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Editorial

You still use Dycal?

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I remember in dental school the words Dycal liners and bases rang supreme in the preclinical setting. Since first year of “dental preclinic” we were always told about a variety of products to soothe the tooth after preparation, to help sustain its vitality after the trauma that is preparing the tooth. Whether from micro-fractures, bacteria or etch sensitivity, we knew we wanted it gone quick to be successful at our mission. However, not enough curing lights were available to teach us how to use composites, never mind, light activated liners coming out such as Limeline and Vitrebond. So upon our ripening in the finally of second year, we would be unleashed on real teeth, attached to real live people. These real people we saw in the dental school clinics also wanted composite fillings as well, and without cold sensitivity.

It was always tough to teach composite back in the 2000s since most of the preclinical chairs didn’t have water and suction, but each station had a mercury disposal jar. So liners fell by the wayside. These live patients also wanted their teeth to not require root canals, even though for years now these people had not cared for, nor brushed, never mind flossed their teeth. But at the dentist office it was now my inherited problem and I had to preform the Herodontics needed to save these teeth and avoid the perception of impending DOOM of a root canal. Even if the patient never had a root canal, the words, letters R.C.T. alone, are enough to always have the patient reply… “do I really need one, isn’t there something else that could be done?” As if we’re in a lunch deli.

The answer was always based on the depth of decay, but there were always those radiographs that looked deeply decayed, but with a glimmer of hope of saving the tooth from a root canal. Especially on a young patient or a tooth with that small amount of decay that you know you can get away with leaving behind if there was just something to make it not hurt after, and kill off as much of the remaining bacteria as we can, then the tooth could pull through and heal, remaining in reversible pulpitis and hopefully returning to health.

We were taught to etch teeth for 30 seconds in preclinic and to use Dycal sparingly because composites do not bond to a big useless glob of chunky white liners. Whether on amalgam or composite restorations, it is always best placed in the tooth’s center, as well as in deep areas of removed decay in the core build up or an operative cavity preparation, in sparing amounts since it is not a solid substance but a highly malleable one. We were told that Dycal would desensitize the deep areas of lost tooth more proximal to the pulp chamber and help kill off the lingering bacteria. However, after a few 30-second etchings, Dycal was just not enough and the clinic staff finally introduced us to Vitrebond. And this love affair continued together with Dycal and Vitrebond for years to come, and we did a lot of indirect pulp caps, and a few small direct ones. I continued to use liners in small amounts often on anything I consider a deep area of the prep. Anything that’s deeper then 2 mm qualified in my book, and I would always line with Vitrebond if in doubt.

4 years ago and years since graduation, we opened our practice and my goal was to fight the need for root canals. The idea was to use resin liners and cleaning materials like Chlorohexidine and Hydrogen peroxide in varying concentrations on the insides of the isolated tooth preparation areas to avoid sensitivity and nagging post-op discomfort. Both of the rinses worked well, but not better then Dycal and Vitrebond in the short term post-op sensitivity.
Before this my team and I worked on our amalgams and composites with my old friend Dycal in real deep, spots and Vitrebond on top. We removed a lot of old amalgams and composited, all of them lasting decades, but all of them ending in cracked anatomic tooth crowns and a need for prosthetic crown and bridge work.

As we were building the office, what I envisioned to be the greatest place to get dentistry both as the provider and a patient I ran into an article on www.DentalTown.com. The article mentioned using Sodium Hypochlorite as a 2 minute wash before a Vitrebond Glass-Ionomer style liner was applied after a full rinse and dry.

The first time trying the procedure after the read I was nervous and used the Endodontic designated Hypochlorite gel, which was much less potent and useless as a viscous wash then it may be as an endodontic irrigate. Since we saw no blanching of the dentinal tubules as in the Dental Town article, we tried a second wash of pure Sodium Hypochlorite. After the second 2-minute wash the tubules looked noticeably cleaner and blanched. The tooth is then rinsed and dried for a few seconds (5-10 seconds) and after the tooth is dry we proceed to place the Vitrebond Liner.

While maintaining dryness on the tooth prep, we layered a liner size layer of Vitrebond under a millimetre in thickness in the deepest areas of the prep. However, no trusty but brittle Dycal was used.

The 2-week follow-ups consistently showed the least amount of post-op sensitivity then we have ever had before. Even with the pulp less than a millimetre away and even in some direct yet small exposures, the Hypochlorite wash almost always lead to a successful result with the Vitrebond liner. And at times the Hypochlorite would even help stop the chamber bleeding in the exposure site of the perforation after the 2 minute wash.

After the liner was cured for 20 seconds the tooth was Phosphoric Acid 37% etched for 15 seconds, never 30 seconds like we were taught in school, and under isolation and in dry conditions, we apply and air dry the bond and cure the bond layer over the Vitrebond liner for an additional 20 seconds.

After that, and still under isolation, we then layer the composite and cure it in increments after levelling out the floor with Surefil as the first layer. 30 Second Cure and Packable composite on top and layered for the remainder of the prep.

Since doing this for the past 5 years, our practice growth has been off the charts for a new practice. It is truly amazing what avoiding a root canal for someone will do for business and word of mouth referrals. With the thousand dollar marketing budget for Yelp as a form of online exposure, we are growing at a staggering rate of 60 plus new patients a month and are going to hire our third dentist. Out of the 3 of us only I do endo on a consistent base and there will always be plenty of it. But the ability to build trust and success with your patients by delivering a vital tooth and a beautiful crown or composite on it, as opposed to an in-house endo, or worse a referral appointment, which will drain the patients benefits for the insurance cycle, and be a loss of production and a tooth’s life in the balance.
Effects of Cotinine on Human Gingival Fibroblast Migration

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ABSTRACT

Nicotine has a deleterious impact on gingival fibroblast cell viability, adhesion, and migration. Less is known regarding the effect of cotinine, the main metabolite of nicotine, on such processes. The objective of this study was to determine if cotinine affects the adhesion or migration of Human Gingival Fibroblasts (HGF) in culture. HGF were treated with nicotine or cotinine at several concentrations and dose-response cytotoxicity was determined by MTT assay. The effects of nicotine and cotinine on HGF adhesion were measured colorimetrically and cell migration was determined using the scratch wound assay. The number of HGF oriented parallel to the wound edge at 24 hours was counted using phase contrast images. Data were analyzed using ANOVA and Dunnet’s multiple comparison post-test. At the highest concentrations of cotinine (640 ng/ml) and nicotine (400 µg/ml) both HGF survival and cell adhesion were significantly inhibited (p<0.01). By scratch wound assay HGF migration from the wound edge at 24 hours was significantly inhibited by 320 ng/ml (p<0.001) and 640 ng/ml (p<0.001) cotinine, and by 400 µg/ml (p<0.01) nicotine. HGF migration was significantly inhibited by 80 ng/ml (p<0.05), 320 ng/ml (p<0.01) and 640 ng/ml (p<0.001) cotinine and by 100 µg/ml (p<0.01), 200 µg/ml (p<0.01) and 400 µg/ml (p<0.001) nicotine at 48 hours. Significantly more HGF were oriented parallel to wound edge with pre treatment of 10 ng/ml cotinine or 50 µg/ml nicotine before wounding (p<0.001). In HGF exposed to nicotine (400 µg/ml) or cotinine (640 ng/ml), cell survival, cell adhesion, and migration were significantly decreased, but cell polarity was not affected. These concentrations are within ranges of serum levels in smokers, providing evidence that multiple cellular aspects of wound healing are compromised in tobacco users.

KEYWORDS: Adhesion; Cotinine; Gingival fibroblast; Migration; Nicotine.

INTRODUCTION

It is well known that tobacco smoking impairs wound healing; a systematic review and meta analysis concluded that smoking cessation in surgical patients was associated with significantly decreased rates of post-surgical complications.1 Tobacco use is a prime behavioral contributor to periodontal disease with accompanying poor oral wound healing and potential tooth loss.2 As a phase in the wound healing process, fibroblasts transition to myofibroblasts and form granulation tissue by secreting and remodeling the extracellular matrix.3 Fibroblasts are located in gingival, lingual, buccal, labial and palatal structures as well as the periodontal ligament fiber groups, and thus are central to production and maintenance of the connective tissue underlying the surface epithelium of the oral mucosa and periodontium. Indeed fibroblasts are the main cell type of the periodontium.

Although cigarettes are a mixture of thousands of carcinogenic compounds, many studies have focused on nicotine as a main deleterious agent in cigarette smoke. With respect to the oral cavity, isolated nicotine has been implicated in affecting gingival fibroblast cell
viability, tissue remodeling, cell adhesion and migration, and myofibroblast transition. Nicotine at 0.5 mM inhibited human gingival fibroblast migration, potentially through Rac signaling pathways, and altered the response to transforming growth factor-beta 1 by decreasing the morphological change from fibroblast to myofibroblast. Based on these observations it has been suggested that nicotine interferes with wound closure by changing the ability of oral fibroblasts to contract wounds.

Additional mechanisms to explain nicotine-inhibited cell migration may be through effects on cell adhesion. Nicotine in the range of 5 ng/ml to 10 mg/ml inhibited the attachment and growth of human periodontal ligament fibroblasts. Nicotine-induced decrease of beta1 integrin expression suggests an impairment of human gingival fibroblast ability to adhere to extracellular matrix. Conversely whole cigarette smoke inhibited fibroblast migration and correlated with an increased level of focal adhesions, suggesting that nicotine-inhibited cell migration was due to increased cell adhesion. Using nicotine alone, increasing nicotine concentrations correlated to increased human gingival fibroblast adhesion.

In humans 70-80% of nicotine is metabolized to cotinine, which can be assayed in blood, saliva, and urine. Cotinine has a five- to ten-fold longer half-life compared to nicotine, and the literature has documented it to be a specific and sensitive marker for determining exposure to tobacco and nicotine. According to the Foundation for Blood Research, serum cotinine levels that are less than 10 ng/ml indicate non-smoking, levels of 10 to 100 ng/ml are indicative of light smoking or passive secondary exposure, and levels greater than 300 ng/ml suggest heavy smoking. Scott et al. reported that in heavy smokers serum cotinine levels are greater than 100 ng/ml, light smoker cotinine levels are less than or equal to 60 ng/ml, and in non-smokers the levels are less than or equal to 10 ng/ml. An analysis of United States National Health and Nutrition Examination Survey (NHANES) data from 1999 to 2010 shows that serum cotinine levels have risen over time for males, females, and whites, and with exposure to second hand smoke at home.

In contrast to cigarette smoke or pure nicotine, there are relatively fewer reports of the effects of cotinine on cell adhesion and migration. In smooth muscle cell culture, nicotine and cotinine increased the expression of several matrix metalloproteinases that are critical in cell migration.

The concentration of serum soluble Intercellular adhesion molecule-1 (ICAM-1) and soluble Vascular Cell Adhesion Molecule-1 (sVCAM-I) correlated directly to serum/plasma cotinine levels in smokers.

Although studies of nicotine and cotinine exist, an electronic database (PubMed) search using the combined terms of “cotinine AND gingiva AND fibroblast” yielded no publications. With the aim of expanding current knowledge on the effects of cigarette compounds on oral cells, the objective of the present study is to determine if cotinine effects on the adhesion or migration of human gingival fibroblasts in culture is similar to nicotine. Concentrations of nicotine and cotinine analogous to clinically relevant human serum and saliva levels were utilized. It is hypothesized that similarly to nicotine, cotinine will adversely affect human gingival fibroblast adhesion and migration with implications for wound healing in smokers.

**MATERIALS AND METHODS**

**Human Gingival Fibroblasts**

Human Gingival Fibroblasts (HGF) were obtained from a commercial source (ScienCell, Carlsbad, CA, USA) and were maintained in serum-free fibroblast medium as recommended by the manufacturer. Cells were obtained at passage one and propagated in T-75 flasks. Cells were trypsinized and replated as needed for experiments, and used between passages two and four.

**MTT Assay**

HGF at 90% confluence in wells of a 24-well plate were treated with 0, 10, 80, 320, or 640 ng/ml cotinine (Sigma Chemical Co., St. Louis, MO, USA). In an analogous assay HGF were treated with 0, 50, 100, 200, or 400 µg/ml nicotine. Cotinine and nicotine solutions were freshly made for each study and prepared in the fibroblast culture medium. 0.01% chlorhexidine was used as a positive control and culture medium alone as a negative control. After 24 hours a 3-[4,5-dimethylthiazol-2-yl]-2,5-diphenyltetrazolium bromide (MTT) assay was performed according to the protocol of the Sigma Cell Growth Determination Kit MTT Based (Sigma Chemical Co., St Louis, MO, USA). HGF were incubated with the MTT reagent for 3 hours (n = 4 for all treatments and controls). The resulting formazan crystals were dissolved with MTT solubilization solution, and the absorbance of samples was determined at 570 nm using a SpectraMax M3 microplate reader (Molecular Devices, Sunnyvale, CA, USA). Data were reported as absorbance and as relative cell viability setting the controls of no cotinine or nicotine to 100%.

**Cell Adhesion Assay**

HGF at 90% confluence were treated with 0, 10, 80, 320, or 640 ng/ml cotinine, or in a separate experiment with 0, 50, 100, 200, or 400 µg/ml nicotine for 24 hours. HGF were then trypsinized and pelleted by centrifugation in trypsin-neutralizing solution. Cell pellets were washed three times in fibroblast medium and resuspended in the same medium. HGF were plated onto non-treated flat-bottom tissue culture 96-well plates at 2x10^5 cells/well and incubated for 1 hour at 37°C in 5% CO₂. The wells were washed with medium to remove unattached cells, and attached cells were fixed in 3.7% formalin, stained with 2% crystal violet, and lysed in 2% SDS (200 µl of each solution per well). The absorbance of the lysate was measured at
570 nm wavelength. Each adhesion assay was repeated three times, with six wells of each treatment and control assayed each time. The results were reported as absorbance and as the percentage of adhesion compared with controls of no cotinine or nicotine set at 100%.

**Cell Migration Assay**

HGF were cultured in wells of a 24-well plate until confluent and then pre-treated with 0, 10, 80, 320, or 640 ng/ml cotinine, or in a separate experiment with 0, 50, 100, 200, or 400 µg/ml nicotine for 24 hours. Scratch wounds were created in each well by dragging a sterile tip for an automatic pipettor down the middle of the well several times. At 24 and 48 hours following the wounding procedure, the extent of cell migration from the wound edge was measured and calculated in mm using the NIH ImageJ image processing program. In addition, non-pre-treated confluent HGF were wounded and then treated with 0, 10, 80, 320, or 640 ng/ml cotinine. Cell migration from the wound edge was monitored for 24 hours. Experiments were repeated three times. Data were analyzed using one way ANOVA with Dunnet’s multiple comparison post-test and probability at \( p < 0.05 \).

**Image Analysis of Cell Orientation**

The orientation of migrating cells with respect to the wound edge 24 hours following wounding were analyzed using phase contrast images of HGF treated with 0, 10, 80, 320, or 640 ng/ml cotinine or 0, 50, 100, 200, or 400 µg/ml nicotine. The number of cells with an orientation parallel to the defined wound edge was counted for each treatment. Data are reported as the mean of ten images and were analyzed using one way ANOVA with Dunnet’s multiple comparison post-test and probability at \( p < 0.05 \).

**RESULTS**

The current study utilized nicotine concentrations within the ranges of those reported by other investigators using culture models.\(^{25-23}\) However to determine appropriate concentrations of both nicotine and cotinine specifically for the HGF used in this study dose-response curves were generated. Cotinine concentrations in ng/ml indicative of non-smoking, light smoking, or heavy smoking were used to treat HGF prior to cytotoxicity testing using a colorimetric MTT assay. Both absorbance values and calculated percentage of cell survival as shown in figure 1A and 1B demonstrate that all cotinine concentrations tested significantly suppressed cell proliferation and proved cytotoxic (specific \( p \) values provided in Figure 1 legend). Compared to control, 85% of fibroblasts survived following 24 hours of treatment with 10 ng/ml cotinine, 78% survived following 80 ng/ml, 74% survived following 320 ng/ml, and 68% survived following 640 ng/ml cotinine exposure (Figure 1B). Using the colorimetric MTT assay, the cytotoxicity of nicotine was evaluated using HGF. Only the highest concentration of nicotine used, 400 µg/ml, resulted in significant cytotoxicity (Figure 1C, \( p<0.01 \)). Compared to control 86% of fibroblasts survived a 24 hour exposure to 400 µg/ml nicotine (Figure 1D).

A colorimetric assay was used to determine rapid HGF adhesion to uncoated tissue culture substrate. Cytotoxic effects of cotinine and nicotine as shown in figure 1 would not have an effect on the results of this assay as adhesion was determined after 60 minutes, a time frame that is too early to detect cytotoxic effects. Of the cotinine concentrations tested, only the 640 ng/ml value significantly suppressed rapid cell adhesion (Figure 2A, \( p<0.01 \)) with 88% of cells adherent compared to control (Figure 2B). Similarly, only the highest concentration of nicotine tested, 400 µg/ml, resulted in a significant decrease in cell adhesion (Figure 2C, \( p<0.001 \)) with 58% of cells adherent compared to control (Figure 2D).

Cell adhesion from a wound edge using an in vitro scratch wounding model was measured 24 and 48 hours following the initiation of the wound. Figure 3 depicts results when HGF were pre-treated with the agents and then wounded. Compared to control, 24 hours following wounding cotinine at 320 (\( p<0.001 \)) and 640 (\( p<0.001 \)) ng/ml significantly inhibited migration (Figure 3A). At 48 hours following wounding (Figure 3B), cotinine concentrations of 80 (\( p<0.05 \)), 320 (\( p<0.01 \)) and 640 (\( p<0.001 \)) ng/ml significantly inhibited migration (Figure 3B). In nicotine experiments, a concentration of 400 µg/ml significantly inhibited migration at 24 hours (Figure 3C, \( p<0.01 \)). In contrast 48 hours following wounding (Figure 3D) 100 (\( p<0.01 \)), 200 (\( p<0.01 \)), and 400 (\( p<0.001 \)) µg/ml nicotine significantly inhibited migration from the wound edge. Similar inhibitory effects of cotinine were also noted if untreated HGF were first wounded, then treated with cotinine for 24 hours following
wounding (Figure 4). However the deleterious effects were noted at lower concentrations at the 24 hour time point when cotinine was present during the migratory phase. Cell migration was significantly inhibited by the presence of 80, 320 and 640 ng/ml cotinine \((p<0.001)\).

Cell migration based on morphological orientation of cells at the wound edge was assessed by inspection of phase-contrast images. 24 hours following wounding, cells treated with 10 ng/ml cotinine showed multiple cells oriented parallel to the wound edge (Figure 5A). With increasing concentration of cotinine however fibroblasts took on an elongated spindle shape oriented perpendicular to the wound edge. In many of these cells the nucleus was polarized towards the wound edge (Figure 5B, C, D).

The number of HGF oriented parallel to the defined wound edge was counted for both cotinine and nicotine treated cells. A dose-response relationship was observed. Fewer cells oriented to the wound edge were observed as both cotinine and nicotine concentrations increased. The lowest concentrations of both cotinine and nicotine were correlated with significantly higher numbers of cells oriented parallel to the wound edge.
compared to control or HGF treated with higher concentrations of cotinine (Figure 6A $p<0.001$) or nicotine (Figure 6B $p<0.001$).

![Figure 6: Effect of cotinine and nicotine on orientation of HGF with respect to the wound edge. Phase-contrast images of cells treated with the indicated concentrations of cotinine (A) or nicotine (B) were analyzed to determine the numbers of cells oriented parallel to the wound edge. For both cotinine and nicotine the lowest concentrations used resulted in the highest number of cells with parallel orientation compared to controls or to other concentrations (* in A and B $p<0.001$).](image)

### DISCUSSION

Numerous studies have investigated the effects of nicotine on oral cells, however the correlative data for cotinine is not as abundant. In this study the effects of biologically relevant concentrations of nicotine and cotinine on human gingival fibroblast cytotoxicity, adhesion and migration were examined and compared. Alpar et al. reported that concentrations of 6 mM (973 µg/ml), 8 mM (1298 µg/ml) and 10 mM (1620 µg/ml) nicotine decreased the cell viability of human periodontal ligament and gingival fibroblasts. The data from this study shows that a nicotine concentration of 400 µg/ml (2.46 mM) is cytotoxic to HGF, demonstrating that an even lower concentration than that reported by Alpar, et al. can kill oral cells. Cytotoxicity was not detected at lower concentrations so taking the data together it appears that nicotine levels above approximately 2 mM (300 to 400 µg/ml) are toxic to human oral cells in culture. This is well within the range of saliva nicotine concentrations of 96 ng/ml to 1.6 mg/ml measured in tobacco users.

Testing cell lines by neutral red cytotoxicity assay, Babich and Borenfreund concluded that nicotine was more cytotoxic than cotinine, which was more cytotoxic than nicotinic acid or nicotinamide. The cell growth of MA-10 Leydig tumor cells was significantly inhibited by 1 mM cotinine, or 176 µg/ml. This study revealed that HGF cell growth was significantly inhibited by 10 ng/ml cotinine (57 nM), substantially less than previous reports, and in contrast to the study concluding that nicotine is more cytotoxic than cotinine if such a comparison is based solely on concentration.

James et al. reported that nicotine and cotinine inhibited the attachment and growth of human periodontal ligament fibroblasts. In agreement, this study showed that both nicotine and cotinine significantly inhibited rapid HGF adhesion to plastic tissue culture substrate. In contrast increased vinculin expression and focal adhesions in fibroblasts exposed to mainstream whole smoke suggest that nicotine-exposed cells have increased adhesion. Fully functional focal adhesions would likely not be formed during the 60 minute rapid adhesion assay and would explain the different outcomes in the effects of nicotine and cotinine on adhesion. During wound healing, cells must be adherent to a substrate \textit{in vitro} or to extracellular matrix \textit{in vivo} to allow for subsequent migration. The role of nicotine in extracellular matrix modeling is not clear, as it has been reported that 2.4 µg/ml nicotine did not affect collagen degradation but 25 to 500 µg/ml nicotine increased collagen degradation in HGF. There is essentially no information about the effects of cotinine on extracellular matrix. To explain discrepancies in the effects of nicotine and cotinine on cell adhesion it is certainly plausible that different cell types respond differently to any agent in culture. Although many of these studies used human gingival fibroblasts, the concentrations of nicotine and cotinine that were used varied. Standard concentrations of these agents for use in \textit{in vitro} analyses would allow for better comparisons between individual studies.

Migration is an essential component of wound healing and it is well documented that tobacco use correlates to poor wound healing. A previous study demonstrated that nicotine inhibits cell migration between 16 and 162 µg/ml. The results of the present study agree that nicotine can be detrimental to cell migration at similar concentrations, and extend previous reports by suggesting that cells become more sensitive to lower concentrations of nicotine with extended wound healing time. Cotinine affected cell migration in a similar manner as for nicotine, with HGF showing greater sensitivity to lower cotinine concentrations with increased wound healing time. Based solely on the concentration needed to affect HGF migration, cotinine is more detrimental to the migration phase of wound healing compared to nicotine.

Maninova et al. reported that cell polarity is an essential step in the process of cell migration. These authors showed that in polarized cells the axis of migration was aligned perpendicular to the wound edge. The present study showed that as the concentration of nicotine and cotinine increased, relatively fewer HGF were oriented parallel to the wound edge and...
relative more cells were oriented perpendicular to the wound edge. This suggests that nicotine and cotinine may facilitate the polarization of HGF at the wound edge. While this seems counter-intuitive it may be that polarity, adhesion, and cell movement are not linked in cells exposed to higher concentration of tobacco components.

In summary, in HGF exposed to nicotine (400 µg/ml) or cotinine (640 ng/ml), cell survival, rapid cell adhesion, and migration were significantly decreased, but cell polarity with respect to the wound edge was not affected. These concentrations are within ranges of serum levels in smokers, providing evidence that multiple cellular aspects of wound healing are compromised in tobacco users.

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CONFLICTS OF INTEREST

We have no conflicts of interest to declare.

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"Endodontic Sealers": Current Concepts and Comparative Analysis

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ABSTRACT

The main aim of root canal therapy is the removal of microbial contaminants in conjunction with the total closure of the root canal system. Root canal sealers along with solid core material plays a major role in achieving the three dimensional sealing of the root canal system. These sealers are binding agents which are used to adapt the rigid gutta-percha to canal walls and to fill up the voids, accessory canals and irregularities within the canal. Root canal sealers, although used only as adjunctive materials in the obturation of root canals, have been shown to influence the outcome of endodontic treatment. A perfect combination of sealing ability and biocompatibility is what an ideal root canal sealer should possess. This article discusses the current concepts in the usage of different sealers in endodontic therapy and their comparison in order to draw some clinical inferences.

KEYWORDS: Endodontics; Root canal treatment; Sealers.

INTRODUCTION

Root canal therapy depends on integrally related root canal treatment phases: microbial control, cleaning and shaping, and effective sealing of the root canal system. The success of each depends on the execution of the final phase. Endodontic filling materials may be considered true implants as they touch and are based in vital tissues of the body. The main components of a root filling are: a solid core material and a sealer. The most commonly used core material is Gutta-percha, which occupies bulk of the canal space while the root canal sealer fills the interface between the core material and the dentin wall, the voids inside the core material and the accessory canals and also serves as a lubricant, thus helping to obtain a fluid tight seal.

Ideally, the root canal sealer should be capable of creating an effective bond between the core material and the dentine of the root canal thus preventing leakage. It should also be non-toxic and preferably have a positive effect on the healing of periapical lesions.

A great variety of endodontic sealers are available commercially and they are divided into different groups according to their chemical composition. It is a well known fact that three dimensional impervious obturation of the root canal system is of prime clinical importance for the long-term success of endodontic treatment.

At present epoxy resins based sealers possess very good physical properties, excellent apical sealing and ensure adequate biological performance. However, the creation of most desired ‘Three dimensional obturation’ seems to get hampered by the general lack of chemical union between the polyisoprene component of gutta-percha cone and the components of endodontic sealer.

Although predictable clinical results have been reported with the use of these non-
bonding root canal sealers, there has been a continuous quest for alternative sealers or techniques that bond simultaneously to canal wall dentin as well as filling materials. These bondable root canal sealers are getting popular these days because of their property of creating monoblocks within the root canal space.\(^5\)

The term monoblock refers to the scenario wherein the canal space becomes perfectly filled with a gap-free, solid mass that consists of different materials and interfaces, which improves the seal and increases the fracture resistance of the filled canals. The most recently introduced self-adhesive type bondable root canal sealers are also associated with the additional benefits of reduced application steps and being user friendly.\(^6\)\(^,\)\(^7\)

This review article attempts to compile information on various new generation root canal sealers which are advocated to be superior to their contemporary counterparts and also compare their properties.

CLASSIFICATION OF SEALERS

Before we discuss the new generation of sealers, let us have an overview of the ones available to us for clinical use. Endodontic sealers have been historically classified in various ways such as: according to eugenol content; usage; absorbance, etc.\(^6\)\(^,\)\(^8\)\(^-\)\(^12\) A comprehensive categorization of the endodontic sealers has been provided in table 1 according to their composition.

Table 1: Categorisation of Endodontic sealers according to their composition.

<table>
<thead>
<tr>
<th>ROOT CANAL SEALERS</th>
<th>BRAND NAME</th>
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<tbody>
<tr>
<td>1. Zinc Oxide Eugenol based sealers</td>
<td>Roth sealer</td>
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<td>Kerr PCS</td>
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<td>Procoseal</td>
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<td>Endomethasone</td>
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<td>2. Epoxy resin based sealers</td>
<td>AH Plus</td>
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<td>3. Silicon based sealers</td>
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<td>4. MTA based sealers</td>
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<td>5. Calcium-silicate-Phosphate based bioceramic sealers</td>
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<td>Third generation- Epiphany,</td>
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<td></td>
<td>Fibrofill</td>
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<td>Fourth generation- Realseal SE,</td>
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<td>Metaseal SE,</td>
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<td>Smartseal</td>
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<td>7. Calcium-phosphate based sealers</td>
<td>Capsseal I</td>
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<td>Capsseal II</td>
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RECENT ENDODONTIC SEALERS

ProRoot Endo Sealer

It is an experimental calcium silicate-based root canal sealer that is designed to be used in conjunction with a root filling material in either the cold lateral, warm vertical or carrier-based filling techniques. The major components of the powder component are tricalcium silicate and dicalcium silicate, with the inclusion of calcium sulphate as a setting retardant, bismuth oxide as a radiopacifier and a small amount of tricalcium aluminate. The liquid component consists of a viscous aqueous solution of a water soluble polymer. Similar to other tricalcium silicate and dicalcium silicate-containing biomaterials, the sealer produces calcium hydroxide on reaction with water.\(^13\)

Herbal Sealer (Biosealer)

It is an experimental root canal sealer based on Copaifera multijuga oil-resin. Trees belonging to the genus Copaifera are distributed around northern South America, mainly in the Amazon Rainforest. It is one of the most popular and promising phytomedicines used in Brazil. The powder is composed of zinc oxide, calcium hydroxide, bismuth subcarbonate, natural resin (resin) and borax, and the liquid is purified Copaifera multijuga oil-resin.\(^14\)

Nano Seal plus root canal sealer

A common cause of failure of root canal treatment is due to the inability to seal the accessory canal in most cases. One of the newest update in endodontics is the development of the first endodontic sealer based on nanotechnology which actively seals the tiny gaps thereby reducing the infection. It is made up of calcium phosphate hydroxyapatite nanoparticles range from 40-60 nm. The rod shaped active nanoparticles can penetrate the dentinal tubules & enter accessory canals to ensure that all the spaces are effectively sealed.\(^15\)

Hybrid root seal

It is a commercially available fourth generation self-adhesive dual-cure sealer, available in the powder-liquid form. It is an insoluble, radiopaque material that can be used either with resilon or Gutta-percha. The liquid comprises of 4-META, monofunctional methacrylate monomers and photo-initiators, while the powder consists of a mixture of zirconia oxide filler, silicon dioxide filler and polymerization initiators. 4-META is able to promote monomer diffusion into the acid-conditioned and underlying intact dentin and produces functional hybridized dentin with polymerization.\(^16\)\(^,\)\(^17\) The formation of the hybrid dentin is the major mechanism of bonding and also the high quality hybridized dentin resists acidic challenges.\(^18\) However, polymerization shrinkage is inherent to methacrylate resin-based sealers that tend to produce debonding at the resin-dentin interface.
Gutta flow 2 sealer

This is a modification of the original Gutta flow sealer which was available in the cartridge form. The excellent flow of this material made it the sealer of choice. However, the larger armamentarium required was a drawback. Of late, Gutta Flow 2 has been introduced which is available in the syringe form and has an excellent property of slight expansion after mixing which helps in better sealing.

iRoot SP/EndoSequence BC sealer

The manufacturers of these sealers claim the ability to form hydroxyapatite during the setting process and ultimately create a chemical bond between dentinal wall and the sealer. These are convenient, premixed, ready-to-use, injectable white cement paste developed for permanent root canal filling and sealing applications. These are insoluble, radio opaque and aluminium free material based on a calciumsilicate composition, which requires the presence of water to set and harden. Dentin is composed of approximately 20% (by volume) of water and “iRoot SP” uses this water to initiate and complete its setting.

Bioceramic sealers in general.

The term monoblock literally means a single unit. Franklin R. Tay first described the concept of monoblock in endodontics. Primary monoblock

It has only one interface that extends circumferentially between the material and the root canal wall. A classic example of primary monoblock would be obturating the root canals with gutta percha, without using the sealer. Use of Hydron sealer alone is another example of this concept. The lack of sufficient strength and stiffness is the major drawback and this led to the development of Secondary monoblocks.

Secondary monoblock

Secondary monoblocks are the ones having two circumferential interfaces, such as one between the cement and dentin and the other between the cement and the core material. A classic example would be the use of sealer for obturation, wherein one interface is between Gutta Percha point and sealer and the other interface is between the sealer and root canal wall.

Interest in utilizing the monoblock concept for reinforcing the root canal space was got resurfaced in around 2004 with the advent of bondable root filling materials that were launched as alternatives to conventional gutta-percha as obturating materials.

Resilon, a bondable root filling material which falls into this category, may be used for either lateral or warm vertical compaction techniques. As Resilon is applied using a methacrylate-based sealer to self-etching primer treated root dentin, it contains two interfaces, one between the sealer and primed dentin and the other between the sealer and Resilon, and hence may be classified as a type of secondary monoblock.

Tertiary monoblock

Tertiary monoblocks are the ones having an additional third circumferential interface between the bonding substrate and the abutment material. Fiber posts that contain either an external silicate coating or those that contain unpolymerized resin composite for relining root canals that are too wide or not perfectly round for the fitting of conventional fiber posts may be considered as tertiary monoblocks. Tenax Fibre post (Coltene) has a specific resin coating on its surface, which when cured with dual cure resin ParaCore (Coltene) forms a typical Tertiary monoblock: with one interface between the fibre post and the resin coating; the second one between the resin coating and the luting cement; and the third one between the luting cement and the root canal wall.

Another product that falls into this category is the EndoRez system (Ultradent), in which the conventional gutta-percha cones are coated with a proprietary resin coating.

EVALUATION AND COMPARISON OF VARIOUS ENDODONTIC SEALERS

Orstavik has listed the various evaluation parameters for testing endodontic sealers. They include technologic tests standardized by the ADA/ANSI in United States, and the ISO internationally. These technological tests include flow, working time, setting time, radio opacity, solubility and dimensional change following setting.

Leakage

Leakage continues to be a major reason for failure in root canal therapy. Ideally, a root canal filling material should provide a barrier that prevents bacterial ingress from the oral cavity. Compared with zinc oxide-eugenol sealers, methacrylate based resin sealers were found to be more effective in sealing. Using a fluid-transport method, Tunga and Bodrumlu concluded that Epiphany and Resilon leaked significantly less than gutta-percha and AH-26. In bacterial leakage tests Epiphany and Resilon were superior to gutta percha and various other sealers. The Resilon/Epiphany system is reported to establish an immediate coronal seal after light curing of the dual-cured sealer at the canal orifices. An immediate coronal seal is clinically advantageous because there are situations in which filled root canals might be exposed to the oral environment and subject to
bacterial recontamination.

Weller et al suggested that the newly introduced calcium silicate based Pro Root Endo Sealer is comparable in sealing quality to the epoxy resin-based sealer and seals better than the ZOE-based sealer after immersion in phosphate containing fluid.28 Moreover, Pro Root Endo Sealer exhibits amorphous calcium phosphate-like phases that spontaneously transform into apatite-like phases after immersion in the phosphate-containing stimulated body fluid. This phenomenon probably accounts for the in vitro bioactivity of this calcium silicate-based sealer (Huffman et al 2009).13

Biocompatibility

One of the principal requirements of an endodontic root canal sealer is that it should be non-cytotoxic and immunologically compatible with peripheral tissue.

The biocompatibility and antimicrobial activity of a specific root canal sealer remains one of the principal considerations for selecting an appropriate sealer for a dental restoration.29 It has been demonstrated that sealer material based on zinc oxide-eugenol release potentially cytotoxic concentrations of eugenol. Calcium hydroxide-based sealers promote calcification but tend to dissolve overtime and compromise the endodontic seal. A new calcium hydroxide-based sealer, Acroseal appears to have lower solubility than other calcium hydroxide sealers, probably because of its epoxy resin component. Glass ionomer sealers may bond tooth structure but also may activate the release of prostaglandins in periapical tissues.30

Spangberget et al noted that the AH26 releases formaldehyde following component mixing that reaches a maximum rate two days after mixing. Formaldehyde release from curing endodontic material has been recognized for many years, formaldehyde being reputed to act as a disinfectant.11 The disinfective agent in AH26 is methenamine, which is hydrolyzed to ammonia and formaldehyde.32 The efficacy of long-term disinfection of canal by formaldehyde released from a root canal sealer has previously been shown to be low.33 There have been case reports of adverse reactions such as paraesthesia of the inferior alveolar nerve attributed to the formaldehyde released from root canal sealers.34

Scarparo et al found that Methacrylate resin-based sealers brought about greater quantities of macrophages.35 Studies have shown that the Epiphany root canal sealer was the only material that presented intraosseous biocompatibility among the resin based sealers.36

Newer generation of sealers such as iRoot SP have shown a promising biocompatibility owing to their composition.

Flow

It has been found that the flow depends on particle size, temperature, on the internal diameter of the tubes and the rate of insertion of materials.3 It has also been noted that flow of Tubliseal is better than that of Kerr sealer, which was better than Diaket and Kloroperka NO. He also stated that flow properties may be affected by changes in the powder to liquid ratio.2 Studies have shown that Tubliseal EWT had a thinner film thickness among the conventional zinc oxide eugenol sealers. Increased strain rate gave a significant increase in the flow rate of all sealers. Other studies concluded that among the medicated sealers Endomethasone did not confirm to ISO specification.37

Sealers such as Gutta flow 2 have an excellent flow which helps in better sealing. On the other hand improvements are still going on to make the flow of Bioceramic sealers better for clinical usage.

Bond strength

Root filled immature roots or roots that are otherwise weakened internally run a greater risk of fracture. With the introduction of adhesive filling techniques, attempts have been made to strengthen such teeth through reinforcement of the coronal part of the root by composite cements and fillings. More recently, this concept has been taken further by attempting to reinforce the whole root canal system via an adhesive filling and integrated resin core (Resilon).38

Souza SFC et al concluded that Epiphany had higher flow, polymerization stress and lower bond strength values to dentine than AH Plus.39 Other study concluded that the 980 nm diode laser irradiation of root canal dentin increased the bond strength of AH Plus sealer, but did not affect the adhesion of Epiphany sealer. Among the methacrylate based sealers the self adhesive sealers exhibited higher push out bond as compare to the non-etching sealer.

Newer Bioceramic sealers such as Endosequence possess very high bond strength with the dentin walls. This, together, seems highly advantageous but can serve to be a limitation in the long run as retreatment in such cases would be highly difficult.

Antibacterial activity

Current concepts of root canal sealer functions do not emphasize on its antimicrobial activity as its primary function, but it is well recognized that most sealers in current use exhibit some such properties. With increased emphasis on improving procedures for disinfecting the root canal system, this particular property may be more appreciated in the future. Studies have concluded that among the resin based sealers EndoRez did not show any antimicrobial activity. Kayaoglu G et al found that AH
Plus and Grossman’s sealer were effective in reducing the number of cultivable cells of *E. faecalis* while Calcium hydroxide-based sealers, Sealapex and Apexit were ineffective.

The new generation sealers are also claiming their antimicrobial efficacy of a broader spectrum. However, higher levels of research are required to evaluate the long term antibacterial activity of these sealers, in vivo, before any final conclusions can be drawn.

**CONCLUSION**

The degree of endodontic success is directly proportional to a clinician’s knowledge of the root canal anatomy and the techniques selected while performing treatment. Properly performed endodontic therapy is the cornerstone of restorative and reconstructive dentistry. Three-dimensional sealing of the root canal is one of the main goals of endodontic treatment to prevent the reinfection of the canal and for preserving the health of the periapical tissues, thereby ensuring the success of root canal treatment. Thus, several types of endodontic sealers have been recommended to achieve this goal. It is important to note that not only the apical seal of the root canal but the coronal seal is of equal importance for the success of endodontic treatment. Ideally, further directions should focus on materials that penetrate the patent dentinal tubules, bind intimately to both organic and inorganic phases of dentin, neutralize or destroy microorganisms and their products, predictably induce a cemental regenerative response and strengthen the root system.

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Web 2.0: How Social Networking Sites are Impacting Dentistry

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ABSTRACT

The popularization of Social Networking Sites (SNSs) is changing the behavior of human society in several ways and very quickly. Applications of Web 2.0 permit new forms of interaction with others, renew the learning process of Universities, and modify how people consume products and services. This phenomenon regularly occurs, making SNSs omnipresent: people can be connected with others all the time and anywhere. Although some health professionals remain resistant to new internet-based technologies, the reality is that more than 1 billion people have an account on Facebook. This is currently the most popular SNS worldwide, but there are many other examples, such as YouTube, LinkedIn, Twitter, Second Life, and Instagram. In these applications, people can be connected to each other and share thoughts, creations, opinions, and knowledge. Therefore, to be online on Web 2.0 and SNS is no longer a business choice for most practitioners and professors. Students and consumers are online, specially the younger ones. In order to illustrate the diverse ways that social-media can be used in the dentistry field, this article provides some examples of how health professionals use SNSs as a pedagogical tool in order to enhance their students’ participation in the learning process, promote dental services, and create a communication channel with patients. We also discuss implications regarding online professionalism and ethics for students and practitioners by referring to some of the topics presented in the polices of dental schools in the United States (US) and in the US Health Insurance Portability and Accountability Act (HIPAA).

KEYWORDS: Social Networking Sites; Dental education; Marketing; Dentistry; Professionalism.

INTRODUCTION

Since the first e-mail was sent in 1971,¹ it is easy to see how the Internet has deeply changed society with respect to communication and information exchange. In addition, the Internet has impacted people’s daily habits, and the own concept of Internet is continuously evolving.

The first period in the history of the Internet, known as Web 1.0, was characterized by a content-generated monopoly created by companies and the press, and people were only information consumers. However, this evolved into the second, current, period, which is known as Web 2.0. This latter period is characterized by users generating content through tools, applications, and approaches called social media, and this social phenomenon is resulting in new forms of interactions and social relations between people.²³ Social media is built on the technological foundations of Web 2.0, and usage numbers demonstrate its importance to society: 1.32 billion people use Facebook each month,³ which represents approximately one-seventh of the global population. Therefore, discussing whether dental professionals should or should not be using social media is irrelevant.
Facebook is considered the largest and most famous social media site worldwide, but there are many other types of social media available for people to use. These applications can be used for personal (e.g., increasing connections to others), educational (e.g., by educations as a pedagogical tool), and marketing or other professional uses (e.g., by health professionals to create a relationship with their patients or to promote dental services). The aim of this article is to provide an overview of usage of Social Networking Sites (SNSs) regarding the educational and marketing aspects of dentistry. In addition, implications of SNS usage on privacy and professionalism are discussed in terms of the policies of some dental schools in the United States (US) and the US Health Insurance Portability and Accountability Act (HIPAA). Finally, recommendations regarding how dental professionals can make better use of this technology are offered.

**MARKETING OR PROFESSIONAL USAGE OF SNSs**

Although the recent popularization of SNSs makes social media appear as a new concept, it is not. Usenet, a web-based site that allowed people to discuss and publish public messages, was developed in 1979 by professors from Duke University. However, the era of social media seems to have officially begun in 1998 when Bruce and Susan Abelson founded “Open Diary,” a community of writers that gathered daily. This platform was the precursor of what is today known as a daily blog.6

Although Facebook is currently the most popular SNS, there is much diversity across different SNSs. Today, people can socialize; learn; express themselves; articulate ideas; publish photographs, images, videos and texts; and connect with people who share similar interests online such as Facebook, LinkedIn, Twitter, YouTube, Pinterest, Instagram, Snapchat, MySpace, Flickr, WordPress, Blogger, Wikipedia, Wetpaint, Wikidot, Second Life, Reddit, and Tumblr. The different social-media applications are classified by type in table 1.

Because all of the aforementioned SNSs and abilities are web-based, social media has become omnipresent. In other words, with just an internet connection, people can stay connected with others using a variety of devices (e.g., computers, tablets, or mobile phones) and can have access to the information everywhere at anytime. In this context, it can be seen that the development of social media has created a new scenario. Before the evolution of Web 2.0 and SNSs, the Internet was characterized by the one-way flow of information from companies to users. Web 1.0 was saturated with websites containing information generated by companies and the press, and people were mere observers. In one respect, this was an ideal scenario for business marketing because consumers could only see the information the companies wanted to share, and only in the way that the companies wanted them to see it. Thus, the companies had great control of their reputation online.

Currently, people can express themselves, generate content for others, and state opinions about the news, products, or services via forums, posts on Facebook, 140-character messages on Twitter, or YouTube videos. These types of content can easily reach a large number of people on the seven continents within a few minutes, and can, in many cases, influence their behavior. Moreover, the use of social media by companies’ marketing departments is already consolidated, and the literature contains a number of successful demonstrations and reported benefits.7 However, dental-care service providers are just beginning to experiment with using social media to promote services.

<table>
<thead>
<tr>
<th>Application</th>
<th>Type/description</th>
<th>Examples</th>
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</thead>
<tbody>
<tr>
<td>Blog</td>
<td>A log about some specific subject. In general, there is no limit of space for publications. People can interact with content by commentaries.</td>
<td>Wordpress, Blogger</td>
</tr>
<tr>
<td>Microblog</td>
<td>A limited space to express ideas, images and links. People</td>
<td>Twitter</td>
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<tr>
<td>Social interaction</td>
<td>Sites to promote integration and interaction between person to person and person to business.</td>
<td>Orkut, Facebook</td>
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<tr>
<td>Content Communities</td>
<td>Online platforms for organizing and sharing collaborative generated content.</td>
<td>Youtube, Flickr, Wikipedia</td>
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<tr>
<td>Forums/bulletin boards</td>
<td>Web spaces for exchanging information about some specific interest/product/service.</td>
<td>Epinions, Amazon</td>
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<tr>
<td>Content aggregators</td>
<td>Sites that use Rich Site Summary (RSS) in order to allow users to customize web content according to their desires.</td>
<td>Picasa, It is used for some web browsers.</td>
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<tr>
<td>Social Worlds</td>
<td>Games to simulated real life in a virtual environment.</td>
<td>Second Life.</td>
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Table 1: Adapted from Constantinides E.7
There is great potential for worldwide exposure and enhanced communication with patients at a low cost.8

In a 2012 survey of 550 US practitioners, approximately half of the respondents declared that they were making use of social media as a marketing strategy for their practice, and Facebook, LinkedIn, and Twitter are the most frequent sites used. Marketing, communication with patients, and having a better online presence were the most common motives for practitioners to be on SNSs. However, at the same time, nearly half of the respondents who used social media declared they did not know how to measure the success of online strategies.9

In order to encourage and guide practitioners regarding the use of SNSs, Jorgensen,10 a private practitioner, listed and described the top 5 most useful social media sites for orthodontists. The author’s list included Twitter, YouTube, blogging, Facebook, and Google Place, which was the number one site. Google Place is a service from Google that automatically lists commercial places that have a physical address. Initially, Google Place only includes basic information (e.g., the practitioner’s name, address, and telephone number), but it offers the possibility of editing the page to add information (e.g., the logotype, website address link, etc.).10

More recently, Cox and Park illustrated the importance of having an online presence. They created a 35-item survey about orthodontic patients’ Facebook usage. The authors discovered that although 76% of respondents were likely to visit the professional’s webpage before the first consultation, 35% declared that the professional’s Facebook page could influence their final choice of an orthodontist. The authors concluded that Facebook is a valuable marketing approach for dental professionals.11

Although being on SNSs could enhance the health professional’s online presence, there are serious implications regarding privacy. Jain, an doctor, described a dilemma that occurred when a patient sent a “friend request” to his personal Facebook account. This situation could be encountered by any student or professional. Accepting the friend request could discourage some online posts and/or status updates that may contain unsuitable content for that audience (e.g., photos of his family vacation on the beach). If the professional does not accept the friend request, this could cause social tension and discomfort for the patient and possibly disrupt a future interaction in real life.12

Dental Education in the Social-Media Era

Undergraduates are massively connected to social media,13-15 and some educators can use that as a tool to enhance communication, collaboration, and student participation in academic activities. Professors and students can also access information about books, new publications, and library locations using social media.16 There are infinite possibilities for applying social media to dental learning;17 however, the use of social-media applications is new in the academic field.

George and Dellasega used several social-media applications in their medical humanities classes. In one presented case, the students created a video of their work with elderly residents with memory loss. The video can be seen on YouTube (https://www.youtube.com/watch?v=BOxdpBy0g11). The authors concluded that this experience was more effective than traditional methods.18

In order to maximize students’ learning, nursing students at Queens University of Charlotte were asked to generate short messages regarding key course concepts to the class on Twitter. The students all considered the use of Twitter as a study aid favorably.19 Estus20 used Facebook to enhance student-patient group communication in an elective geriatric pharmacotherapy class by creating a discussion board. The author identified certain benefits, such as the interest of older patients in Facebook and the opportunities to discuss with students the content posted on their Facebook pages. However, she also concluded that students’ connections to the site were not for educational purposes.20

To improve the training and habits of health care students, educators could use virtual reality (e.g., the game Second Life), a type of SNS that recreates the three-dimensional environment (or a parallel world) in which people interact via avatar representation. In this virtual world, the health care student can make clinical decisions, practice diagnostics, determine a treatment plan, and virtually practice some dental procedures. This methodology could provide a measure of security for the students during real patient-professional interactions, thereby decreasing anxiety.21

However, the introduction of these new technologies takes time and the knowledge of educators, who could demonstrate an aversion to them. Arnett et al. assessed the attitudes about social media of faculty members from five dental schools. Most of the respondents were over the age of 50 years and demonstrated a barrier to use of these applications in the classroom. Their stated concern was the time to prepare the content and privacy issues.17

The use of SNSs remains a challenge for dental educators. While future students could be considered “native digital students”, or people who were born into the Internet era, they do not necessarily know how to employ technological strategies to optimize their learning experiences.22 Moreover, professors who are responsible for providing guidance to these students could feel some resistance, experience difficulties, and be unfamiliar
with using SNSs in the classroom. One reservation is that the use of social media in the educational field is recent; whether use of these tools actually results in real improvement or the broadening of students’ skills and knowledge needs to be further analyzed.

PROFESSIONALISM IN SOCIAL MEDIA

When social media is combined with dentistry, or any other health care field, professionals may engage in unprofessional behavior. Our group analyzed more than 1,000 posts on Facebook from 56 Brazilian dental professionals’ fan pages and discovered some practices that were inconsistent with the Brazilian Ethics Code for Dentistry. For example, there were advertising contests in which patients could win a dental bleach treatment and instances of one professional disparaging the treatment done by another dentist. There were also publications of “before and after” images of treatments that included exposure of the patients’ faces, for which we could not determine whether informed consent had been obtained.

These sorts of scenarios are of particular concern when we consider “Net Generation” (i.e., the people who were born between 1980 and 1994 for whom the use of the Internet may be intrinsic and who may consider the Internet as a part of their personal identities). This intimacy and facility of use regarding SNSs tools may have an impact on professionalism on the Internet.

In order for health care faculty and students to avoid inappropriate online behavior, some US universities have created policies to guide behavior both on- and offline. Kind at al. found in 2010 that only 10% of medical schools in US had specific policies regarding social media, most likely because the popularization of social media and concerns about what students publish is relatively recent. To aid reflection, we have presented a list of points included in US medical schools’ policies and in HIPAA regarding use of social media by students and staff:

- Discouragement of the use of electronic media (e.g., cell phones, fax, and email) to transmit confidential content about patients;
- Prohibition of communication with patients on social networks;
- Suggestion to use the privacy functions on SNSs;
- Suggestion to reflect on the content before publishing any content regarding professionalism;
- Prohibition to publish photographs with patients without consent and discouragement of taking pictures of patients using cell phones;
- Statement that students and staff are responsible for their publications;
- Statement that the student is considered an official university representative;
- Prohibition of posting confidential patient information;
- Statements regarding vulgar language; disrespectful and discriminatory content with respect to age, race, gender, ethnicity, sexual orientation; and posts regarding excessive use of alcohol, substance abuse, and sexually suggestive material;
- Reminder that students’ professional behavior on- and offline reflect on both the user’s and the organization’s image.

Despite guidance and ethical classes on curricula, incidents involving unprofessional content published online could be identified by most medical schools’ student-affairs deans, and several cases involving students violating conduct codes by posting impermissible content could be found in court records. The consequences for these behaviors were expulsion, suspension, and charges by local law-enforcement agencies. It is also important to note that even though the students were punished, these cases had repercussions that could damage the images of both the user and institution.

RECOMMENDATIONS

Social media comprises part of the day for approximately 1 billion people, and, thus, it is inevitable that dentistry professionals become comfortable with it for professional, educational, and personal purposes. For practitioners, participation in social media must be part of marketing strategies. Consumers are online talking about what they like, including service providers, and social media facilitates “word-of-mouth” recommendations. In order to have a quality social-media presence, professionals must be dedicated to creating interesting and highly presentable content for the public that is engaging and promotes interaction. One way is to regularly spend some time managing social media, visiting patients’ personal pages, and responding to comments. When doing so, all the published information must be reviewed with regard to professionalism and ethics, and the person publishing the content should reflect on the content before publishing it.

We also recommend that dental practitioners have separate personal and professional SNS accounts. The personal profile must have the privacy settings activated and be restricted to friends, family, and private interests. This type of account organization prevents patients from accessing the professional’s personal life, protecting their privacy.

Facebook, for example, has privacy settings that allow users to keep their information safe. Another interesting configuration permits user to actively allow the publications made by others else on the user’s page; this also the user to prevent his/her friends from seeing certain posts. Many SNSs also permit users to separate friends into groups. After separation, the user can choose which group can access certain content.

In the dental education field, in order to captivate the attention of a new generation of students, educators must monitor technological advances and use them to facilitate improvements to learning and generate better experiences for students. For this reason, we encourage an increase in the use of these
tools even though the literature on this subject is small. Moreover, professors have an impact on students' education regarding professionalism and professional ethics and should ensure adequate use of these tools during undergraduate courses and in their professional lives.

REFERENCES


A Technique to Obtain and Transfer Jaw Relation Records from Conventional Complete Denture to Implant-Supported Complete Denture

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ABSTRACT

Prior to the fabrication of implant-supported fixed complete dentures, the existing or transitional removable complete dentures can be used to establish the optimal jaw relation. This article introduces a simple technique to accurately transfer the established jaw relation from removable complete denture to final fixed prosthesis.

KEYWORDS: Jaw relation transfer; Conventional complete denture; Implant-supported complete denture.

INTRODUCTION

Implant-supported or retained complete dentures are increasingly accepted as an alternative to conventional dentures for the oral rehabilitation of edentulous patients.1-4 In most clinical situations, there exists a transitional period when patients need to wear conventional complete dentures while waiting for the osseointegration of dental implants. These transitional complete dentures can greatly facilitate the establishment of optimized jaw relation. However, it remains a challenge for clinicians to accurately and efficiently transfer the established jaw relation obtained with these conventional complete dentures to implant-supported prostheses. Several reports have described the use of duplicate dentures to transfer vertical dimension of occlusion at the centric relation position to fabricate the final implant-supported prostheses.5-8 In all these reports, an additional duplication step is required, during which inaccuracy might be introduced. A technique was recently reported to transfer jaw relation with an existing denture.9 In this technique, the intaglio surface of the denture must be relieved to accommodate the autopolymerization of acrylic resin or a rigid vinyl polysiloxane impression material around the healing abutments. However, the success of this approach relies heavily on the accurate seating of the denture on the cast as in patient’s mouth, which is soft and resilient. Thus, precise seating and transfer of dimensions is not always easily achievable.

The technique described below can aid clinicians to accurately and conveniently transfer the established jaw relation information from the conventional complete denture to the implant-supported complete denture. With this technique, no duplication of denture or mounting the existing denture is necessary. However, this technique does require proper distribution of implants to achieve desirable stability.
TECHNIQUE

1. Remove the existing complete denture after confirming its correct vertical dimension and centric occlusion.
2. Insert a bite registration aid (Straumann, Andover, MA) on the most posterior implant unilaterally (Figure 1).

3. Prepare an occlusal opening in the denture in the area corresponding to the location of bite registration aid (Figure 2).

4. Seat the existing complete denture and make sure that the bite registration aid is below the occlusal surface.
5. Lubricate the prepared denture and opposing teeth with petroleum jelly (Pearson Lab Supplies, Sylmar, CA).
6. Add a small amount of autopolymerizing pattern resin (GC America, Alsip, IL) to the top of bite registration aid and ask patient to occlude in the established occlusal position (Figure 3).

7. Wait until the pattern resin sets and remove the complete denture (Figure 4).

8. Insert a second bite registration aid on an anterior implant and repeat steps 3 to 7.
9. Insert a third bite registration aid on a contra-lateral posterior implant and repeat steps 3 to 7 to establish a tripod support (minimal number of support).
10. (Optional) Insert additional bite registration aids on other implants and repeat steps 3 to 7.
11. Connect the individual bite registration aids with pattern resin to acquire a jaw relation record (Figure 5).

12. Take a face bow transfer and mount the casts by using the jaw relation record (Figure 6).
13. Repair the denture with autopolymerizing acrylic.

**DISCUSSION**

The described technique can facilitate the accurate transfer of jaw relations from existing conventional complete denture to implant-supported complete denture. It is simple, economical and can significantly reduce the number of visits needed to fabricate implant retained prosthesis. In order to minimize the shrinkage of pattern resin, it is advisable that one bite registration be performed at a time. However, it is also acceptable for clinicians to prepare multiple occlusal openings in the dentures and insert several bite registration aids at the same time. Other materials can also be used to obtain jaw relation records (e.g. elastomeric bite registration material, etc.). Although a Straumann bite registration aid is used in the aforementioned case, any commercially available implant system can use this technique with modifications. Screw-retained temporary abutments instead of a Straumann bite registration aid can be used if such is the case. Temporary abutments need to be modified to be below the occlusal surface in order to provide room for the occlusal registration material. After having obtained occlusal registration (step 6), a small screw access hole in the center of the pattern resin needs to be drilled for the registration device to be removed. To achieve sufficient stability, a slightly larger occlusal opening (and thus a larger recording pattern resin) is required to accommodate a patent screw access hole.

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**CONFLICTS OF INTEREST**

The authors have no conflicts of interest to declare.

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