. HPV transmission to the oral cavity is mostly through autoinfection in the case of benign lesions such as squamous cell papillomas and verruca vulgaris. Sexual activity, especially oral sex, is the most common mode of infection in the case of HPV-related oropharyngeal carcinomas. Direct contact is therefore essential and there is no evidence that HPV is transmitted through saliva on its own.7

HPV infection of epithelium is initiated through the basal cells and the virus most likely gains access following trauma or epithelial erosion when the innate protection afforded by the layers of superficial cells is lost.6 Different receptors facilitating this process have been identified. Binding of HPV to heparin sulphate proteoglycans in the basement membrane appears to be the initial step.8

The tonsillar area is the most prevalent extra-anogenital site for the development of HPV-associated carcinoma, implying early entry of high-risk HPVs into the epithelial lining of the tonsillar crypt. That epithelium is more loosely arranged with a reticulated configuration compared with other epithelial surfaces where the cells are densely packed and joined by desmosomes.9 The tonsillar crypt is therefore well adapted to facilitate contact between ingested antigens and the abundant subjacent lymphoid tissue. The lack of protection afforded by this microscopic arrangement is exploited by the virus for infection of the crypt epithelium.9

Once inside the basal cells, the HPV migrates to the nucleus and remains as an episome (or in a non-integrated state). During normal epithelial maturation the infected daughter cells divide and migrate towards the surface of the epithelial lining. This differentiation triggers the viral genome to initiate the expression of genes required for viral replication, resulting in the shedding of mature viral particles from the epithelial surface.5 The virus does not destroy the infected epithelial cells, as their vitality is required for replication and protection from the immune system of the host.

Cell-mediated immunity is implicated in the control of HPV infection. HPV antigens are however exposed, to a limited extent, to the immune system due to viral proliferation occurring within the epithelial cell.10 Immune evasion is important in the establishment of persistent HPV infection, a prerequisite for neoplastic transformation following infection by high-risk HPV subtypes. If the virus becomes successfully integrated in the genome, a sequence of events follows. Transcription occurs of the E6 and E7 genes which interact with the p53 suppressor gene and retinoblastoma protein (pRb) respectively, resulting in degrading of the p53 protein and inactivation of pRb. This leads to an increase in cell cycling with a reduced capability to repair defective DNA, resulting in cell vulnerability and eventual malignant transformation.

Low-risk HPV subtypes also have E6 and E7 genes and express E6 and E7 proteins. However, the E6 protein in these viral subtypes is unable to degrade p53, while E7 binds with a significantly lower affinity to pRb without the serious complications attributed to the high-risk subtypes.11 The viral genome of low-risk HPVs also remains in a non-integrated episomal form within the nucleus in contrast to the nuclear integration of high-risk subtypes.

ORAL LESIONS

Squamous cell papilloma

Oral squamous cell papillomas are smaller than 1cm in diameter, painless, can occur anywhere in the oral cavity and involve patients over a wide age range. They have papillary (warty) projections and are often pedunculated (Figure 1). The lesions may have a white appearance if excessive keratinisation is present. Squamous cell papillomas are most often associated with HPV-6 and 11 and are not premalignant. Surgical excision is the treatment of choice.

Oral squamous cell papillomas are typically solitary with the exception of lesions noted in HIV/AIDS patients on anti-retroviral therapy. Lesions in this latter group are multiple and multifocal and are frequently larger than the solitary variant (Figure 2). It is postulated that the numerous papillomatous HPV-related benign oral lesions seen in association with antiretroviral therapy (ART) in HIV/AIDS represent a disorder of immune reconstitution.12 ART-associated papillomatous lesions frequently exhibit atypical histological features and may be diagnosed erroneously as HPV-associated dysplastic lesions or as papillary squamous cell carcinoma. However, these well-documented dysplastic features seen in oral papillomas associated with ART are not related to progression to cancer.13 The clinical features are important and should guide the pathologist to a correct interpretation.
**Verruca vulgaris**

Verruca vulgaris is a common skin wart. Oral lesions are the result of auto-inoculation as reflected by the preferred areas of involvement namely the anterior aspects of the oral cavity, especially the lower lips. The clinical presentation is characteristically that of painless lesions measuring 2-5mm in diameter with pronounced white, papillary projections due to marked hyperkeratosis. (Figure 3) The lesions occur mainly in children. HPV-2, 4 and 57 are typically involved. Excision is the treatment of choice although as with the cutaneous warts, oral lesions will often spontaneously resolve, usually within 2-3 years.

**Multifocal epithelial hyperplasia**

Multifocal epithelial hyperplasia (MEH) also known as focal epithelial hyperplasia or Heck’s disease, typically affects children. Many of the affected children are exposed to a crowded environment. MEH presents as multiple mucosal coloured nodules measuring 2-10mm in size with a characteristic cobblestone appearance (Figure 4). The lesions are predominantly present on the lips and gingivae, but can be identified at all oral mucosal sites. HPV types 13 and 32 are the usual causative agents in MEH. Lesions are clinically recognisable and resolve spontaneously within a few-months, obviating the need for treatment. Surgical or medical therapy is only indicated for large lesions which have caused functional and/or severe aesthetic complications.

**Condyloma accuminatum**

Condyloma accuminatum is a sexually transmitted HPV-related squamo-proliferative lesion occurring predominantly in an anogenital location. Oral lesions are transmitted through orogenital sexual contact. The presence of lesions in children should raise the possibility of sexual abuse, although it is possible that HPV may be transmitted by non-sexual contact. This implies that strict criteria should be used when diagnosing oral condyloma accuminata. Condyloma accuminata are larger than squamous cell papillomas and present as multiple broad based, cauliflower-like lesions with blunt processes frequently larger than 1cm (Figure 5). The most common intraoral sites of involvement include the labial mucosa, lingual frenum and soft palate. HPV subtypes 6 or 11 are aetiologically implicated, although high-risk subtypes may also be involved. Oral condyloma accuminata can be treated with cryotherapy or surgical excision. If such lesions are clinically or histopathologically diagnosed, it is strongly recommended that the patient undergo testing for the possibility of underlying immune dysfunction, notably for HIV/AIDS.

**Oropharyngeal carcinoma**

An increase in the incidence of head and neck carcinomas has been observed in the USA recently. This is due to an escalation of oropharyngeal carcinoma (OPC) linked to high-risk HPVs, especially HPV-16. The increase is predominantly observed in young males, many of whom had no associated aetiological factors such as tobacco usage or excessive alcohol consumption. Similar trends and increases in the incidence of OPC have been reported from different geographical areas worldwide.

The oropharynx consists of the palatine tonsils, base of tongue and soft palate. Most HPV-associated OPCs develop in the palatine tonsilar area. The tumours have a predominantly endophytic growth pattern and are characterised by early cervical lymph node metastases, which are frequently cystic in nature and may be the only clinical feature at the time of presentation. HPV-associated OPCs have a characteristic non-keratinising histological appearance.

Notwithstanding the advanced clinical stage of these neoplasms at the time of diagnosis, patients with HPV-related OPC have a far better prognosis than those with conventional smoking and alcohol-associated tumours. This fact necessitates pathological investigation and detection of a possible HPV-associated aetiology for all tumours occurring at this site. Fortunately, expensive diagnostic techniques are not necessary as immunohistochemical demonstration of p16 protein together with a non-keratinising histologic growth pattern are markers sufficient to confirm HPV involvement in OPC. There is good evidence that HPV is of limited importance in squamous cell carcinomas...
of the oral cavity, regardless of the immunohistochemical expression of p16.\textsuperscript{20} The vast majority (90-95\%) of HPV-associated OPCs are attributable to HPV-16. The distinction between oral cavity proper and the oropharynx as sites of cancer is therefore prognostically significant and will have an impact on pathological diagnosis and therapeutic management.

**VACCINATION**

Due to the infective nature of the HPV associated OPCs, it is reasonable to postulate that vaccination has a potential role in decreasing the spread of the infection with a subsequent drop in the incidence of OPC. Vaccines against HPVs are highly effective in preventing persistent HPV infections and cervical cancer associated with the HPV subtypes covered by the vaccine.\textsuperscript{21} Three HPV vaccines are currently licenced by the US Food and Drug Administration: a bivalent (HPV-16 and 18) vaccine (Cervarix, GlaxoSmithKline), a quadrivalent (HPV-6, 11, 16 and 18) vaccine (Gardasil, Merck) and a new 9-valent (HPV-6, 11, 16, 18, 31, 33, 45, 52 and 58) vaccine (Gardasil9, Merck).\textsuperscript{22} HPV vaccination is routinely recommended for adolescents at an age before the onset of sexual activity. The vaccines are used for prevention of the infection and cannot cure an existing HPV infection or an established HPV-associated cancer. Although it makes common sense to vaccinate all boys, the cost prohibits a roll-out of a vaccination program on a national basis. It may be argued that it is not necessary if a successful national vaccination program for girls is in place. This is the case in the UK where the national vaccination program with the quadrivalent vaccine resulted in a 95% coverage in girls. The UK Department of Health therefore only offers vaccination to men who have sex with other men.\textsuperscript{23}

Vaccination for all girls nine years and older in Grade 4 in public schools was implemented in South Africa by the Department of Health in 2014. Cervarix\textsuperscript{\copyright} was awarded the tender and is administered in two doses. The coverage and uptake in public schools is high\textsuperscript{24} although the uptake in private schools (funded through private health care) is at unacceptably low levels.

South Africa has the highest number of people living with HIV/AIDS and an extremely high incidence of cervical cancer. These worrying statistics suggest that vaccination of boys against high risk HPV types is desirable.\textsuperscript{25} It has been proven to be a cost effective strategy for the prevention of OPC in several countries.\textsuperscript{26, 27} As mentioned before, the vaccines are expensive and any effective programme will in all likelihood require funding through private health care.

**Conflict of interest:** None declared

**References**

ABSTRACT

Introduction:
Brittleness and low strength render conventional ceramic systems unsuitable for routine restorative use in molars. Modern, high-strength ceramic core materials such as high purity aluminum oxide (Al₂O₃) and yttrium - partially stabilized zirconia (Y-PSZ) have been designed for aesthetic, metal-free, all-ceramics in posterior teeth.

Aims and objectives:
1. To compare the biaxial flexural strengths of these two core materials.
2. To compare the strengths of Y-PSZ samples produced by two manufacturers.

Materials and methods:
Three groups of discs measuring 16mm diameter and 2mm thickness were prepared for each of the sample materials, high purity Al₂O₃, commercially available as Turkom-Cera, and Y-PSZ, commercially available as Cercon and LAVA. The Biaxial flexural strengths were measured using a Zwick Z010 Material Testing Machine. Reliability was compared using Weibull Moduli.

Results:
Mean strengths for LAVA, Cercon and Turkom-Cera were 866.44, 586.92, 155.71 MPa respectively. Statistically significant differences were shown between the mean values.

Discussion and conclusions:
This project showed that the samples of Y-PSZ had higher biaxial flexural strengths than those of high purity Al₂O₃. The biaxial flexural strengths of Y-PSZ, sourced from two manufacturers, are significantly different. It is suggested that Y-PSZ is suitable and indicated for restorative use in molar regions.

Keywords: High-strength ceramics; tensile stress.
a blend of kaolin and other minerals such as silica and feldspar, which imparted both strength and translucency. The first metal-free jacket crown was fabricated in the late 1800s by moulding platinum foil over an abutment, and then layering this with porcelain. This mould was then repeatedly fired until the desired characteristics were obtained. Many years later (1965), high alumina jacket crowns were developed in the attempt to overcome the low fracture resistance of the metal-free jacket crowns. These were produced by spreading alumina particles into a glassy matrix, and moulding this over the platinum foil. The resulting reinforced porcelain core contained about 40 to 50% alumina which reportedly increased the strength of the final crown by about 50%. In the late 1900s, the use of platinum-bonded alumina was extended to include fixed partial dentures. It was hoped that its increased strength would address the problem of fracture through the connector area while doing away with the original cast metal substructure. Unfortunately this material still suffered high fracture rates. Since then, there has been a vast expansion of growth and research into dental ceramics. At present these can be divided into three distinct groups: Silica-based, Aluminium oxide-based and Zirconium oxide-based.

a. Silica based ceramics
Conventional silica based ceramics, or feldspathic porcelains, were the first types of porcelains used for dental crowns. These ceramics offered adequate translucency, but their major disadvantage was low flexural strength and compromised longevity. The development of platinum bonded alumina cores seemed to be a promising breakthrough in terms of strength, allowing them to be used for fixed partial dentures. However, inadequate wetting of the platinum foil resulted in poor bonding between the substructures and the overlying porcelain, which became a major clinical problem.

This led Innotek to develop the Cerestore system which made use of an epoxy die and an injection moulded aluminium porcelain core. The process involved the use of a wax pattern flaked onto an epoxy die, then the wax was boiled out, the ceramic material was heated, injected into the space and immediately fired. By controlling the firing process and by converting alumina and magnesium oxide to a magnesium oxide crystal, a totally shrink-free crown was produced. The high alumina concentration appreciably improved strength, which allowed these crowns to be used in posterior regions, however, despite improved light transmission, aesthetics were compromised due to the high content of alumina particles. Further disadvantages were the costly equipment and the restorations were found to be no stronger than conventional sintered alumina restorations.

Dicor (Dentsply International) revolutionised a castable glass method by using a conventional wax pattern that was invested, burnt out and then cast with a glass consisting mainly of: SiO2, K2O, MgO and MgF2. The advantages of this system were the minimal tooth preparation required along with improved aesthetics.

The Renaissance system (Williams Gold Refining Company) then developed a material based on the premise that if the platinum foil were left on the inside of the core, the strength could be improved. However, the new material replaced the platinum with a gold foil in an attempt to enhance the natural tooth colour and improve aesthetics. Not only was this system technically challenging, but once again the lack of a core made these restorations weak.

The IPS-Empress system (Ivoclar), is a metal-free ceramic consisting of silicone dioxide, lower amounts of aluminium dioxide, and reinforced with leucite. It was developed as a cast-free ceramic with the intent to exclude the micro-porosities seen in materials that had undergone a firing process. The first system, Empress 1, accommodated preparations using a conventional wax mould as well as those created digitally using a CAD/CAM processes. The main problem was that the product had low fracture resistance and could only be used for single restorations. Later, Empress 2 was developed using an identical manufacturing progress, but with the inclusion of a lithium disilicate glass core which improved its flexural strength to 300-400 MPa. Unfortunately it has a discouragingly challenging technique sensitive laboratory process.

b. Aluminum oxide (Al2O3) based ceramics
These all have Al2O3 cores interspersed with infiltrates in varying proportions depending on the manufacturers and the systems. In-Ceram Spinell (Vita Zahnfabrik, Bad Säckingen) is infiltrated with magnesium, and is suited to the anterior regions of the mouth due to its enhanced translucency, but the material has inadequate flexural strength for use in the posterior regions. In-Ceram Alumina (Vita), was the first ceramic system that could be used for three unit fixed partial dentures due to the increased flexural strength gifted by the partially sintered alumina (352 to 600 MPa). Despite the alumina being denser than leucite glass, the final product still has excellent aesthetics. In-Ceram also offers two fabrication methods. In the dry press method, pre-sintered blanks are milled with or without CAD/CAM software. In the slip method, alumina particles are spread into an aqueous solution, which is then plastered onto the die. The long-term survival rates of the In-Ceram Alumina restorations are contentious, with reported higher failure rates in premolar and molar restorations than in the anterior region.

The Procera AllCeram System (Nobel Biocare) aims to maximize on the strength of alumina, and uses a pure, densely sintered aluminium oxide core (99.9% Al2O3). The flexural strength is between 480-700 MPa, allowing it to be used in both anterior and posterior restorations. Although some studies have reported higher failure rates in posterior restorations, there are sufficient short-term clinical studies demonstrating success, as well as reports showing good accuracy when used for crown substructures. TurkomCera (Turkom Ceramics) is another high purity Al2O3 (99.98%), but in contrast to those mentioned above, the system employs conventional methods of crown fabrication. This eliminates the need for costly CAD/CAM systems, making it an appealing option.

c. Zirconium oxide based ceramics
Zirconium oxide based ceramics consist of predominantly zirconium-oxide polycrystalline cores, which are prepared at much higher sintering temperatures than used in other ceramic systems. One of the early zirconium based ceramics was In-Ceram Zirconia (Vita). It consists of a 35% partially stabilized zirconia reinforced aluminium base which greatly enhanced flexural strength (600 and 800 MPa), and
provided a fracture toughness that was much higher than that achieved in the Empress 2 system.\textsuperscript{30,31} It was thus advocated for use in both anterior and posterior regions as well as for fixed partial dentures.\textsuperscript{4,30} However, there are contraindications, the main problem being that the zirconia reinforcement prevents adequate light transmission.\textsuperscript{15} Attempts to overcome this by reducing the thickness of the concentrated aluminium core resulted in a decrease in the flexural strength of the final prosthesis.\textsuperscript{30} Therefore, if this system is to be used, more tooth reduction is necessary to maintain the required thickness.

Structurally, zirconium oxide is a multiphase material having three forms, depending on the temperature to which it is exposed. Pure zirconia, at 2370°C, has a cubic structure.\textsuperscript{6} When it starts to cool to between 2100°C and 1170°C, it presents with a tetragonal structure\textsuperscript{6} below 1170°C, the tetragonal phase shifts into a monoclinic phase during which it undergoes a volume expansion of about 3%.\textsuperscript{6} This volume expansion can enhance crack propagation through the material which is undesirable. Stabilizing agents can be added to the zirconia to control this volumetric expansion.\textsuperscript{1,3,33} For example, addition of yttrium oxide stabilizes the transforming zirconia system in the tetragonal phase and retains the layer of compressive stresses. The subsequent formation of a yttrium-stabilized tetragonal zirconia polycrystalline (Y-PSZ) ceramic permits the characteristic high fracture strength.\textsuperscript{4,31-33} This is the concept of transformation toughening, which is the basis for longevity associated with Y-PSZ ceramic systems.\textsuperscript{4,31-33}

Recently the use of yttrium tetragonal zirconia polycrystals (Y-PSZ) as high strength core materials has received increased focus.\textsuperscript{4,31,32} Many ceramic systems like LAVA and Cercon embrace the use of this Y-PSZ. These high strength ceramic systems depend mainly on the reliability of CAD/CAM technology. The Cercon system involves conventional waxing up procedures for designing the substructure.\textsuperscript{34} The zirconia cores are milled by the Cercon-smart ceramics system using Cercon blanks made of yttrium-partially stabilized zirconium (Y-PSZ).\textsuperscript{34} The first step is the laser scanning process of the hand carved wax pattern of the substructure. Then the enlarged shape of the core is milled out of prefabricated blanks and then sintered to full density. During firing, the framework shrinks to the desired definitive dimensions. The milling process is faster and the abrasion of hardware is less than the milling from a fully sintered blank.\textsuperscript{34}

The LAVA system also employs Y-PSZ core materials, but unlike the Cercon system, it is fully CAD/CAM dependant. The LAVA copings are manufactured using partially sintered zirconium oxide blanks, because fully sintered blanks are too hard to be machined efficiently.\textsuperscript{34} These partially sintered milled copings, (greatly oversized to compensate for shrinkage), are then fully sintered and fitted onto the abutment die.\textsuperscript{31}

Although positive clinical outcomes have been reported using Y-PSZ systems, the majority of studies are short term, and reports that compare different manufacturers are scarce.\textsuperscript{31,34,35} Biaxial flexural strength of between 900 and 1200 MP for Y-PSZ have been cited.\textsuperscript{6,32,33}

**Computer aided design/Computer aided manufacturing (CAD/CAM)**

The first CAD/CAM use in dentistry was in 1985, when Sirona launched Cerec 1 to produce direct computer-aided ceramic inlays.\textsuperscript{36} After further development of the milling unit and refining the resolution of the cameras, Cerec 2 emerged which helped improve the marginal accuracy and to increase the scope of use of the system.\textsuperscript{36} There are numerous long-term reports showing the success of veneers prepared with CAD/CAM technology, and stating that the quality of fit was comparable with that produced by hand in laboratories.\textsuperscript{37,38}

There are now many modern CAD/CAM systems for producing ceramic restorations, all of which claim to minimize flaws otherwise associated with the conventional fabrication method. Thus the quality of the final finished product is enhanced.\textsuperscript{33,38} The process involves scanning a die and then sending the data to a laboratory where alumina or zirconia cores are fabricated, after which the final porcelain is processed onto the restoration. Each type of modern ceramic is linked to a specific CAD/CAM system which includes scanning, a unique manufacturing plant and specific software. The operator uses precision software to program the design of the coping, and then instruct the milling machine on the correct manufacturing routine for the final restoration. LAVA and Cercon are among these modern systems.

Laboratory CAD/CAM systems recreate occlusal anatomy and functional contacts using accurately replicated abutment dies, in the attempt to minimize the amount of intraoral occlusal adjustments.\textsuperscript{39} The main advantage of CAD/CAM technology is that it allows predictable machining of high-strength core materials like Y-PSZ, that would otherwise be almost impossible, because grinding by hand, without accurate cooling, would create surface cracks and flaws and thus reduce final strength values. In addition, CAD/CAM technology reduces the number of appointments and chairside stages (impressions), eliminates many of the problems that arise from indirect fabrication, and allows for the use of stronger and more resistant ceramic materials.\textsuperscript{33,34} For example, without a computer it would be tedious and probably inaccurate to try to estimate the shrinkage of zirconium oxide. Thus specific software has been created to calculate this shrinkage, and the extent of enlargement of the die, which is required in compensation. With so many systems being marketed, more scientific reports are needed on the performance and long-term successes of the restorations which are produced with each system.

Most dental ceramics are able to withstand compressive better than tensile stresses. The latter are more pronounced during function and parafunction, and should be the focus of analysis when testing the performance of ceramics.\textsuperscript{39} Although uniaxial strength tests were common in the past, it is recognised that biaxial flexural tests are more reliable.\textsuperscript{40} This is because with most ceramic restorations there is already a state of biaxial stress present thus test results from uniaxial tests cannot be totally accurate.\textsuperscript{41} In addition, unwanted edge fractures can occur during uniaxial testing, which would influence the precision of measurement of the final strength value.\textsuperscript{39,41} In biaxial flexural strength tests, the edges are not under load and the accuracy of the results is improved.\textsuperscript{3,39} This study has therefore relied on biaxial flexural strength tests and calculation of the Weibull moduli.\textsuperscript{3,39}

**AIM**

The aim of this *in-vitro* study was to compare the biaxial flexural strengths of three different ceramic core materials.
These consisted of two Y-PSZ products (Cercon and LAVA), and one Al₂O₃ product (Turkom-Cera). Additionally, there was an objective to assess whether there were any differences in the strengths of the samples of Y-PSZ produced by the two manufacturers.

MATERIALS AND METHODS
The test material consisted of three different all-ceramic high-strength systems, namely: LAVA (3M ESPE, Dental Products, Saint Paul, Minnesota, United States of America), a polycrystalline ceramic of Y-PSZ used in a system in which the restoration is completely CAD/CAM fabricated; Cercon (Dentsply, Degudent Rodenbacher, Hanu, Germany), a polycrystalline ceramic, Y-PSZ, the restoration being CAD fabricated from a scanned wax pattern; Turkom-Cera (Turkom-Ceramic, (M) SDN. BHD, 238 Jalan Tun Razak, 50400 Kuala Lumpur, Malaysia), a high purity aluminium oxide used to produce restorations through conventional processes using indirect laboratory procedures. Two groups of test specimen discs were prepared from each material. The dimensions were as follows (Figure 1):

**Turkom-Cera:**
16 samples of 1.2mm thickness and 16mm diameter
16 samples of 2mm thickness and 16mm diameter

**LAVA:**
16 samples of 1.2mm thickness and 16mm diameter
16 samples of 2mm thickness and 16mm diameter

**Cercon:**
16 samples of 1.2mm thickness and 16mm diameter
16 samples of 2mm thickness and 16mm diameter

Biaxial flexural strength was tested using a Zwick Z010 electronic hydraulic testing frame (Wirsam Scientific and Precision Equipment (Pty) Ltd.). The reliability of strength was also compared using Weibull Moduli as described in the studies by Pittayachawan et al., and Wagner and Chu.9,39

(LAVA and TurkomCera samples were sponsored by the respective manufacturers. Cercon samples were purchased directly from manufacturer.)

The test apparatus (Figure 4) is made up of a specimen placement surface consisting of three steel ball bearings (4mm in diameter), positioned in a circular arrangement, 120 degrees apart, on a support table (10mm diameter). Each disc specimen is placed centrally on the table (Figure 2). The upper arm is the loading table which exerts the required force to the test specimen from above, via a loading pin with a 1mm radius tip (Figure 3). A cross head speed of 1mm/min was set and each specimen was loaded until fracture occurred. The load at failure (N) of each specimen was noted as a measure of the biaxial flexural strength.

Statistical analysis and recording of data
The test results were automatically recorded and saved using the software program Testexpert, which is linked to the Zwick Z010 Electronic Hydraulic testing machine. Strength values were analysed with an analysis of variance (ANOVA) and Scheffe tests at a significance level of 0.05. In addition, Weibull moduli were calculated to assess variability between samples from the same manufacturer. A high value demonstrates homogeneity between the samples. After failure, all specimens from each company were collected and photographed under a light microscope in order to be able to describe the patterns of failure.

RESULTS
There were statistically significant differences noted in the biaxial flexural strength between each of three materials.
tested (Figure 5). Turkom-Cera had the lowest value (155.71 MPa), Cercon was higher (586.92 MPa), and LAVA was the highest (866.44 MPa).

The Weibull moduli were calculated as 4.98, 6.76, and 6.37 for Turkom-Cera, LAVA and Cercon, respectively (Figure 6). The high values for LAVA and Cercon demonstrate that these materials are reliable and that there is consistency between samples. Turkom-Cera had a much wider range of strength between samples. The most consistent range was seen with LAVA (Figure 6).

All fractured samples were realigned and spaced, and then viewed under a light microscope. The patterns of fracture were described in an attempt to analyse conformity between materials. While LAVA and Cercon demonstrated similar patterns of multiple fractures Turkom-Cera exhibited a pattern of fewer fractures (Figures 7, 8, and 9).

**DISCUSSION**

The preference of patients for metal-free restorations, and their high aesthetic demands, are fundamental factors influencing treatment planning and restorative options. This in turn has led to major advances in the development, production and use of dental ceramics. 42, 43

Due to the inherent brittle nature of these ceramics, the materials generally handle compressive forces better than they do the tensile stresses induced during mastication.41

It has been reported that while the average chewing force in posterior sites is about 350N, this can rise to over 1200N in severe bruxers.34 The strength of the core material which supports the overlying porcelain is a key factor in determining the long-term success of ceramic restorations.30, 41 For this reason it is relevant that the flexural strengths of available high-strength ceramic core materials be tested to guide selection and techniques.

Three point, four point and biaxial flexural strength tests have been used for dental ceramics.32 The three point bending test, although extensively used, is influenced by the microstructure of the edges of the sample.34 The biaxial flexural strength test used in this study focused on the central area of the samples thus avoiding inaccuracies from irregular edges.34

The results of this in-vitro test showed significant differences between all three materials tested. Turkom-Cera ceramic core (high purity Al₂O₃) had the lowest mean biaxial flexural strength (155.71 MPa), LAVA ceramic core (Y-PSZ) the highest (866.44 MPa), and Cercon ceramic core (Y-PSZ) had an intermediate mean value (586.92 MPa). These differences suggest a significant superiority of partially stabilized zirconia over high purity Al₂O₃. Despite the relatively low value of Turkom-Cera, all three of the tested ceramic core materials had higher strength values than the older silica based ceramic systems.

The strength values found in this study were lower than those previously reported in the literature, which is an inexplicable concern. These were in the range of 900-1200 MPa for yttrium partially stabilized zirconia and 487-699 MPa for densely sintered high purity Al₂O₃.42 Another study by Yilmaz and Aydin, which compared six different all-ceramic materials, found the mean biaxial flexural strength of Y-PSZ and aluminum-based glass infiltrated ceramics to be 1140.89 MPa and 341.89 MPa respectively.34

The Weibull analysis revealed that Turkom Cera had a wide range of strength values between individual samples, while LAVA exhibited the most consistency, followed by Cercon. In addition, the fracture patterns for LAVA and Cercon were very similar to each other and in strong contrast to those of Turkom-Cera. There is a scarcity of literature regarding the relevance of patterns of fracture of ceramic materials, and this may be a suitable focus for future research.

Inadequate core material has often been cited as the reason for failure of all-ceramic restorations, as the core is the foundation that reinforces the overlying porcelain veneer. The biaxial flexural strengths of LAVA and Cercon as found in this study approximated the strength of metal...
substructures, and satisfy the suggested strengths required for use in the posterior segments of the dentition. Turkom-Cera, however, did not demonstrate sufficiently high strength values and its application for restorations on posterior teeth may therefore be limited.

Another factor of concern was the difference in biaxial flexural strength of samples of the same material but produced by different manufacturers. This may be attributable to a lack of standardization with regard to the software and the processing employed for the production of Y-PSZ. However, before any definitive clinical recommendations can be made, these in-vitro results should be verified with long term clinical studies.

CONCLUSION

Within the confines of this study, it can be concluded that LAVA, Cercon and Turkom-Cera display significantly different biaxial flexural strengths. Y-PSZ presented with higher strengths compared with high purity Al₂O₃. It can further be concluded that the biaxial flexural strength of the Y-PSZ samples in this study is manufacturer dependent. The results of this in-vitro study highlight the need for long term clinical studies aimed at assessing the strength of newer core materials.

Acknowledgements and Conflict of interest

The authors thank 3M ESPE and Turkom-Ceramic for donating the LAVA and Turkom-Cera test material. Cercon samples were purchased directly from the manufacturer. No conflict of interest is declared with respect to the donated test material.

References

Xerostomia and salivary flow rates in HIV patients

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AP Cherian¹, A Jeftha²

SUMMARY
Introduction: Whilst the incidence of oral manifestations in HIV infected patients has decreased with the advent of highly active antiretroviral therapy (HAART), salivary gland disease is reported to be increasing among those on this treatment regime.

Aims and objectives: To compare the prevalence of xerostomia and mean salivary flow rates in three groups: HIV negative (Gr-1), HIV positive but not on HAART (Gr-2) and HIV positive on HAART (Gr-3).

Design: A cross sectional analytical study.

Methods: Xerostomia was assessed using a questionnaire. Saliva was collected and flow rates established. CD4 counts, viral loads and HAART regimens were recorded where appropriate.

Results: Significant differences were observed between the groups regarding the prevalence of xerostomia (p=0.006), mean resting (p=0.010) and stimulated (p=0.034), salivary flow rates. Gr-2 showed the greatest salivary deficiency. Salivary flow was not decreased by HAART. Levels of CD4 ≤350 were linked to low resting flow rates in Gr-2. In Gr-3, patients on fixed dose combination (FDC) showed a significantly lower stimulated flow rate (p=0.034) than those on other HAART regimens.

Conclusion: HIV positive patients not on HAART are more vulnerable to decreased salivary flow rates. HAART did not adversely affect xerostomia or salivary flow rates in this population group.

INTRODUCTION
It is reported that South Africa has the largest population in the world of persons living with HIV. The total number of infected persons has been estimated to be 6.4-million (12.2% of the population).¹ This marked prevalence had been attributed by the Human Sciences Research Council (HSRC) to the combined effects of new infections and the success of an expanded ART programme, which had increased survival rates among HIV-infected individuals.¹

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ACRONYMS
ART: Anti-retroviral therapy
ARV: Anti-retroviral
FDC: Fixed dose combination
Gr: Group
HAART: Highly Active Anti-Retroviral Therapy
HIV-SGD: HIV associated salivary gland disease
HCT: HIV Counselling and Testing
INH: Isoniazid, Iso-nicotinic acid hydrazide
NRTI: Nucleoside reverse transcriptase inhibitors
NNRTI: Non-Nucleoside reverse transcriptase inhibitors

Although HIV had been associated with a variety of oral opportunistic lesions during the early days of its emergence, the incidence of these lesions has decreased in patients on HAART.²⁻⁵ In contrast, HIV-associated Salivary Gland Disease (HIV-SGD) in general seemed to be slowly increasing in prevalence during the HAART era.⁶⁻¹² Reduced salivary flow and xerostomia have been reported with the use of HAART.⁹⁻¹⁰

The most common salivary gland changes reported were those related to saliva production, manifesting as hypposalivation and xerostomia, the perceived feeling of a dry mouth, which may or may not be associated with salivary gland hypofunction. It is subjective and can be measured by means of questionnaires or visual analogue scales.¹³

Hypposalivation on the other hand, is a demonstrable reduction in salivary flow rate that can be measured objectively by collecting saliva over a specified period of time.¹⁵ Often these terms have been used interchangeably but studies have demonstrated that xerostomia may not necessarily indicate an actual measurable reduction in salivary flow rate. The reverse is also true, as some patients with reduced flow rates did not complain of xerostomia.¹⁵

The functions of saliva include lubrication, buffering capacity, tooth remineralisation and antimicrobial and antifungal protection. A reduction in the flow rates of saliva would adversely affect these vital functions resulting in an increase in dental caries, certain oral infections and a general oral discomfort. Salivary gland hypofunction has been shown to have a high predictive value for recurrent candidial infection.¹⁸ Denture wearers with low salivary flow rates have low denture retention. Busato et al.¹⁷ concluded in their study that xerostomia further reduces the quality of life of people living with HIV and AIDS.
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AIM
This study evaluated and compared the prevalence of self-reported xerostomia and the mean salivary flow rates in three patient groups: HIV positive patients on long term HAART, HIV positive patients not on HAART and HIV negative patients.

DESIGN AND METHODS
This was a cross-sectional analytical study. Ethical approval was obtained from the Senate Research Committee, University of Western Cape. Permission to conduct the study was obtained from the Department of Health, Eastern Cape.

Adult patients (18-55 years of age) who attended the HIV Counselling and Testing centre (HCT) and the Antiretroviral (ARV) section at a public health care facility in East London, South Africa, were invited to participate in the study by written informed consent. The sample size was 150, with 50 individuals in each group. HIV negative patients were allocated to Gr-1. The HIV positive patients were divided based on treatment. Gr-2 included those who were HAART naive and Gr-3, those who had been on HAART for two years or more.

The exclusion criteria included patients who were acutely ill, those on any medication (other than HAART) that had a side effect of xerostomia, those diagnosed with any auto-immune salivary gland disease, and those who had received any head and neck radiation. Pregnant patients were excluded from the study. Totally edentulous patients were also excluded.

Data collection and procedure:
The incidence and the expression of xerostomia were evaluated based on the responses to a questionnaire which had been proposed by Sreebny and Valdini and which included only four questions:

1. Does your mouth usually feel dry?
2. Do you regularly do things to keep your mouth moist?
3. Do you get out of bed at night to drink fluids?
4. Does your mouth usually become dry when you speak?

These four questions were found by Sreebny and Valdini to have a high specificity and predictive value. A positive response to any was considered as indicative of xerostomia.

Subjects refrained from eating and drinking 90 minutes before saliva collection. Saliva was collected in sterile plastic tubes through a funnel (Figure 1). A countdown timer was used to mark time elapsed.

Unstimulated whole-mouth saliva was collected by the “spitting method” into the tube for 3 minutes. At the end of three minutes, the tubes were collected and new tubes used for collecting chewing-stimulated saliva. A 2cm piece of sterile rubber was used for chewing and saliva collected by the same method. A metronome was used to regulate chewing to 45 strokes per minute. The subjects were asked to chew for one minute and spit the accumulated saliva into the tube. The rubber piece was kept in the mouth of the subject and the process was repeated two more times. All saliva samples collected were weighed on a calibrated scale and the flow rate per minute was calculated. Since the specific gravity of saliva is one, 1 gram is considered equivalent to 1 ml.

Statistical analysis
Data was captured on Microsoft Excel. Data analysis was done with the statistical software “R” version 2.15.0 (2012-03-30) (Copyright © 2012, The R Foundation for Statistical Computing). The data collected was subjected to descriptive analysis and prevalence was calculated. The significance of the differences of prevalence were calculated by Chi-squared test and, where applicable, Fischer’s exact test. Statistical significance was set at p-value <0.05.

The influence of independent variables such as gender, age, CD4 count, smoking, viral load and medications on the prevalence of xerostomia was examined, using logistic regression. The differences in mean flow rates between the groups were examined by least squared linear regression and associated analysis of variance (ANOVA). The Student’s t- test was used whenever differences between two mean flow rates needed to be analysed for significance.

RESULTS
The demographic and clinical data collected were as shown in Tables 1 and 2. The mean age of the sample was 34yrs with Gr-3 having a slightly higher mean age of 39 and Gr-1 having a younger sample with mean age of 30yrs. 73% of the patients in the study were female. The total number of smokers was 17 (11%) with 8, 7 and 2 in Gr-1, Gr-2 and Gr-3 respectively. Of these only 2 (1%) patients, both in Gr-1, smoked more than 10 cigarettes per day. The mean CD4 count in Gr-2 was 339 and in Gr-3 it was 577. Six of the patients in Gr-2 and twelve in Gr-3 were on either Co-trimoxazole or INH or on both. In Gr-3, 34 of the 50 were on FDC (Fixed dose combination) and 16 were on other HAART regimens. Viral loads were available only for Gr-3 and 78% (39) of this group had a value lower than the detectable level (LTDL) so the effect of viral loads on the outcome measures were not calculated.

The influence of covariates on the prevalence of xerostomia was examined by fitting generalized linear models with the dependent variable xerostomia and the independent variables group, age, gender, smoking, CD4 and use of Co-trimoxazole and/or INH (using only Gr-2 and Gr-3). Multiple regression analysis revealed that for xerostomia, the significant predictor besides group was age, which was found to have a significant negative correlation at p=0.002. When mean flow rates were analysed, it was seen that although males generally had a higher mean flow rate, a significance was seen only for chewing-stimulated flow rate p=0.031.

Table 1: Distribution by demographics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Gr-1 (N=50)</th>
<th>Gr-2 (N=50)</th>
<th>Gr-3 (N=50)</th>
<th>Total (N=150)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
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</tr>
<tr>
<td>Male</td>
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<td></td>
</tr>
<tr>
<td>18-30 yrs</td>
<td>30</td>
<td>26</td>
<td>5</td>
<td>61</td>
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<td>31-40 yrs</td>
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</tr>
<tr>
<td>41-55 yrs</td>
<td>5</td>
<td>8</td>
<td>21</td>
<td>34</td>
</tr>
</tbody>
</table>
A summary of outcome measures and the comparison thereof between the groups can be seen in Table 3. Significance was found between the groups for all relationships.

The overall prevalence of xerostomia was 50% in the total study population. Gr-2 showed the highest prevalence with 33 (66%) out of 50 patients responding affirmative to at least one of the xerostomia questions in the questionnaire. 25 (50%) patients and 17 (34%) patients, in Gr-1 and Gr-3 respectively, responded similarly. The differences in prevalence between the groups were examined using the Chi-Squared test. The hypothesis of homogeneous prevalence was rejected at level 0.006. The difference between Gr-2 and Gr-3 was found to be significant at p=0.002. Although Gr-2 had a higher xerostomia prevalence than the HIV negative patients in Gr-1, the difference between the two prevalences was not significant at p= 0.156.

The mean resting and chewing-stimulated salivary flow rates for each group was subjected to a one way Analysis of Variance (ANOVA). There was a significant difference for both flow rates between the groups as seen in Table 3.

When the outcome measures were compared between the two HIV positive groups, similar results were seen (Table 4). Patients in Gr-2 had a higher prevalence of xerostomia (p=0.002) and a significant reduction in both resting and chewing-stimulated mean flow rates when compared with those in Gr-3. The difference in the mean flow rates between Gr-2 and Gr-3 was significant with p=0.003 for resting flow rate and p=0.013 for chewing-stimulated flow rates.

The influence of low CD4 (≤350) on the outcome measures were analysed in both the HIV positive groups (Gr-2 and Gr-3) separately and together, irrespective of HAART. When mean flow rates of all the HIV positive patients were compared, although the flow rates were reduced in those with CD4 counts ≤350 cell/mm³, there was no statistical significance (Table 5). The difference in mean resting flow rates came close to significance at p= 0.055. When analysed separately, the mean resting flow rate was found to be significantly influenced by a low CD4 count only in Gr-2 (p=0.035).

In Gr-3 68% (n=34) were on FDC (which contains two NRTI’s and one NNRTI). There was a non-significant decrease in the prevalence of xerostomia and a significant reduction in the mean chewing-stimulated flow rate for those on FDC (p= 0.034) when compared with those on other HAART regimens (Figure 2).

**DISCUSSION**

A decrease in salivary function and a significant increase in xerostomic symptoms were noted among those who were not on HAART, ie Gr-2. The difference was greater for resting flow rate than for chewing-stimulated flow rate. During the resting phase, 65% unstimulated saliva
is produced by the submandibular gland, 20% by the parotid, 7-8% from the sub-lingual and the remaining from minor salivary glands.\[^{18}\] According to Atkinson \textit{et al.}\[^{19}\], the function of the submandibular gland is affected earlier during the progression of HIV infection and the parotid glands are affected over a greater time.

While low CD4 counts (<200 cell/mm\(^3\)) have been attributed by many authors to being a significant risk factor for xerostomia and hyposalivation,\[^{9,20,21}\] others did not find this correlation significant.\[^{10,22,23}\] According to Schiødt \textit{et al.}\[^{24}\], the reduction in salivary flow is “likely to be a function of the degree of inflammatory infiltrate in the gland but not associated with degree of immune deficiency”. In the current study, a CD4 count ≤ 350 was used as the criterion for a low value since this is the reference level used by the South African Public Health system at which HAART was initiated at the time of the study.

Xerostomia prevalence did not show a significant difference between the two CD4 groups. The mean resting flow rate for those with CD4 counts ≤350 cell/mm\(^3\), when calculated in Gr-2 alone, was found to be significant at \(p= 0.035\) (Table 5). This further points to the oral health vulnerability of these HIV positive patients with a low CD4 count in whom HAART is yet to be initiated and during the period while waiting for the therapeutic effect of HAART to improve the CD4 count. Low CD4 counts in patients on HAART, Gr-3, did not seem to affect mean resting flow rates.

More than 50% of the saliva produced under stimulation is from the parotid gland.\[^{18}\] Although the exact mechanism and long term effects of HAART on the parotid is unknown, lymphocytic infiltration, acinar changes, lipomatous changes and immune reconstitution inflammatory syndrome (IRIS) have all been proposed.\[^{6,9,25}\] When comparing the outcomes of those on FDC with those on other HAART regimens, there was a statistically insignificant increase in the prevalence of xerostomia. But a significant reduction was seen in the mean chewing-stimulated flow rate for those on FDC. The patients on FDC were further separated based on duration of time on FDC as <3 month, 3-6 months and >6 months. Further evaluation of their mean flow rates showed
progressive improvement in both resting and chewing flow rates as the duration on FDC increased. This could be due to the fact that of the 34 patients that were on FDC, 32 had just switched their HAART regimen in the past six months. Silverberg et al.,26 and Navazesh et al.,27 had found in their study that patients on stable HAART usage had higher salivary flow rates and lesser xerostomia complaints than those that switched HAART or had discontinued treatment in the previous six months.

Interestingly, age was negatively co-related to xerostomia unlike many other reports that associated increasing age with increasing xerostomia complaints.13,18,28 The range of ages included in the study; 18-55 years, do not significantly affect xerostomia27 and this contradictory influence could be coincidental due to other systemic factors. The fact that in this study, Gr-3 had the oldest mean age yet the group had the lowest prevalence for xerostomia and the highest mean flow rates, might have influenced this result.

CONCLUSION
Salivary gland dysfunction was observed more readily in those who were immuno-compromised and not yet on HAART. When planning an intense prophylactic treatment regimen, special attention should be paid to prevent and manage the oral conditions that are associated with reduced salivary flow in these individuals. HAART in itself did not appear to adversely affect xerostomic perceptions or salivary flow rate. The improved immunity that came from being on anti-retroviral treatment was beneficial to salivary gland function. Duration of HAART, change in regimen, type of regimen, all seem to have had an effect on salivary flow rate.21,23,26 Thus, studies on larger samples and of longitudinal design are necessary to explore the possibility of similar findings in the South African context. This would in turn further pin point those vulnerable to salivary hypofunction and its effects, enabling timeous prophylactic actions.

The HIV prevalence in the Eastern Cape is estimated to be 11.6%.1 With HIV infections being managed progressively more successfully by the country’s health care services, more and more HIV infected people are living longer and healthier lives while on HAART. Therefore, it is imperative that the general dental practitioner be aware of the salivary gland effects and resultant oral consequences seen in HIV infection and subsequent HAART.

References
A comparative study to determine the shock absorption ability of two popular mouth guards available on the South African market

ABSTRACT
It is expected that most mouth guards will provide some level of protection to teeth. In this study a device was developed to measure the relative impact absorption of two different mouth guards (Proform, Type III vacuum-formed and Max, Type IV pressure laminate). Seven of each of the two types of mouth guards were made and each batch was exposed to between six and 10 impact trials.

Results:
The variations in shock absorption between the batches per mouth guard were found to be not statistically significant on a 1% significance level (two-way ANOVA and the Tukey multiple comparison test). Furthermore, impact absorption on the control where no mouth guard was in place, was more than four times lower. The Max mouth guard was found to be superior with a shock absorption value of 88%. It is advised that a mouth guard should always be used in all contact sports.

Clinical significance:
This study shows that the two tested mouth guards (Max and Proform) have the ability to significantly reduce the force of an impact on teeth.

INTRODUCTION
Mouth guards were originally introduced about 100 years ago for use by boxers. These prototypes were made from sponge, cotton, tape or small pieces of wood.1 Thus, mouth guards have a long history in sport as protective devices worn to prevent direct and indirect injuries to the teeth, soft tissues and jaw.2,3,4 Mouth guards have been shown to protect teeth against the energy generated from potentially traumatic blows. Instead of the energy being transferred directly to the underlying dentition, it is absorbed and dissipated.5 The mouth guard therefore functions as a shock absorber by reducing the forces applied to the oral structures.6

Mouth guards keep the soft tissues away from the teeth. Displacement injuries and soft tissue lacerations are therefore reduced.7 Fractures of the teeth and the alveolar bone (including fractures of the mandible or its condyles) and concussion injuries may also be minimized and even prevented with the use of mouth guards.2,4 Although studies have demonstrated a decrease in dental injuries when mouth guards were used,8 their use in sport is not compulsory in most countries. The American Dental Association, however, has recommended the wearing of mouth guards in 29 sport/exercise activities.9

Custom-made mouth guards have been shown to provide better adaptation, retention, comfort and stability than over-the-counter versions like stock and “boil-and-bite” mouth guards.3 Further, when compared with mouth guards that are available from sporting goods stores, the custom-made appliances are shown to interfere minimally with speech and to have almost no effect on breathing.3

A guard for personal use is made in the dental clinic or laboratory on a cast poured from an impression taken of the athlete’s mouth. These mouth guards are mostly made

ACRONYM
EVA: ethylene polyvinyl acetate
from ethylene polyvinyl acetate (EVA).4 They may be designed for a specific sport or to accommodate for patients with malocclusions, erupting teeth4 and other orthodontic needs, including fixed appliances.6 The disadvantage7 with this type of mouth guard is that at least two appointments are required with the dentist and it is more expensive than an over-the-counter purchase.10 However, the improved fit, retention and comfort justifies the higher cost5 and enhances the readiness of the sportsman to wear the protective, if somewhat cumbersome, guard.

Custom-made devices are manufactured either by using a single layer of EVA which is adapted to the plaster model of a patient’s teeth using low vacuum suction (Type III mouth guard) or by laminating multiple sheets of EVA over the model by using heat and high pressure to produce a Type IV pressure laminate mouth guard.11,12 The combination of high heat and pressure allows chemical integration of the layers and eliminates the probability of shrinkage.

Both Type III and Type IV mouth guards have been recommended in favour of the over-the-counter types as they both adapt accurately to the athlete’s mouth. Therefore, the purpose of the study was to test the shock absorption ability of two different options of custom-made or model formed mouth guards available in South Africa i.e. the vacuum-formed mouth guard (Type III, Proform) and the pressure laminated mouth guard (Type IV, Max).

MATERIALS AND METHODS

Fourteen guards were manufactured in total i.e. seven of each of the two types. A single standard, reproducible model was used in the manufacture of the Max and Proform mouthguards. The process was standardized in terms of equipment used and heat and pressure applied and both types were manufactured by the same laboratory technician. The pressure-laminate mouth guards (Max) were produced using a Dreve Drufomat machine (Dreve Dentamid, Unna, GmbH, Germany), applying six bars of pressure for 120 seconds. The vacuum-formed mouth guards (Proform) were manufactured on a Buffalo EconoVac Vacuum Forming System (Buffalo Dental Manufacturing Co., Inc., Syosset, NY, USA) with low vacuum suction and following the standard manufacturing technique.

These two varieties of mouth guards were investigated for their ability to absorb impact. The forces were applied using a pendulum type impact testing machine with a steel ball impact object (weight: 172g) attached to the point of the arm (50cm) of the pendulum (Figure 1). This apparatus was manufactured according to specifications published by Handa et al.11 A strain gauge which recorded the transmitted forces was attached to the centre of the labial surface of the tooth (Figure 2). The point of impact of the ball was set at the centre of the tooth, precisely where the strain gauge was positioned. Mechanical forces recorded by the strain gauges were amplified (PJ Dynamic Strain Amplifier with SGA0911 Dynamic Strain Amplifier card, Peter Jones Electronic Equipment (PTY) LTD, Rivonia, South Africa) and converted into an electric output in millivolt and stored as data by the Graphitec GL 900 4 channel logger, Graphitec Corporation (Figure 3).

A plaster model without a mouth guard was used as the control and was subjected to the impact to generate a reference, or control, reading. The mouth guards were then each sequentially fitted to the standard model fitted with the strain gauge and each was exposed to between six and 10 impacts. The pendulum was released from a distance of 10 cm from the tooth surface, which gave a potential energy of 6.6 kg m²/s².11 The impact force through the mouth guard was measured in millivolts and these data were captured by the apparatus. An increase in the shock absorption of the mouth guard is associated with a drop in millivolts.

All recorded values were entered into the Statistical Package for Social Sciences (SPSS v. 15.0, SPSS Inc., Chicago, IL). Tabled values are presented as means plus or minus the standard deviation. A statistical comparison was made using a two-way ANOVA and the Tukey multiple comparison test (p <0.01).

RESULTS

The overall means (mV) and standard deviations (7 batches exposed to six to 10 impacts) are represented in Table 1. (The higher the mV value, the less the impact absorption or vice versa).

The differences between the data recorded for the two mouth guards was tested by a Univariate analysis of variance with MAX and Proform as fixed, and batches as random factors. The Type IV mouth guard (Max) had a significantly higher level of shock absorption (Table 1) than Type III (Proform): F_{1,6}=96; p<0.001 𝑥 𝑝 = 0.94.
The variations in shock absorption between the batches per mouth guard and the interaction between batches and mouth guard were found not to be statistically significant: p>0.05. Furthermore, impact absorption on the control (where no mouth guard was used), was more than four times lower than with the mouth guards in place (Table 1). (ie the plaster model sustained an impact four times more severe).

**DISCUSSION**

In this study, an apparatus was first constructed for the measurement of the shock-absorbing ability of different mouth guards (purchasing such an apparatus was prohibitively expensive). The bench-type pendulum (Figure 1) was made by an engineering company (at a fraction of the normal cost) according to the specifications published by Handa et al. The electronic components (Figure 3) were assembled from parts provided by the Peter Jones Electronic Equipment (PTY) LTD, Rivonia, South Africa. This study demonstrated that it is possible to save about 40% of the cost by making use of local companies, enabling the construction of an affordable alternative, albeit with more effort and time.

Different mouth guards have different degrees of shock absorption capability and this is dependent on many factors such as: the materials used; the thickness of the material; the number of layers of material/s and the fit of the mouth guard. Despite these variations, all mouth guards do generally provide protection. Direct comparison of the shock absorbing values as published in the literature is mostly not possible, due to major differences in the experimental designs like variations in impact objects, impact strength, etc. Publications have shown a wide range of the shock absorbing potential of mouth guards and mouth guard materials. Thus, studies relying on the same settings (same laboratory) and where many different mouth guards are compared are relevant, because the values can then be directly compared.

Tests on mouth guard products do not really reveal the effect of shock absorption when a sample of the material is simply placed on a model. Therefore, this study focussed on the results of fully prepared mouth guards. It has been reported that a custom ethylene vinyl acetate mouth guard (4mm thick) showed a 40% reduction relative to the control (no mouth guard) in comparison with our values of 80% (Proform) and 88% (Max). (If we use the average control value of 386.5 mV, as shown in Table 1, to do calculations, only ~12% of the impact came through the one mouth guard (Max) and only ~20% through Proform under our experimental conditions). A study involving the development of the “Hard and Space” mouth guard reported an impact absorption rate as high as 95%. However that mouth guard consisted of two layers of EVA with a hard middle layer of acrylic resin. Vensimmo also reported on the advantages of using hard insertions in mouth guards. Kataoka tested a four layer EVA (total thickness of 4mm) in a mouth guard and found an impact absorption of 77%. This value is close to the 80% found in the current study for a 4mm thickness EVA (Proform). In contrast to many reports a study done on 18 adult mouth guards, found that “boil-and-bite” mouth guards were not inferior to custom mouth guards.

However, mouth guards are not only about high shock absorbing abilities but also about comfort, ease of speech and breathing whilst worn. In default, the appliance would not be used at all. Over the past 50 years or more the material of choice for a mouth guard has been mainly the ethylene-vinyl-acetate (EVA) copolymers. However, quite recently the mass produced EVA (as a “boil-and-bite”) was reported as a failure because the guard did not fit well and had poor retention. In an extensive study EVA mouthguards were shown to have a shock absorbing value of 33% in comparison with the 65% for appliances constructed with polyolefin. That study lead to the patented CustMbite MVP Mouthguard manufactured by the Bite Tec Inc which was the only guard approved by the ADA. It is claimed that this mouth guard has all the positive features of a custom-made mouth guard, but in a “boil-and-bite” format. Reportedly, it gives a good fit, causes no impairment of speech or breathing and offers protection of teeth, jaws and cranial structures. It is made from a family of the polyolefin elastomers called Vistamaxx which is a semi-crystalline polyolefin propylene-ethylene copolymer.

In our study, two different custom-made mouth guards were evaluated: The Max mouth guard which is made of a semi-crystalline propylene ethylene copolymer (US patent 7950394 as propylene alpha olefin polymer elastomer) and comes in different colours to satisfy users. The other mouth guard, Proform, consists of one layer of EVA (ethylene-vinyl acetate). It also comes in different colours. Today, most mouth guards are made from EVA of which the major component is a copolymer of ethylene and vinyl acetate (vinyl ethylene vinyl acetate chemical is approved as safe by the FDA). Mouth guard sheets made from copolymers have recently become available. It was found that the shock absorption capacity of a polystyrene-polyolefin copolymer-based material was higher than that of the EVA, polyolefin-based material. A thesis investigated the impact energy absorption of three popular mouth guard materials in three different environments (saliva, water and dry). The results showed that the mouth guard PolyShock (containing EVA + polyurethane) was the most energy-absorbent material in all three environments and was a better shock absorbing mouth guard than Proform (containing EVA alone) because of the addition of polyurethane. It therefore becomes clear that the main reason why the Max mouth guard showed higher shock absorption than Proform is because of the layers of polyolefin material which are used. In another study on five different designs of the Bioplast mouth guard, a shock-absorption rate of up to 55% was reported.

Both mouth guards tested showed a high degree of impact absorption when compared with the control where no mouth guard was used (Table 1). In the comparison to determine whether different samples of a mouth guard varied (Max or Proform) no statistically significant (p<0.01%) variation was found. However, in total, Max was found to be superior as far as the impact absorption (Table 1) is concerned. These two mouth guards are not the cheapest on the South African market and the cheaper ones should also be evaluated under similar conditions. Furthermore, this study was not done in vivo, which is a limitation. However, the results should still give a good indication of their value as protective devices.

<table>
<thead>
<tr>
<th>Type of mouthguard</th>
<th>Mean</th>
<th>SD</th>
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<tr>
<td>Control</td>
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<td>25.6</td>
</tr>
<tr>
<td>Max</td>
<td>45.7</td>
<td>14.0</td>
</tr>
<tr>
<td>Proform</td>
<td>77.6</td>
<td>16.6</td>
</tr>
</tbody>
</table>
CONCLUSION

Within the limits of the study it can be concluded:
1. Both mouth guards would protect teeth to a considerable extent.
2. The Max mouth guard should give better protection.
3. Although these mouth guards are more expensive than the over-the-counter varieties, both probably afford better protection, may prevent more severe dental injuries and result in greater cost savings in the long run.
4. We would like to stress the importance of using mouth guards for all those who participate in any contact sport as well as in any other activity where injury to the mouth can occur.

Conflict of interest: The authors whose names are listed above certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Acknowledgement: We wish to thank Prof Herman Kruisje for the statistical treatment of the results.

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A compromise between orthodontics and surgery: a case report

INTRODUCTION
Careful planning goes into the management of the patient who is to receive surgery to complement the orthodontic treatment, which may in fact be prolonged. Quite often, extraction of teeth is required, and the extraction spaces will, most of the time, need to be closed before the patient undergoes surgery. Space closure may demand some 18 months and even longer if there is sequential retraction of the canines followed by the incisors as in Group A anchorage.1 The same is true in Group C anchorage where the treatment requires protraction of the posterior segments.1

Space closure prior to orthognathic surgery is the ideal situation. However, there could be a compelling reason that the surgical procedure be expedited and the surgery then performed prior to the completion of space closure. In the USA, for example, the insurance of adolescent patients was sponsored under the parent’s plan, and usually termed out at 18 years. Hence the family, for insurance reasons, will want to have the surgery completed by the time their child reaches 18 years of age. In such circumstances, the surgeon and orthodontist have to work together closely to achieve a desirable result. The orthodontist in particular may have to compromise from the ideal to help the patient have the surgery before the extraction spaces are fully closed.

Paradoxically, orthodontic space closure after the operation may progress faster than prior to surgery. This has been demonstrated with corticotomies performed to expedite the orthodontic treatment.2,3 This approach of surgery first is indicated for the regular orthodontics-orthognathic surgery patient but may not be desirable in the case of severe craniofacial anomalies as in cleft palate. In the event that such an approach of early surgery is elected, it is imperative that the orthodontist be involved in the surgical setup and it is crucial that the patient be seen by the orthodontist as soon as possible after the surgery so that space closure may proceed immediately and the proper use of elastics be instituted.

The purpose of this clinical report is to show that with proper communication between the orthodontist and the surgeon, it may not be necessary to mandate space closure prior to surgery - even in patients with severe craniofacial anomalies. The report highlights a patient who underwent surgery prior to completion of space closure, the residual spaces being subsequently closed a short while later.

PATIENT HISTORY
The patient was a Caucasian male with chronological age of 17 years nine months (CA = 17-9) and Class III (Cl III) occlusion (Figures 1, 2). He had a repaired Veau Class III4 hard tissue cleft to the right. Clinical and radiographic examination revealed the presence of 31 permanent teeth. The maxillary right lateral incisor was missing (UR2), which is not unusual for a patient with a cleft. There were generalized carious lesions and demineralization with the maxillary left second molar being the most affected. The patient had completed a phase of orthodontic treatment elsewhere at an earlier age as well as surgical augmentation of the nose. While the cleft had been repaired, the closure was of the soft tissue only with the bone still severely deficient in the area of the cleft. The previous orthodontist had closed the space of the missing upper right lateral incisor, resulting in the maxillary midline being displaced to the right.

Cephalometric evaluation indicated that the patient also had a prognathic mandible for which mandibular surgery was needed to harmonize the patient’s occlusion and aesthetics. However, the patient’s medical insurance would not authorize double jaw surgery. Notably, he was approaching 18 years and the surgery needed to be done promptly. Hence, the patient presented with the following as the major problems with the possible solutions listed:

1. The maxillary arch was one tooth smaller than the mandibular arch due to the missing UR2. It would not be possible to re-open space for the missing lateral incisor since there was no bone in the area. Even with a bone graft, we risked damage to the maxillary right central incisor (UR1).
A tooth had to be extracted in the maxillary anterior segment so as to match the missing UR2. If this were not done, the midlines would never coincide since the mandibular anterior segment held one incisor more than the maxillary. Hence, we opted to extract the maxillary left lateral incisor (UL2).

However, we could not first extract, consolidate space and only then send the patient for surgery since at the time, the State Child Health Insurance Programme (SCHIP), a form of medical aid designed specifically for children, terminated when the child reached 18 years of age. The surgery had to be done expeditiously and grafting of bone also had to be effected at the time of surgery.

The mandible was prognathic thus complicating the case which ideally required double jaw surgery. The patient was, however, denied that option hence we were limited to maxillary surgery only.

**FINAL TREATMENT PLAN**

We planned to extract the UL2 at the time of surgery with eventual substitution of the maxillary lateral incisors by the canines. This meant that the midlines could not be used for the surgical setup. The premolars and canines had to be used as the surgical guides, with the maxillary first premolars as canines and in Class I canine relation (Figure 3). This information had to be clearly communicated to the surgeon. The bone defect on the right would be grafted during surgery as well. With the participation of the orthodontist, the pre-surgical setup was designed so that the maxillary and mandibular midlines were not
coincident, and the maxillary midline was off to the right with more overjet on the left. Orthodontic treatment proceeded after the required restorations were completed and fluoride treatment was delivered.

**POST TREATMENT REVIEW**

Two weeks post-surgery, the patient presented to the orthodontist with no overjet and the maxillary first premolars (now serving as the canines) in a Cl III relationship (Figure 4). We resolved to use a reverse pull headgear (RPHG) to protract the maxilla while closing the space from which the UL2 had been extracted. A midline correction loop was used to unilaterally close the space and move the maxillary midline towards the left (Figure 5). The RPHG was worn at night and Cl III elastics were used 24/7. The Cl III elastics (Moose, 6 oz, 5/16 inches, Ormco Corp, Glendora, Ca, USA) were prescribed to deliver both 1st and 2nd order vectors of force. The patient was seen every three weeks and the space was closed in three months with successful correction of the midline (Figures 6 and 7). However the occlusion was not refined as there was some relapse resulting in a less than perfect interdigitation of the teeth.

**DISCUSSION**

Both orthodontist and surgeon would prefer to conduct the surgical procedure when the respective dental arches are relatively well aligned and coordinated. This is especially true where extractions are involved and the situation demands prior closure of the extraction spaces. However this is not always possible for a variety of reasons, a major consideration being insurance limitations and in particular state/federally funded insurance programmes as in SCHIP.
Such programmes are an important resource. However, the cutoff age of 18 years presents some problems to patients with craniofacial anomalies since treatment is likely to extend beyond that age. Hence, the orthodontist and surgeon have to be prudent in their management of these patients to ensure the most appropriate care possible is delivered in a timely manner.

The patient presented in this paper demonstrated the importance of good communication and coordination between the orthodontist and the surgeon. Once the surgery is completed, it becomes the responsibility of the orthodontist to properly coordinate the arches. This can be a difficult challenge if the post-surgical outcome is not ideal... as indeed was the situation in this patient. While there was adequate communication between the orthodontist and the surgeon, some unpredictable things could still happen...... which in this patient was immediate post-surgical relapse.

The surgical planning should accommodate for relapse by over-correcting. This security was probably not properly provided for and the patient presented with a Cl III relationship at the orthodontic post-op appointment, which was only two weeks after surgery. In as far as this patient was concerned, better postoperative results could have been achieved had the surgical plates been removed to facilitate protraction of the maxillae. However, this was not possible since bone had been grafted over the plates. This type of grafting had to be done since the patient did not have adequate bone on the facial/buccal surfaces of the maxilla.

It is imperative that the patient visit the orthodontist as soon as immediately possible post-surgery, for a variety of reasons, one being the need for post-op control since it is the orthodontist who has the planned vision of how the teeth should interdigitate when all the procedures have been completed. A second reason in this case was that since the surgery was conducted prematurely the spaces should be closed as soon as possible post op. Teeth move by inflammation and all the relevant factors required for bone remodeling would have been activated by the surgery. Taking advantage of the surgical procedure is equivalent to performing corticotomies for enhanced tooth movement.5

The rate limiting step of tooth movement is bone resorption.6 Resorption depends upon the type and quality of bone as well as osteoclast (OC) recruitment to the remodeling site. OC are members of the reticuloendothelial system. These osteoclasts do not necessarily originate from the bone marrow but develop from circulating monocytes.7 Delivery of the osteoclasts to the remodeling site is also dependent upon the vasculature. The system becomes highly active when there is inflammation. The surgical procedure provides an opportunity for faster bone

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Figure 4: Immediate post-surgical photographs. The UL2 was extracted during surgery. Notice that the first premolars which are designated to substitute as canines are in Cl III relationship and the patient has no overjet.
Figure 5: Post-surgical photographs illustrating the closing loop that was utilized to move the midline to the left, subsequently closing the space. Notice the overcorrection of the midline.

Figure 6: Final records of photos
remodeling since all appropriate angiogenic factors come into play after surgery. Hence, it is prudent that the patient see the orthodontist as soon as immediately possible to initiate space closure. Efficient systems need to be designed to close the spaces as shown in the case presented here.

Based on the determinants of tooth movement which include type of bone, its quality and osteoclast recruitment, it may not be necessary to complete the space closure prior to surgery. Indeed, these movements should be easier and more convenient after the surgery. However, a proper plan needs to be in place well ahead of time to ensure efficient management of the patient immediately post-surgery. The role of the orthodontist becomes critical in the pre-surgical setup.

**SUMMARY AND CONCLUSION**

It is not necessary to always complete space closure prior to surgery. Teeth move faster immediately post-surgery. Tooth movement is an inflammatory process and this is enhanced by the surgery.

In such cases, it is critical that the orthodontist view the surgical setup considering that the greater proportion of the space closure will be accomplished post surgery. The orthodontist will need to see the patient as soon as it is physically possible after surgery to complete the necessary, orthodontic movements. The intervals between appointments will need to be shortened since the space closure is more of a distraction than regular tooth movement. The treatment of a patient was presented which demonstrated the importance of good communication between the orthodontist and the surgeon. The presentation demonstrated that extraction space closure can be accomplished much faster post-surgery.

**References**

Finally Finished: Part 7: The Writing Sequence

INTRODUCTION
Having taken the plunge, conducted the research, and analysed the results, the only step remaining is to write up the report and submit it for publication. As they say “There is no science without writing”. The purpose of a scientific article is to construct a clearly written manuscript that describes a question and then logically presents answers, based upon theoretical or experimental results. It generally consists of three main components: the overall idea, a detailed description of the execution and analysis of the work, and a discussion of the findings. The guidelines below deal mainly with how to go about writing and presenting the work for publication.

A recap of the major steps involved in conducting research are:

- Identification of a research problem
- Literature Review
- Specifying the purpose of research, the Aim
- Determining specific research questions, the Objectives
- Specification of a conceptual framework, the Hypothesis
- Explanation and Description of Materials and Methodology for data collection
- Data collection
- Verification and documentation of data, the Results
- Analyzing and interpreting the data
- Evaluating the results and debating the findings with reference to current literature, the Discussion
- Communicating the research findings, Publication submission

These steps represent an outline of the overall process. However, they should not be seen as a fixed structure, but rather an interactive set of activities. Most research begins with the problem statement, i.e. the purpose for conducting the study. The Literature Review acknowledges previous research in the field and helps to identify gaps in knowledge. It is often conducted before the research question is drafted as the identified deficiencies lead onto the research question, and provide justification for the study. The research question or Aim is synonymous with the hypothesis, and is the supposition to be tested. The Materials and Method then explains how the researcher will collect data to test the hypothesis. Results are then analyzed and interpreted via a variety of statistical methods. Discussion of the findings with reference to other literature help confirm or reject the Null hypothesis, and may lead to recommendations and suggestions for future research. Finally the paper is written up and submitted for publication.

When writing up the research, there is no strict sequence to follow, with different investigators all having personal preferences for tackling this task. Gauch suggested a “flip approach”, starting with the findings and discussion and then moving up to identification of the research problem that emerged from the findings, and finally conducting a literature review to introduce the findings. He argues that “the flip approach is justified by the transactional nature of the research endeavour where research inquiry, research questions, research method, relevant research literature, and so on are not fully known until the findings have fully emerged and have been interpreted”.

This paper presents an alternative writing sequence that may help guide novice researchers in their initial publications.

WRITING SEQUENCE
1. Begin with the Aim, and write it out as a concise problem statement. It should clearly state what is being investigated and why.

2. Next document the Materials and Method used. This is relatively easy as you will have just completed the study and should therefore know the exact details of the procedure. State: What was done; To whom; How it was done; and What materials were used to do it. It must be written with enough detail and clarity to allow others to duplicate the study. At this stage do NOT state what was found.
NB: Keep back-up copies of your work at regular intervals, and date them each time new information is added. At this early stage it is also advisable to select one referencing system and format, and keep to that throughout the paper. If possible make use of one of the referencing software programmes available (End Note; Refworks). Try to use the style recommended by the journal to which you wish to submit the final paper, as this will save a lot of time at the end. Many journals reject a paper before it is even sent for review, based on minor technical errors such as incorrect referencing, labels, figures, author titles and affiliations, and accompanying documentation. When doing this electronically it can take hours of valuable time to re-upload the entire paper. Look at the Instructions to Authors section of the journal to find the exact requirements and adhere strictly to them.

3. The Results are then documented giving full details of what was found, but not actually showing all of the raw data unless it is specifically required in that situation.

For each variable investigated there should be a corresponding point of finding. Results may be presented as written statements, in tables or as figures. However, don’t be tempted to exhibit the same results in all three forms. Choose the method which best suits that type of results or which highlights the information that you would like the reader to focus on. When deciding on which to use, consider that a figure may illustrate striking results better, however, figures are less exact than tables with numbers. Again, do not at this stage try to speculate as to why these results were seen or how the variables may have interacted with each other. There is no discussion or explanations in the Results section, but mention must be made of any outliers, fallout, or findings that were excluded, as well as the reasons for their omission. When using figures and tables, they are introduced as follows:

Table 1 represents the number of left-handed students in the final year dental class. Then insert a brief version of this statement as the table title, and place it above the table. (Note: Table numbers are written numerically as 1,2,3 etc. and not as Roman numerals, and ‘Table’ is capitalised).

<table>
<thead>
<tr>
<th>Category</th>
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<th>Series 3</th>
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<td>Category 3</td>
<td>7</td>
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If necessary take a few important points from the Table to mention in the results but do not repeat in words what is clearly evident from the charts. Similarly for Figures, Introduce the Figure with a brief statement, noting that the heading comes below the Figure. Be consistent with styles, fonts and colours for ease of reference when reading.

Don’t be tempted to elaborate with descriptive words or value judgements e.g., amazingly, we found that there were more left-handed girls than boys, which was very interesting. State only the facts. Mark Twain had some (very damn) wise words for authors when he said “Substitute ‘damn’ every time you’re inclined to write ‘very’; your editor will delete it and the writing will be just as it should be”.

4. The Discussion should be the main focus of the paper. As a guide, write one paragraph for each finding in the results, explaining what the findings mean. Now compare your findings with the literature that you have already reviewed during the planning stages. Structure and flow are important, thus each paragraph should end with a linking statement that leads into the next discussion point. Depending on the study type the structure can follow a geographical sequence where results are first compared to the local situation, then to the broader South African conditions, and then with global trends. It may be necessary to conduct another literature review to check for new developments, especially if a few months have elapsed since the research was initiated. It can be embarrassing to publish a “new” discovery and then find that others have already reported on the same findings. At least if you aware of this, you can link the new literature into your own paper showing how it substantiates your work or discus the differences. Throughout the discussion, try to link points to those mentioned in the Introduction. This ensures that the paper stays focused. NB: Do not suddenly introduce any new findings if they were not mentioned in the Results.

5. The Literature Review is best left until the end to write. By this stage you may be tiring, so it is an easier task to handle as you will have most of the information from your preliminary searches during your planning stages. It is also wise to leave it until the end in case any new research findings have emerged (see discussion above). Cite all relevant literature as you proceed, making sure to also include these in a comprehensive reference list. Chose and use only one reference style throughout (this should be that recommended by the particular journal to which you plan to submit your work). There are many software packages available that making citing literature easy e.g. End Note; Ref Works. It saves a lot of time and confusion later if they are used from the outset, especially when revisions are needed or new references added. Don’t be tempted to add references for the sake of embellishing the review. Use only those that are appropriate, current and relevant. The review should have three sections, an introduction, the main body and concluding remarks. In the introduction the basic ideas are presented, and placed into focused categories. Thereafter try to identify themes and dedicate a section to each, using a funnelling process. E.g. caries; caries in children; caries in children on medication. Other ways of ordering may be to follow a chronological progression, geographically (from local
to global) or developmentally. The concluding section of the review should tie up with the aim and objectives, and attempt to refine the research question, offering also possible recommendations or areas where future research is needed. It may also state the relevance of the study and possible clinical implications.

NB: Keep back-up copies at regular intervals, and date them each time you add new information.

6. The Conclusions should be a brief summary of the findings and should include a “take-home” message or recommendation based on the results. It should not be a repeat of the Discussion, and should not include further literature references. It should be concise and stated in the researchers own words. The conclusion to this paper is a good example. (It’s also a deliberate bad example in that it contains a reference, and the opening line repeats the same word three times. Try to avoid verbosity as well as repeated use of the same word. A thesaurus is a great friend).

7. Proof read the paper in its entirety to ensure it is coherent, and that ideas flow logically. Edit spelling and typing carefully and if necessary ask a second person to cross check this.

8. Finally insert the Abstract. An easy way to do this is to read through the complete paper and highlight one to two sentences from each of the sections above. Then, simply cut and paste each highlighted section in the correct sequence, and structure them into a comprehensive overview of the research in its entirety. The abstract should be a single continuous paragraph, which can almost be considered an independent document. It does not rely on any material in the body of the report and vice versa. It is a short, easy to read summary that clearly states the objective, the hypothesis and its evaluation, how the investigation was carried out, a precise summary of the results, and a final sentence describing the significance of the findings and the impact of this work or clinical applications.

9. Create a Covering page consisting of the research title which should be concise, descriptive and captivating. Include the names of the author(s), their qualifications and affiliations. Also provide approximately five key words. These words should correlate with words that a potential reviewer may type into their search engines when conducting a literature review. Obviously you would like them to match your paper so that it will be read and cited by others. In the covering letter many journals also require that you include Acknowledgements, such as efforts of participant or consultants who are not co-authors. A statement of where the funding for the project was obtained from, and any conflict of interest. The Committee on Publication Ethics (COPE) states in its Guidelines on Good Publication Practice (2003) that: “Conflicts of interest arise when authors, reviewers, or editors have interests that are not fully apparent and that may influence their judgments on what is published. They have been described as those which, when revealed later, would make a reasonable reader feel misled or deceived. Articles will be evaluated fairly and will not necessarily be rejected when any competing interests are declared”. Examples of conflicts of interest include: having received fees for consulting; having received research funding having been employed by a related company; holding stocks or shares in a company which might be affected by the publication of your paper; having received funds for attending a related symposia, or a talk.

You may also have to declare an Ethics statement, especially when the study made use of participants or patients. It should briefly state that the study was conducted in accordance with the guidelines set out by the Declaration of Helsinki, that consent was obtained and that anonymity and confidentiality were ensured. It may also be required to mention how data is being stored.

10. Finally, Submit for Publication (to the SADJI). This is the most important step after completion and editing is to submit the findings for publication. After all, the main aim of research is dissemination of knowledge to the broader scientific community, plus there is no greater thrill than to see your own name in print (and it impresses colleagues, family and friends!).

CONCLUSIONS

The conclusion should not have any references, however this Internet conclusion was the best conclusion we could find and has to be cited to avoid plagiarism! Close with logic. If the research paper presented multiple sides of an issue, use the final paragraph to present a coherent, rational opinion based on the evidence. Include enough information to back up the statement but avoid excess detail. If the research did not provide any clear-cut answers to the problem statement, indicate this. Restate the initial hypothesis and specify whether it should still be believed or if the research has proved otherwise. Specify that an answer may still exist and propose further research that could shed more light on the topic at hand.

References

Lasers in periodontics

INTRODUCTION
Ablation has been described as the expansive vaporisation of tissue. In periodontal procedures the ablation capacity of the laser can be used for excision and incision of pathology. The Erbium doped lasers can be used effectively for soft tissue procedures with or without water. It is essential that the air supply is turned off when soft tissue procedures or any procedure with a flap is performed, to prevent subcutaneous emphysema. Hard tissue lasers are effective in bone ablation provided that the water is present preventing collagen denaturation and necrosis of the targeted tissue.1 The clinician should be vigilant with the use of personal protective equipment due to the plume and blood spatter that develop. Patient comfort is increased when the hard tissue laser is used in place of the rotary drill, due to the relative low energy required to induce bone ablation.2

A SYNOPSIS OF LASERS IN PERIODONTICS
The lasers with the shorter wavelengths like the diode and neodinium-doped yttrium aluminium garnet (Nd:YAG) lasers are widely used due to their capabilities for deeper soft tissue penetration. The clinician should be conscious of the thermal tissue interaction of the various lasers in order to prevent high temperature damage to the underlying periostium and bone.3,4 In this respect the diode lasers have preset energy and wave selection settings that indicate to the clinician whether the tip must be initiated. Starting at these pre-set settings is advisable so that tissue interaction may be assessed before venturing to increased energy levels. Root damage during periodontal pocket lasing has been noted with settings above 1.5 W for diode lasers.5 The presence of chromophores like melanin and haemoglobin should be considered during the selection of energy levels since these pigments impact greatly on the absorption of laser energy.6

CONCLUSION
The use of lasers (Diode, Erbium, Nd:YAG) in Periodontics is generally accepted as adjunctive to traditional treatment modalities. Multiple published clinical trials have indicated only a slight improvement in the clinical attachment loss, some reduction in periodontal probing pocket depths, and no significant reduction in subgingival microbial loads.7 The greatest stumbling block for research which may have supported the option of lasers as an adjunct to traditional periodontal treatment was the lack of homogeneity between studies identified when a meta-analysis was performed.8

REFERENCES
A diagnosis of secondary hyperparathyroidism was made. Her blood picture at the time was as follows: serum calcium within normal limits, urea increased 7-fold, creatinine 13-fold and alkaline phosphatase 7-fold. The pantomograph (Fig.2) shows generalized relative rarefaction of the jawbones and absence of the lamina dura around the teeth giving the roots a tapered appearance. A unilocular radiolucency (red arrow) is discernible distal to the lower left 2nd molar tooth in the mandible, suggestive of a brown tumour. The skull radiograph (Fig.3) shows a generalized granular appearance. The radiopaque outlines of the maxillary sinus are not discernible. (Figs 2 and 3). Figure 4 shows granularity of trabecular pattern in bones of the hand and wrist and subperiosteal erosion of the cortex (green arrow), especially in the mid phalanges, and erosion of the terminal tufts (yellow arrow). A biopsy specimen was taken from the mandibular radiolucent area. Microscopic examination revealed a cellular fibrous lesion containing irregular trabecular bone and a few scattered multinucleated giant cells. With the available clinical data a diagnosis of a brown tumour of secondary hyperparathyroidism was made.

Chronic renal failure is the most common cause of secondary hyperparathyroidism. Failing kidneys do not convert enough vitamin D to its active form, and do not adequately excrete phosphate. When this happens, calcium is taken up from the circulation and insoluble calcium phosphate forms in the body. Both processes lead to hypocalcaemia and hence secondary hyperparathyroidism. The condition can also result from malabsorption (chronic pancreatitis, small bowel disease, malabsorption-dependent bariatric surgery) in that the fat-soluble vitamin D cannot be reabsorbed. This leads to hypocalcaemia and a subsequent increase in parathyroid hormone secretion in an attempt to increase the serum calcium levels. The bone changes of secondary hyperparathyroidism are identical to those found in primary hyperparathyroidism.

**Reference**

Dental identification of decomposed, burned and mutilated remains usually involves comparing the ante-mortem with the post-mortem dental records of the suspected victim. This procedure is dependent on the availability of usable ante-mortem records obtained from the respective dentist or dental specialist.

This suicide case involved a gunshot wound to the mouth. The individual had pointed the barrel towards his mouth, destroying the tooth crowns in the pre-maxilla area. Many of the posterior teeth which were unaffected by the shooting were however restored with amalgam fillings and root treatments were observed on three of the molars. The ante-mortem records received from the dentist contained handwritten notes describing a three unit porcelain veneer bridge which he had placed from the 12 to the 21. He stated that there was a root treatment on the first lower left molar, but had no other dental records or radiographs of the patient. The explanation given was that he had only done the anterior bridge and had noticed the root canal during that treatment. The digital radiographs had been destroyed in a thunderstorm and no backups had been made.

Although a root treatment was present on the 36 that was not sufficient for a positive identification to be made in this case without a radiograph of the tooth. Two days after the initial dental examination it was decided to revisit the body and see whether any clues could be found regarding the anterior bridge. The roots of the two anchor teeth were still intact, but no sign of the bridge was present on visual examination. The pre-maxilla was then re-examined under magnification. The magnified images of the two roots, after the mucosa had been retracted, clearly showed the margins of the bridge preparations. Figure 1 shows the prepared crown margin of tooth 12 as well as cement remnants on the prepared surface. The two pieces of the pre-maxilla were repositioned and showed that a bridge had been present before the shooting, see Figure 2. The presence of a root treatment on the 36, a missing 11, and crown margin preparations on the 12 and 21 were sufficient to positively identify the individual. All the above features are regarded as special dentistry and are thus uncommon in the general population. The positive dental identification expedited the return of the body to the next of kin. The alternative methods, namely DNA and fingerprint analysis, generally take extended periods to analyse which would further add to the psychological trauma of the already grieving family.

This case clearly shows the need for dental practitioners to keep good dental records. How was it possible for a patient who had extensive dental work, that radiographs were not taken, and that an odontogram or descriptions of the root canal treatments were not recorded? Also highlighted is the need to make backups of digital radiographs. It was only the force of circumstances that led us to perform microscopic analysis on the root remains of the teeth suspected of being the bridge anchors.

Reference

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Continuous education in sedation: 
The importance of training and updating the sedation practitioner

INTRODUCTION
The number of office-based surgery cases for minor and major surgical procedures under sedation has increased dramatically over the last few years. This emphasizes the importance of providing safe procedural sedation and analgesia to patients in this setting. Physicians providing sedation need to be trained and to update their knowledge and skills regularly according to contemporary sedation guidelines.

Keywords: Training, office based sedation, guidelines

DISCUSSION
Over the last few decades, there has been a dramatic increase in the amount of office based anaesthesia or sedation due to the rise in major and minor surgical procedures performed outside the traditional setting. This includes: physicians’ offices, dental offices, procedure suites, e.g. endoscopic suites, imaging facilities, emergency departments, other inpatient hospital settings and ambulatory surgical day centres.

Goodchild et al comment on the recent 2016 update of the Sedation Guidelines of the American Dental Association is to the effect that we need to raise the bar of safe sedation without creating barriers for access of care. They further say that previously outdated guidelines cannot continuously account for the constant changing variables – our patient population who are presenting for, and expecting, safe sedation.

Benefits of office-based sedations are numerous and include convenience, patient satisfaction, scheduling flexibility as well as a major increase in cost-effectiveness. However, it may not be appropriate for all practitioners or patients. Concerns about office-based surgery and anaesthesia are based on many factors. These include whether the facilities meet the requirements for safe practice, the provision of back up in case of medical emergencies, the ability of the practitioner to rescue and a lack of support personnel.

When setting up an office-based service, the physicians involved as well as the staff must be committed and enthusiastic to develop a culture of teamwork, safety and continuous quality improvement.

Worldwide there have been many attempts to unify sedation guidelines nationally, and on internationally agreed standards. These updated guidelines attempt to clarify contentious issues such as the use of continuous expired carbon dioxide monitoring, as well as the level of training that practitioners should have to be able to conduct office based sedation safely.

Research suggests that equipment and facilities should meet the requirements for safe practice and personnel should be properly trained and accredited. Safety check lists have also been devised to improve patient outcomes.

Structured sedation protocols aimed at incorporating safety principles have been widely implemented and shown to successfully reduce morbidity of office-based sedation. Procedural sedation, especially for paediatric patients, has serious associated risks.

Practice recommendations are based on the well-known fact that even if a deeper level of sedation was not intended, the sedation of any patient may present a continuum on which a patient can be more deeply sedated than intended, and therefore at risk of respiratory depression, apnoea, loss of protective reflexes, and cardiovascular instability.

Practitioners performing office based sedation need to understand that the specific setting generally lacks immediate backup. Even if medical services are requested immediately in cases of emergency, the sedation practitioner is responsible for life-support measures while awaiting that back up.

Some studies suggest that these skills are best maintained with frequent simulation and team training. Rescue techniques require specific training and skills.

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Competency with emergency algorithms, especially of the airway, is fundamental for safe sedation and successful patient rescue. The American Academy of Pediatrics published their newest guidelines in 2016 and suggest that practitioners who administer moderate sedation to pediatric patients, as well as their support personnel, need to be trained in providing life-support, such as is offered in the PALS (pediatric advanced life-support) course.

What can sedation practitioners currently use as guidelines and training opportunities to keep updated and appropriately trained to administer safe sedation and able to manage known complications?

SOSPOSA is a special interest group of the South Africa Society of Anaesthesiologists (SASA) as well as a member of the International Federation of Dental Anaesthesiology Societies (IFDAS). Every year, several conferences and opportunities are presented, in which practitioners can partake.

SASA and SOSPOSA offer sedation refreshers courses at their annual conferences and the post-graduate Sedation Certificate is another training opportunity for practitioners. Advanced life support courses such as PALS and ACLS, as well as basic life support for supporting staff can be completed at various facilities across the country. International conferences are also opportunities when practitioners can be updated in their sedation knowledge, skills, and gain Continuing Professional Development (CPD) points. A part-time Postgraduate Certificate course over a year is also available for training in sedation.

Internationally, various part-time post-graduate courses are available as well as regular conferences from motivated sedation societies when clinicians have access to continuous education and training. The Academy of Medical Royal Colleges in the United Kingdom (UK) states in their most recent manifest “Safe Sedation Practice for Healthcare Procedures” that the “ultimate responsibility” lies with the sedation providers to ensure that they have adequate training to know the risks involved and how to respond to these situations.

In the UK both the Royal College of Anaesthetists and the Society for the Advancement of Anaesthesia in Dentistry (SAAD) support the concept of training in sedation, and the regular update of knowledge and skills.

All evidence in the research points to the importance of a better culture of safety in the ambulatory setting. The 2015 SASA guidelines point out that adverse events occur mostly due to facilities not meeting the requirements for safe practice, to inadequate monitoring, to the inability of the practitioner to manage complications and rescue the patient, as well as to the premature discharge of patients.

Practitioners need to ask themselves whether they are capable of managing a patient’s airway and ventilation should the level of sedation inadvertently become deeper than planned. The ability to rescue a patient has a major impact on the outcome of the adverse event. Practitioners providing sedation must be well trained in both sedation and emergency medical care and be prepared to rescue or manage a serious medical emergency.

Conclusions

Bitar et al. conducted a study which considered the safety and efficacy of anaesthesia and sedation in 4778 consecutive plastic surgery cases. They concluded that appropriate accreditation, safe anaesthesia protocols and proper patient selection constitute the basis for safe and efficacious office-based outpatient surgery.

Guidelines, training and protocols remain the cornerstones of providing a safe sedation service.

References
 Request for records by demanding patient

From the first encounter and at the first consultation, the practitioner knew that the patient would be demanding. The patient continually interrupted the dentist and offered diagnoses based on what she had obtained from Internet searches. Practitioner and patient tolerated each other. Despite this, the dentist completed the initial phases and when it was time for the final treatment, the dentist collected laboratory costs in advance as the patient had no medical scheme cover or insurance. On the day of fitting and delivery of the prosthesis, the patient informed the practitioner that she had forgotten her chequebook and cards and was unable to make payment. The patient made some complaints about the appearance and fit of the prosthesis and the practitioner made detailed notes about this interaction.

Some weeks later the patient had made no effort to pay the bill or to call the office. The practice then received a fax from another dentist accompanied by a signed consent by patient with a request for the patient’s records. The letter from the dentist explained that as this was a patient new to his practice, early receipt of previous records would be appreciated. The first dentist then faced a dilemma… should the new dentist be informed about the ‘problem’ patient and that the bill had not been paid? Should the new dentist be warned?

Does the first dentist add a “bad debt” entry to the notes, send the copy of the records and write off the balance? Or does the practitioner send a copy of the records with a letter of caution about how difficult the patient has been and detailing the unpaid bill. Or does the practitioner send over the records and hand over the bill for collection?

RELEASE OF RECORDS

On the issue of release of records there is really no question. The HPCSA Ethical Rules stipulate that practitioners shall provide patients with their records on request. Dentists may furnish copies and charge a nominal fee for that service. However, dentists may not withhold records because accounts are overdue. The Promotion of Access to Information Act, 2000, permits a person to request records to exercise or protect their rights.

Another issue for consideration is that to whom is it that the dentist owes a duty… to the new dentist (professional colleague) or to the ex-patient who the practitioner dislikes? The ethical obligation to the patient is more compelling than the obligation to colleagues. The Ethical Rules provide that the first and primary duty of practitioners is to benefit the patient and business obligations do not obviate the professional duty of putting the welfare of the patient first.

Some practitioners also believe it is improper to mix financial information with the clinical information. Sending financial information is not normal practice when patient records are requested.

INFORMED CONSENT

The patient often interrupted the practitioner during consultation and treatment and expressed dissatisfaction with the dental services provided. The patient held firm views on treatment outcomes, some of which conflicted with the practitioner’s recommendations. The moral foundation for informed consent is respect for patient autonomy. Patients have a right to make informed choices about what will be done to their bodies.

The patient severed the professional relationship with the original practitioner and is entitled to request that her records be sent to the new dentist. The practitioner is justified in handing over the unpaid account for collection.

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In line with the Health Professions Council of South Africa (HPCSA)'s Strategic Goal of an Improved Business Model to enhance performance, the HPCSA has developed an Online Renewal and Fee Payment Portal that will provide a simpler, quicker and more efficient Annual Renewal of Registration process.

PREFERRED PAYMENT METHOD
From 1 March 2017, practitioners may visit our website on www.hpcsa.co.za and go to Online Renewal tab to renew their registration and make annual fee payments online. We are encouraging all practitioners to use the online portal as it has the capability to generate a Practicing Card immediately after payment is made. The new Practicing Card can be saved on any device, sent via email or printed and is acceptable proof of renewal of registration.

STEP-BY-STEP GUIDE ON RENEWAL AND PAYMENT
Renewal and payment processes are completed in four easy steps as follows:

**Step 1:** Create an HPCSA account – Requirements: 13-digit ID number or passport number

**Step 2:** With ID Number as username and password created in Step 1, LOGIN and Renew. Personal details may be edited at this stage

**Step 3:** Make Annual Payment through Credit or Debit Card or Integrated EFT or Bank Deposit

**Step 4:** Access the HPCSA Practicing Card – electronically or print out.

ALTERNATIVE PAYMENT METHODS
The current payment process via Electronic Funds Transfer (EFT) or bank deposits to HPCSA's ABSA bank account will still be available for practitioners who prefer this method. Even if Practitioners decide not to pay online, they are encouraged to update contact details and provide other relevant information which is requested by the HPCSA on the portal.

For practitioners who opt to pay via EFT or bank deposit, the practicing card will only be accessible on the portal after 72 hours of receiving payment depending on payment method used.

CARD PRINTING
HPCSA will still be printing practicing cards in the old format for practitioners who prefer this format. We do however anticipate to fully migrate to the new electronic format for the 2018/2019 renewal period. In the meantime, all three Practicing Card versions – the QR code encrypted download, the printed summary with QR code and the old practicing card – are acceptable as proof of renewal of registration for the year 1 April 2017 to 31st March 2018.

INSTRUCTIONS ON USING THE PORTAL AND QR CODE SCANNING
For a step-by-step guide to access the Online Renewal and Payment Portal and a guide on the scanning process of the QR code, please go to www.hpcsa.co.za.

ENQUIRIES
Practitioners may contact the HPCSA on our Call Centre number: (012) 338 9300/1 or email us on: info@hpcsa.co.za for assistance.
1. Effects of three types of digital camera sensors on dental specialists’ perception of smile esthetics: a clinical trial


Facial attractiveness and aesthetics have become increasingly common reasons why patients seek dental care in today’s digital world. As dental practice has become computerized, digital photo documentation has also become a standard procedure because of its numerous clinical and research advantages.1

The quality of an image might influence the perception of beauty. Although the main goal of dental imaging has been documented, the general population has become more familiar with and indeed, reliant upon, digital file sharing, and hence dental practice might come to depend more and more on the quality of digital images. It is possible for clinicians to share the results of their practices with each other or with their patients. One of the concerns of patients or dentists might be the beauty of the images, regardless of the technical attributes. Patients might mostly seek aesthetic improvement, and other clinicians might judge one’s work primarily based on aesthetic factors. Therefore, more appealing digital dental images might be considered a clinical advantage.

Nevertheless, it is not known whether objective camera properties might contribute to the subjective judgment of clinicians regarding facial beauty, as there is no relevant study at any level. In digital devices, many of the properties of these images may be affected by the type of digital sensor. The most common types of sensors are CCD (charged coupled device) and CMOS (complementary metal–oxide–semiconductor). CCD is one of the oldest image-capture technologies for digital cameras and has long offered superior image quality compared with CMOS sensors, with better dynamic range and noise control. Although CCD is still prevalent in budget compact models, its complex design and greater power consumption have for the large part prompted camera manufacturers to preferentially choose CMOS alternatives.

CMOS has in the past been considered inferior to CCD, but today’s CMOS sensors have been upgraded to match and even transcend the CCD standard. With more built-in functionality than CCDs, CMOS sensors work more efficiently, require less power, and perform better for high-speed burst modes. The sensor determines just how good the images will look and how much magnification can be applied for viewing or printing. Image quality depends not only on the size of the sensor, but also on how many millions of pixels (light-sensitive photosites) fit on it, and the size of those pixels.

It is also not known whether expertise in a specific aesthetic dental specialty might change the perception of beauty. There are no studies on the influence of camera type in general (and the sensor in particular) nor on the effect of speciality experience on the judgement of beauty. Sajjadi and colleagues (2016) reported on a study that sought to comparatively evaluate the scores of beauty as judged by 12 experts of photographs of smiles taken using cameras equipped with three different digital sensors.

MATERIALS AND METHODS

In the first phase of this clinical trial, 40 female dental students (18 to 24 years old) were evaluated to include students with balanced faces and Angle class I molar relationships. A balanced face was defined as a face looking subjectively normal (but not necessarily beautiful), with no distinguishable disharmony between its facial features, or no excessive departures from normal facial angles, ratios, or linear measurements all regarded subjectively as population norms by two experienced faculty members of the orthodontic department (an orthodontist and a dentist). Participating students needed to be in complete health, without syndromes, and not to be taking any medications.

Smile photographs were taken of posed smiles of the all the enrolled participants under standardized conditions (no makeup, natural head position, focal spot of 100mm, distance = 60mm, f/8, no flash light, standardized fluorescent light, a white background, brightness set at White Balance). The coded photographs were taken using a single 18.0-megapixel digital single-lens reflex (DSLR) camera (EOS 550D; Canon) equipped with a macro lens, and installed on a tripod. The grid visor of the camera was set at taking the lower one-third of the face.

A panel of experts (six orthodontists, three prosthodontists, and three specialists in restorative dentistry) were asked to rank the beauty of the smiles independently. The smile...
photographs were sorted into a random order. The same order was given to all judges. Each judge viewed each image for 20 seconds, without any rewind. They used a 100mm visual analog scale (VAS) to rate the beauty of each smile. After 2 weeks, the images were sorted in a different random order. The images were handed again to the same judges. They rated the images in exactly the same manner. The VAS scores were converted into ordinal scores 0 to 10. The rank of each image was calculated by summing up all the scores awarded by all judges in both sessions. The total ranks were used to select the 20 smiles with the highest scores.

The 20 students with the highest smile ranks were again invited for photography. Digital photographs were taken by a sixth-year dental student who was trained and calibrated by a faculty member certified and experienced in photography, who also supervised the procedures. The posed smiles of the 20 students were photographed using three different calibrated cameras (EOS 5D Mark II; EOS 550D; and PowerShot G12; Canon). A tripod (Canon) was used to ensure a similar distance of the cameras from the students. The camera frames were different, but they were equipped with similar regular lenses (100mm focal spot). The lenses of the 5D and 550D cameras were identical. The lens of the PowerShot camera differed from the other two in terms of its size and model, but was set at 100mm focal spot as well. No macro lens was used in this study. The camera configurations were calibrated and standardized for all cameras (set at manual setting, ISO=800, shutter speed = 1/125 or 1/250, flash; on, distance: 50cm, white balance setting, and f/8). The background was plain white. The natural head position was standardized by asking each student to look at her own image in the mirror placed in front of her (behind the camera).

The cameras had three different sensors:
1. Full-frame 35.8 × 23.9mm DSLR 21.1-megapixel complementary metal–oxide–semiconductor (CMOS) sensor (camera: EOS 5D Mark II, Canon)
2. Advanced Photo System type-C (APS-C) half-frame 22.3 × 14.9mm (1.6x conversion factor) DSLR 18.0-effective megapixel CMOS sensor (camera: EOS 550D, Canon)
3. Compact 7.62 × 5.59mm 10.4-megapixel charge-coupled device (CCD) sensor (camera: PowerShot G12, Canon)

The images were first sorted in a random order. The same order of images was shown to all judges. Each image was seen for 20 seconds (by the automatic slide view feature, set at 20 seconds) without rewind and without skipping any images. Each expert evaluated the beauty of the smiles on a Visual Analogue Score (VAS). The VAS was converted to 11 equal ranks (0: definitely not pleasing, 10: extremely beautiful). The same procedure was repeated two weeks later, in another (randomly chosen) order. The same random order of images was used for all judges. The average score given over the two sessions to each image was calculated. The study was double blind: the judges were blinded to the type of sensors, and the images were coded.

RESULTS

The highest average beauty score was obtained by images recorded on the 5D camera (full-frame sensor), and the lowest average beauty score was related to the G12 camera (compact sensor), which exhibited a 52% decline in the VAS score. The Kruskal-Wallis test detected a significant difference between the scores pertaining to different sensors (p < 0.0001). The Mann-Whitney U test indicated significant differences between the full-frame sensor and the half-frame and compact sensors (both p values < 0.01); however, the difference between the half-frame and compact sensors was not significant (p > 0.1). The scores given by each group of specialists were close together and not significantly different according to the Kruskal-Wallis test (p = 0.7). The two-way ANOVA exhibited a significant difference between the sensors (p < 0.00001); however, the differences between the scores of the specialties (p = 0.687), and the interactions of the variables “specialty and sensor” (p = 0.894) were nonsignificant.

CONCLUSIONS

The results of this study suggested that sensor resolutions and qualities might affect the subjective judgment of smile beauty. The full-frame sensor of 21.1-megapixels might result in more appealing images and higher consistencies in the perception of beauty. The results of half-frame 18.0-megapixel and compact 10.4-megapixel sensors might not necessarily differ in terms of subjective smile attractiveness. Dentists of different specialties (orthodontics, prosthodontics, and restorative dentistry) might have similar subjective judgments of smile beauty.

IMPLICATIONS FOR PRACTICE

This study revealed for the first time that some types of digital sensors (and some levels of image quality) might affect the perception of beauty as assessed on a digital photograph. Clinicians should take the advantages versus limitations of each sensor (and camera) into consideration when purchasing a camera. If perception of beauty is an important variable, it might be recommended to use the full-frame sensor, judged best among these three assessed sensors.

Given the very close results of the three specialties, it might be concluded that different dental fields have similar aesthetic standards, which might be favourable in multidisciplinary tasks.

Reference

2. Fitting accuracy of zirconia single crowns produced via digital and conventional impressions—a clinical comparative study


As Dentistry moves into the digital age, computer-assisted design/computer-assisted manufacturing (CAD/CAM) of dental restorations is becoming a common feature of many dental practices and teaching/training institutions today. Currently, most of the systems allow for the digitizing of whole quadrants and jaws and additional scanning and correlation of antagonistic teeth. The potential benefits of these intraoral scanning (IS) processes are an improved patient- and operator-acceptance and potential cost- and time-effectiveness.1

The first generation of IS systems required the application of a scanning powder. More recently introduced technologies based on confocal imaging have no such requirement. This simplifies the clinical handling but might affect the accuracy of the scanning results as the powder layer is omitted. Clinical data on these “powder free” intraoral scanners are still sparse.1 Moreover, the precision of a IS can be influenced by several factors, including the finishing line location, moisture control, and patient compliance or scanning strategies.1 Intraoral scans, especially in the molar area where only limited space is available, are challenging. In these areas, the oral cavity limits the handling of the so-called scanning wand. Furthermore, moisture control in these areas is more challenging than in the anterior region.1

As all IS systems can scan only visible and dry areas, this is of high practical relevance, because scanning accuracy may be affected.

Conventional impression (CI) taking with reversible or irreversible elastic impression materials is still a widely used method for generating an exact replica of the intraoral situation and transferring this information to the dental laboratory as the basis for the fabrication of indirect dental restorations. For both methods (CI & IS), the precision of marginal fit and the internal fitting accuracy of the fabricated dental restorations are crucial factors in determining the clinical long-term success. An insufficient marginal fit can lead to plaque retention and washout of the luting agent, allowing secondary caries, periodontal, and pulpal inflammation or retention loss of the restoration.1 Additionally, the consequences of an insufficient internal fit could result in a loss of axial retention, missing rotation stability, and reduced fracture toughness.1

Although there is some controversy regarding the clinically acceptable marginal gap, most authors have accepted a maximum marginal gap of 120 μm as the minimum clinically acceptable standard.1 Rödiger and colleagues (2017)1 reported on a prospective clinical study which sought to evaluate the marginal and internal fit of zirconia molar crown copings manufactured with conventional and intraoral digital impression techniques using a replica technique. The null hypothesis was that the zirconia copings based on digital impression taking would offer statistically significant better marginal and internal accuracy than copings produced via conventional impression taking.

ACRONYMS
CAD/CAM: computer-assisted design/computer-assisted manufacturing
CI: Conventional impression
IS: intraoral scanning

MATERIALS AND METHODS
Twenty patients who met the following inclusion criteria were accepted into this study: they were of legal age and in need of at least one single crown (free from clinical symptoms) in the molar region; the tooth had a visible finishing line not more than 1mm below the gingival margin and patients had an adequate level of oral hygiene expressed by the absence of bleeding on probing and a periodontal pocket probing depth of <4mm. Two restorations in each patient per abutment were manufactured—one coping via conventional impression (CI) and one via digital intraoral scanning (IS). All patients received a fitting of copings with the assessment of internal and marginal fit using a replica technique. Thus, 20 specimens per group were evaluated. After the evaluation of clinical fit, the framework that offered the best accuracy was veneered and inserted.

In terms of tooth preparation, all abutment teeth received an adhesive core built-up with a self-curing using an adhesive system (OptiBond). The preparation was performed under local anesthesia with the objective of getting a 90° chamfer finish line with a circumferential reduction of 1.0mm and an occlusal reduction of 1.5mm. The convergence angle was set at approximately 6°–10°, and all edges were rounded. After preparation, the teeth received a provisional restoration fabricated from an auto-curing resin-based material. Impressions were taken after a minimum waiting time of 7 days to allow complete healing of the soft tissues. Before taking digital and conventional impressions, retraction cords were applied using the double-cord technique for rendering of the finish line.

Prior to the conventional impression taking, the digital intraoral scan using the cara TRIOS system (Heraeus Kulzer, Hanau, Germany) was performed. No powder application was required for this system. The resulting digital data set was directly transferred to a CAD software digital design of the zirconia copings. Additionally, a working model based on this data set was printed by scan LED technology using a light-curing resin. According to the manufacturers’ information, the models were fabricated with a layer thickness of 50 μm and a lateral resolution (edge length of a pixel) of 32 μm. This model was used for the manual adjustments of the copings before the clinical fitting.

For conventional impressions, a one-step putty-wash technique with a polyvinyl-siloxane material (Aquasil Monophase + Aquasil XLV) was used according to the manufacturer’s instructions. To improve the accuracy of the impression, custom impression trays based on study models were implemented. The antagonist arch impression was taken using an alginate material (Blueprint).
To create a data set for the digital design (CAD) of the zirconia copings, the impressions were used to fabricate stone models for indirect digitalization via a model scanner (3shape D700, cara TRIOS).

All copings for both groups (CI and IS) were designed by the same experienced dental master technician using the same software (Dental Designer 2014). All restorations were designed and manufactured using the same settings and following the manufacturer’s recommendations (cement spacer, 40 μm, minimum wall thickness, 500 μm, edge reinforcement, 200 μm).

To assess the clinical accuracy of the copings regarding marginal and internal fit, the inner surfaces of the copings were coated with a white-coloured low-viscosity silicone (Coltex) before seating it on the respective abutment with maximum finger pressure for 10 s. After 4 min, the copings were carefully removed, and to stabilize the adherent thin white silicone film, the crowns were filled with a more rigid orange-colored silicone (Aquasil) to obtain a good contrast for the discrimination of the different layers. Then, the silicone replica was carefully removed from the coping for further processing.

In addition to the undercoating of the white silicone layer representing the marginal and internal gap with the orange silicone (replacing the abutment), a custom-made box was used to cover the replica specimens with a blue-coloured silicone (Aquasil), thus replacing the framework. This box was designed to ensure that the position of all specimens was exactly centralized in the encasing blue (opaque) silicone layer, with all specimens having the same mesio-distal orientation. This allowed for sectioning into four pieces (respectively the measurement locations) of each specimen in the mesio-distal and bucco-oral direction in a reproducible and comparable manner. The four sections of each specimen were used for measuring the internal and marginal gaps by one calibrated examiner. Two sides of each section (mesio-distal and bucco-oral) were evaluated at six points for internal gap (ca = chamfer area, aw = axial wall, aw min = axial wall minimum discrepancy, aw max = axial wall maximum discrepancy, aot = axio-occlusal transition area, oa = occlusal area) and at two points for marginal gap (mg = marginal gap, absol mg = absolute marginal gap). Replica film thickness was measured on digital photographs captured by the integrated camera of a light microscope with a magnification factor of ×35 and a special measuring software after calibration.

RESULTS
When comparing both groups (CI vs. IS), only two locations revealed significantly better internal accuracy for IS: “chamfer area” (ca) (117.94 ± 74.21 μm vs. 147.88 ± 63.88 μm) and “occlusal area” (oa) (164.22 ± 73.17 μm vs. 207.60 ± 69.99 μm) (p ≤ 0.05). The lowest values for internal accuracy in both groups was found at the axial wall (aw min) (CI 43.56 ± 36.98 μm, IS 34.79 ± 28.67 μm), whereas the poorest fit could be found in the “occlusal area” (oa) for the CI group (207.60 ± 69.99 μm) and in the “axio-occlusal transition area” (aot) for the IS group (187.17 ± 77.35 μm).

When comparing the values of the CI group and IS group, no significant differences could be demonstrated regarding marginal accuracy (CI 82.17 ± 75.17/IS: 87.4 ± 91.2)

CONCLUSIONS
The researchers concluded that the CAD/CAM-fabricated single tooth restorations in the posterior region produced by an intraoral scanning system using confocal imaging offered a comparable, or even better, precision of marginal and internal fitting accuracy than restorations based on conventional impressions in combination with the laboratory scanning technique.

IMPLICATIONS FOR PRACTICE
The study results suggest that the complete digital workflow including a digital impression technique can be rated a suitable alternative for conventional impressions, followed by a lab-side digitization, and a CAD/CAM manufacturing process in indications where the preparation limit is visible and only slightly subgingival. The conventional impression method however remains the “gold standard” as the crowns produced using this technique are still within the clinically acceptable marginal gap limit of 120 μm. Additionally, the authors of this study have highlighted the use of digital technology within certain clinical parameters to ensure clinical success.

Reference
GENERAL

1. Identify the INCORRECT statement: The following are characteristics of Human papillomavirus:
   a. Sexually transmitted.
   b. Small double stranded DNA virus.
   c. Less than 100 varieties have been identified.
   d. The link between HPV and carcinogenesis was identified in 1977.
   e. HPV infection of epithelium is initiated through the basal cells.

2. The clinical features of HPV-associated lesions are dependent on the subtype of HPV but not the site of infection.
   a. True
   b. False

3. Early entry of high-risk HPVs enter the epithelial lining of the tonsillar crypt, making the tonsillar area the most prevalent extra-anogenital site for the development of HPV-associated carcinoma.
   a. True
   b. False

4. HIV/AIDS patients on anti-retroviral therapy exhibit lesions which are multiple and multifocal and are frequently larger than the solitary variant seen in non-HIV/AIDS patients.
   a. True
   b. False

Biaxial flexural strength of three ceramic oxide core materials (p 56)

5. Identify the CORRECT statement:
   Poor bonding between the substructures and the overlying porcelain in platinum bonded alumina cores was associated with:
   a. Inadequate adaption of the platinum
   b. Inadequate firing of the porcelain
   c. Inadequate wetting of the platinum
   d. Inadequate thickness of the porcelain

6. The addition of yttrium oxide leads to the formation of a yttrium-stabilized tetragonal zirconia polycrystalline (Y-PSZ) ceramic which permits the characteristic high fracture strength of Zirconium oxide- based ceramics.
   a. True
   b. False

7. All the materials tested in this study were shown to be of a strength adequate for use in the posterior segment.
   a. True
   b. False

Xerostomia and salivary flow rates in HIV patients (p 62)

8. Identify the INCORRECT statement:
   The functions of saliva include:
   a. Lubrication
   b. Antimicrobial capabilities
   c. Antifungal capabilities
   d. Tooth remineralization
   e. Stimulation of blood flow

9. Identify the INCORRECT statement:
   The effects of HAART on the parotid gland are proposed to be
   a. Salivary gland hypoplasia
   b. Parotid enlargement
   c. Lymphocytic infiltration
   d. Immune reconstitution inflammatory syndrome
   e. Lipomatous changes

10. Identify the CORRECT statement:
    Reduction in saliva flow rates:
    a. Increases risk of caries
    b. Improves the retention of intra-oral devices such as dentures
    c. Reduces the risk of opportunistic candida infections
    d. Is always indicative of xerostomia
    e. Is determined by completing a questionnaire with patients

A comparative study to determine the shock absorption ability of two popular mouth guards available on the South African market. (p 68)

11. Most countries are ruling the wearing of mouthguards compulsory in contact sports
    a. True
    b. False

12. Identify the CORRECT statement:
    Some types of mouthguards have recorded impact absorbing rates as high as:
    a. 65%
    b. 95%
    c. 83%
    d. 75%
    e. 55%

13. Multiple layers of polyolefin material in a mouthguard confer higher shock absorption rates.
    a. True
    b. False
14. It was not possible to rely on the verbal record of the dentist in identification of the victim in this case because the models of the teeth were not available.
   a. True
   b. False

Maxillo-Facial Radiology Case 148 (p 84)

15. Hyperparathyroidism may cause loss of the radiopaque lines of the maxillary sinus.
   a. True
   b. False

16. Chronic renal failure is the most common cause of secondary hyperparathyroidism.
   a. True
   b. False

A compromise between orthodontics and surgery: a case report (p 74)

17. Space closure after surgery is usually faster because:
   a. There is enhanced patient compliance
   b. The patient experiences little pain
   c. There is an enhanced inflammatory response
   d. The teeth have been physically loosened by the surgeon.

Lasers in Periodontics (p 83)

18. Diode lasers have favourably deeper soft tissue penetration but root damage during periodontal pocket lasing has been noted above 1.5 W.
   a. True
   b. False

Clinical Windows (p 90)

19. In the Sajjadi et al trial, there was a strong correlation between high beauty scores and full-frame sensor cameras.
   a. True
   b. False

20. In the Rödiger et al trial, values for marginal accuracy favoured the CI group.
   a. True
   b. False

ETHICAL

Request for records by demanding patient (p 88)

21. There is no requirement for the release of records to a patient requesting their documents.
   a. True
   b. False

22. Apart from the HPCSA Ethical Rules, which legislation governs the release of records?
   a. The Freedom of Expression Act
   b. The Health and Allied Professions Act
   c. The Higher Education Act
   d. The Promotion of Access to Information Act

23. To whom is the dentist most obliged ethically?
   a. His/her colleagues
   b. The patient
   c. The Dental Protection Society
   d. The Medical Aid

24. The moral foundation for Informed Consent is respect for patient autonomy.
   a. True
   b. False

25. The practitioner may charge for copies of records which are requested by a patient.
   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.

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Please supply 5-8 questions related to your article, at least three of which should be in the multiple choice format. Answers must be either True or False or, if multiple choice, have only one correct answer. Please provide answers to the questions.

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