Health of the Dental Profession is Shared Concern

Facebook posting sparks conversation about what the future of dentistry looks like.

I recently shared a photo on Facebook from an online card service that showed a man slapping the side of his head. The caption read “Just heard that a few Walmarts will be opening dental offices inside their stores. I bet there will be an express lane for people with 12 teeth or less.” I thought it was funny, which was why I shared the photo. You know, a little dental humor to lighten the day. As far as what impact it had on the readers of my feed, two people “liked” it; one person left a comment; and two people shared it on their pages—so it kind of went viral.

Following that post, I received an e-mail from a Facebook friend, also a dentist. Saying the post rang a bell for him, he lamented the fact that dentistry is becoming more of a commodity than a health service or health profession. He spoke to the continued corporatization of dentistry and how more and more dental offices are opening in malls. And trying to discover who the dentist is in the office is getting more difficult, as these offices all have “dentist” or “dentistry” in their names, but no identification of who the dentist is. Again, lessening the personal and professional touch, making it more corporate like.

My friend, who has been in dental education for most of his career, observed that the new dental schools are more involved in producing clinical dentists and in turning a profit. They seem to be eschewing the scientific basis of dentistry in favor of producing more clinically proficient dentists to address the access-to-care issue. He said basic medical sciences, research, academic inquisitiveness and standards were being downgraded, overlooked and even ignored. He hoped that dentistry was not reverting back to a time when it was considered merely a technical field and not a branch of medicine.

I wrote back to him, thanking him for his thoughts. I told him I agreed that dentistry was being marketed as a commodity and that I didn’t like the trend. I explained I had written two editorials concerning both corporate dentistry and how advertising by dentists on the radio and TV seem to
be diminishing the professional standing of dentistry in the eyes of the public. I went on to say that with states looking into using mid-level providers to help solve the access-to-care problem, the public perception of dentistry as just a technical field would only grow. After all, if all you need is a two-year training program after high school to be able to treat simple cavities, what is the public to think?

I told him dentistry must be proactive on this issue and educate the public about the importance of oral health, not only for their dental health, but also for their overall general health. However, with all the pressure to solve the access-to-care problem, we have politicians making decisions in areas where they have little understanding. We face a very formidable task.

He replied, saying, although he was retired, he couldn’t let the issue lie. Dentistry was such a big part of his life, he still cared and cared deeply. An instructor at my alma mater, the University at Buffalo School of Dental Medicine, he was worried that the dental school will be overlooked once the medical school moves to the downtown Buffalo campus. The move will require that the dental students travel to the medical school to take basic science courses. Alternatively, the dental school will have to offer basic science courses at the dental school. My friend said he was afraid of both scenarios as one would disrupt dental students’ days to a great degree and the other might cause the dental school to lose its high standing in dental education.

My friend is right. Dentistry is going through a time of growth and change. And, as with all professions, this growth and change may not be in the best interests of either dentists or patients. I have written about the dangers of corporate dentistry before. It seems I might have been a bit prescient, as the U.S. Senate has been investigating corporate dental clinics for regulatory violations. This investigation so far has found a failure to meet quality and compliance standards, including unnecessary treatment of children, improper anesthesia administration, providing care without proper informed consent...
and overcharging Medicaid for services rendered—the Senate investigation is focused solely on Medicaid clinics.

Investigators have also found that, while most of the clinics in question were “technically” owned by dentists, they were run by corporate investors and placed profit above patient care.

Sen. Chuck Grassley, Republican of Iowa, ranking member of the Committee on the Judiciary, said, “The actions of some dental practices strain the Medicaid program while putting low-income children in vulnerable and even traumatic situations. The problem is tied to a business model that contradicts state laws requiring dental practices to be dentist-owned as a measure of accountability both to patients and taxpayers.” It seems Sen. Grassley gets this part of the problem.

However, the Iowa Senator went on to recommend that mid-level providers be paid by Medicaid to treat patients. He said mid-level providers are in a position to deliver much of the needed dental care at current Medicaid reimbursement rates. He touted mid-level providers as a common-sense solution to access to care. Again, here is a politician advocating for a solution that may look good on paper, but is not necessarily the best solution to the problem, simply because he can’t really know the nature of the problem. The dental profession knows, and we should be the ones making these decisions.

Dentistry is at a crossroads. We can be involved in the solutions to the problems that exist in the profession today, or we can be steamrolled out of existence. Dentistry as a profession will go on, but under what guiding principles? Will we be just excellent technicians, filling cavities, making crowns, dentures and the like? Or will we be oral healthcare professionals who know the importance of oral hygiene and its interaction with the overall health of the individual? This is our choice to make. We must be careful, or someday you may hear this during your shopping trip to the mall: “Welcome, K-Mart shoppers. Today’s Blue Light Special is two fillings for the price of one!”

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The New York State Dental Association (NYSDA) and New York State Dental Foundation (NYSDF), together with national partner Mission of Mercy, are launching the New York State Mission of Mercy (NYSMOM), a free two-day dental clinic to provide oral health services and education to people who, for many reasons, lack access to dental care.

Go to www.nysmom.org for information and to volunteer.

**NEW YORK STATE MISSION OF MERCY**
**Volunteer Registration is now open**

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Go to www.nysmom.org for information and to volunteer.

**SAVE THE DATE**

**Date: June 13 & 14, 2014**
Edward F. McDonough Sports Complex
Hudson Valley Community College
Troy, New York
Golf, Zen and MMMM

Donald Hills, D.D.S.

Most golfers agree there is a special state of mind one reaches when out on a golf course. Although each player experiences the game in his or her own way, many players enjoy golf because it allows for an escape. Like a mini vacation, golf provides a break from the stress of life, where the world fades away and only the golf exists. Usually by the second hole I enter this mindset; and for the next four or five hours, life is good.

I was discussing this with a friend of mine and she told me how meditation allows her to reach that same place. Lisa can sit quietly by herself, a few candles burning, soft music playing and life for her is also good.

Is this the way to the peacefulness many of us are searching for? Can one escape the stress of a given moment and float above the madness? If the Zen that is golf can exist at home, on a slow grocery store checkout line, or between difficult crown preps, could not most of the angst we experience daily also disappear through this relatively easy process?

Eager to see if it would work for me, I purchased some lavender candles, installed “Calm Meditation Radio” on Pandora and, after a quick Google search of basic technique, settled down to let the soothing tranquility flow through me. It did not go well at first. Then, again, most people would agree it is difficult to master golf the first time on the course. In golf, one concentrates on one’s swing and on the ball. The object of meditation is to concentrate on nothing, to completely clear one’s mind. By day three, I gave up on the lotus sitting position, found a comfortable chair and, by concentrating on breathing deeply, actually began to feel my heart rate slow and a stillness settle in. Meditation pundits describe hour-long sessions of calm detachment. Yet as great as that sounds, in today’s hectic world, I welcome even short three- to five-minute stress busters. I have been practicing to calm myself with ultra-short meditation sessions and decided it was time to bring My Modified Meditation Moment (MMMM) to the dental office.

Although I live only 10 minutes from the office, the first opportunity to test MMMM presented when two of the seven traffic lights I encounter daily turned yellow. Rather than speed up to beat the red, I slowed and paused at the yellow signals. Where is the rush? Will the two minutes saved be worthwhile? Why not stop, breathe slowly and calm myself? Surprisingly, stopping at yellow lights has become one of my new favorite pastimes, as I close my eyes, breathe deeply and relax for a moment. My car is governed at 154 mph, yet these days I get almost as much pleasure sitting calmly at a light as I do contemplating testing the car’s governor.

All dentists experience pressure and tension in a typical day; it is endemic in the work we do. When little Johnny, during an alginate impression, delivers his lunch into the cuspidor, or Officer Bob keeps his hand a bit too close to his gun during an injection, our stress levels naturally elevate. When Mrs. Smith refuses to pay a $20 co-pay because she feels it is too much for an exam, X-rays, cleaning and a filling, the stress levels rise again. Through MMMM, five quiet minutes in my private office and I am ready to face these sympathetic nervous system stimulants head on.

So I propose to you the following. Look into meditation—not the full-blown, candles burning, lotus knee bending style that takes great effort. Instead, try five minutes of calm deep breathing, quieting the mind and see where MMMM can take you!

Dr. Hills practices in Woodbury, NY. He is editor of the Nassau County Dental Society Bulletin, in which his editorial first appeared this past summer. It is reprinted here with the permission of the editor and the NCDS. Dr Hills can be reached at Hillsdds@gmail.com.
Managing Dental Fear and Anxiety


Abstract

Fear and anxiety are primary reasons why individuals avoid visiting the dental practitioner. Dental anxiety appears to vary by type of treatment, with periodontic and endodontic patients reporting higher levels of anxiety than patients receiving restorative or prophylactic treatment. Parents who experience dental anxiety often pass along such feelings to their children.

Front office employees are the first line in screening for anxiety-related behaviors while the patient is in the reception area. It is extremely important to recognize dental fear and anxiety before the patient receives oral care because the stresses can lead to exacerbation of medical problems such as angina, seizures, asthma or hyperventilation. Applying behavioral techniques helps to induce the patient’s relaxation, reduce anxiety and also reduce the need for analgesics with their potential side effects.

Dental fear is defined as an unpleasant mental, emotional or physiologic sensation derived from a specific dental-related stimulus. Dental anxiety, however, is nonspecific unease, apprehensive or negative thoughts about what may happen during an oral healthcare appointment. Usually, the source of the unease is unknown to the individual. For example, dental anxiety is the patient’s reaction when thinking about having his or her teeth probed or scaled, whereas dental fear is the patient’s reaction during probing and scaling. Fear or anxiety that is irrational, persistent and unreasonable in relation to the actual threat is a phobia. This occurs when dental fear and dental anxiety are so extreme they cause a person to go to lengths to avoid any dental visits. In most cases, a patient with a true phobia will need to be referred to a mental health professional for further assessment and treatment before undergoing any dental care.

Dental fear and dental anxiety are primary reasons why many individuals avoid seeking oral healthcare. Failure to seek oral care can lead to deteriorating dental health or exacerbate an existing diseased dental status. Dental anxiety can also lead to frequently cancelled or broken appointments, as well as interrupted or failed completion of active treatment.

Etiology of Dental Anxiety

Dental anxiety persistently affects between 10% and 20% of the general population despite advances in pain control. In addition, almost half of the U.S. population reports significant subclinical dental fear; and approximately two-thirds experience some degree of apprehension when considering upcoming dental treatment.

Smith and Heaton noted that the prevalence of dental anxiety...
has not changed significantly in general adult or college patients since the 1950s.5

While dental anxiety has been at the forefront of research for decades, anxiety related to dental hygiene treatment is still being explored. Dental anxiety appears to vary by type of treatment, with periodontic and endodontic patients reporting higher levels of anxiety than patients receiving restorative or prophylactic treatment.6 Jongh found that only 15% of subjects surveyed experienced no anxiety during dental hygiene treatment and another 15% believed that dental hygiene treatment was more anxiety-producing than dental treatment.7

Dental anxiety spreads across all ages. Past unpleasant dental experiences are cited most often as the causative factor in anxiety about and avoidance of oral healthcare.2 For many anxious individuals, this fear originated with traumatic dental experiences in childhood.9 Surveys have shown that 50% to 85% of dental anxious individuals reported dental fear onset during their childhood or adolescence; the remainder became fearful of dental care during adulthood.10 Also, individuals who became fearful as children are more likely to fear specific dental objects, procedures and smells.9

However, in examining the onset of dental anxiety in young adults 18 to 26 years of age, Thomson found that the particular temperament and psychologic makeup of the individual was more predictive of anxiety than early trauma.12 Fearful or anxious children have fearful or anxious parents. Parental conditioning plays a role in the child’s anxiety in that parents give their children powerful messages consciously and unconsciously about events they find distressing. This is referred to as vicarious learning, which occurs when anxiety is acquired by watching, listening to or reading about the experiences of others.2 Parents who experience dental anxiety often pass along such feelings to their children.

Gender differences in pain perception and dental anxiety add another element to the assessment of patients. Women tend to respond more negatively to stimuli associated with dental care, like chair position or feel of the drill. Women also remember their painful experiences and report more anxiety associated with dental treatment than men.14

Assessment
Front office employees are the first line in screening for anxiety-related behaviors while the patient is in the reception area.15 Behaviors may include pacing, frequent changes in sitting position, repetitious hand and leg movements, as well as a history of frequent or broken appointments. Most health histories in dental offices have one or two broad questions regarding dental treatment fears, and very few are directed at the patient’s feelings toward the upcoming oral care. Having the patient complete a comprehensive health and dental history that includes questions designed to identify anxiety can further aid the dental practitioner in determining a truly effective course of action.2 Questions may include:2,13

- Did your parents have a positive attitude about dental care?
- Do you recall any past unpleasant dental experiences?
- Do you feel nervous about having dental treatment?
- What kind of treatment did you receive at your last dental visit? How did it feel?

| TABLE 1 |

**Can you tell us how anxious you get, if at all, with your dental visit? Please indicate by inserting ‘x’ in the appropriate box**

1. **If you went to your Dentist for TREATMENT TOMORROW, how would you feel?**
   - Not Anxious
   - Slightly Anxious
   - Fairly Anxious
   - Very Anxious
   - Extremely Anxious

2. **If you were sitting in the WAITING ROOM (waiting for treatment), how would you feel?**
   - Not Anxious
   - Slightly Anxious
   - Fairly Anxious
   - Very Anxious
   - Extremely Anxious

3. **If you were about to have a TOOTH DRILLED, how would you feel?**
   - Not Anxious
   - Slightly Anxious
   - Fairly Anxious
   - Very Anxious
   - Extremely Anxious

4. **If you were about to have your TEETH SCALED AND POLISHED, how would you feel?**
   - Not Anxious
   - Slightly Anxious
   - Fairly Anxious
   - Very Anxious
   - Extremely Anxious

5. **If you were about to have a LOCAL ANAESTHETIC INJECTION in your gum, above an upper back tooth, how would you feel?**
   - Not Anxious
   - Slightly Anxious
   - Fairly Anxious
   - Very Anxious
   - Extremely Anxious

**Instructions for scoring (remove this section below before copying for use with patients)**

The Modified Dental Anxiety Scale. Each item scored as follows:

- Not anxious = 1
- Slightly anxious = 2
- Fairly anxious = 3
- Very anxious = 4
- Extremely anxious = 5

Total score is a sum of all five items, range 5 to 25. Cut off is 19 or above which indicates a highly dentally anxious patient, possibly dentally phobic.
Assessment of dental anxiety and fear can be accomplished also through surveys and questionnaires completed by the patient. A rating scale like the Modified Dental Anxiety Scale (Table 1) consists of five questions dealing with feelings and physiologic reactions in different oral healthcare situations, with the total score ranging from 5 to 25. A score of 13 to 18 indicates a dental anxiety patient; 19 to 25 indicates a highly dental anxiety patient. Surveys such as the Dental Fear Survey (DFS) (Table 2) deal with a broad range of dental fear components across three different levels: avoidance and anticipatory anxiety; autonomic or physiologic arousal; and fear of specific objects or situations. DFS has been shown to predict anxiety exhibited during dental treatment and to correlate these items to previous dental experiences, client age and treatment invasiveness.

It is extremely important to recognize dental fear and anxiety before the patient receives oral care because the stresses can lead to the exacerbation of medical problems such as angina, seizures, asthma or hyperventilation. Therefore a comprehensive approach to assessment of fear and anxiety includes a verbal interview, written questions, vital signs and careful observation to recognize the presence of unusual degrees of fear and anxiety. 

### TABLE 2


<table>
<thead>
<tr>
<th>Dental Fear Survey (DFS)</th>
<th>Please rate your feeling or reaction on these items using the following scale:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>1. Has fear of dental work ever caused you to put off making an appointment?</td>
<td></td>
</tr>
<tr>
<td>2. Has fear of dental work ever caused you to cancel or not appear for an appointment?</td>
<td></td>
</tr>
</tbody>
</table>

When having dental work done: (use the following scale)

| 3. My muscles become tense. |       |
| 4. My breathing rate increases. |       |
| 5. I perspire. |       |
| 6. I feel nauseated and sick to my stomach. |       |
| 7. My heart beats faster. |       |

Using the scale above, please rate how much fear, anxiety, or unpleasantness each of the following causes you:

| 8. Making an appointment for dentistry |       |
| 9. Approaching the dentist’s office |       |
| 10. Sitting in the waiting room |       |
| 11. Being scared in the waiting room |       |
| 12. The smell of the dentist’s office |       |
| 13. Seeing the dentist walk in |       |
| 14. Seeing the anesthetic needle |       |
| 15. Feeling the needle injected |       |
| 16. Seeing the drill |       |
| 17. Hearing the drill |       |
| 18. Feeling the vibrations of the drill |       |
| 19. Having teeth cleaned |       |
| 20. All things considered, how fearful are you of having dental work done? |       |

#### Behavioral Management Techniques

**Modeling**

Modeling or behavioral modeling, a strategy frequently used to modify children’s behavior, can produce significant stable changes. This behavior strategy is ideal for children because children learn much of their behavior by observation and modeling. The child either watches another individual undergo a procedure via video or live, or is encouraged to behave as that person did. This type of behavioral modeling provides information about the procedure and allows the child to witness positive reinforcement. It is recommended that an older sibling or parent be the model and that the procedure be chosen wisely. Deep scaling procedures with an ultrasonic device or restorative treatment on an older sibling may not be the ideal modeling scenario.
Distraction
Preoccupation is a form of distraction that may decrease the patient’s anxiety during treatment. Distraction involves engaging the patient’s mind on something other than attending to the dental treatment.27 However, this form of preoccupation may only be advantageous for treatments with short duration, such as exposing radiographs, topical fluoride application and alginate impressions. Distraction techniques may include picking out as many items of a particular set as possible on a mounted poster, mentally reciting one’s multiplication tables, or holding one foot in a position while doing another action with the other foot.

Audiovisual devices, such as listening to music on a headset or watching television, have been shown to reduce anxiety in patients during prophylaxis treatment.28 Using audiovisual distraction is limited and should not be used on individuals with high anxiety who do not want their fears minimized or ignored.2 Frere found that participants with high anxiety had their anxiety unchanged or intensified.17 Frere also noted that some participants missed the interaction with the clinician while using audiovisual devices.17 Therefore, the clinician should note that effective communication can be compromised because the individual may not be attending to professional actions and conversations.16

Relaxation Techniques
Relaxation techniques that do not require advanced training include a variety of techniques that use progressive muscle relaxation, breathing exercises or guided imagery. These types of therapy are used to elicit a relaxation response that decreases stress through decreased heart rate, lowers metabolism, decreases respiratory rate and muscle tension. However, before instructing the patient about any relaxation therapy, he or she should be given a full explanation as well as an option to decline the therapy. Progressive muscle relaxation focuses on systemically tensing and relaxing the muscles from head to toe and using deep breathing to further relax the body.33 The patient is instructed to slowly tense the muscles for five seconds, relaxing each muscle group for 30 seconds, and then

Another important step in treating anxious patients is explaining the proposed treatment and sequence of treatment to eliminate surprises.
repeating the procedure for four or five cycles before moving to the next muscle group. During this technique, the patient uses deep breathing to further relax his or her muscles. Deep breathing promotes increased oxygen to the brain and muscles and gives the patient a sense of calm.

Guided imagery is another simple technique in which the dental practitioner plays an active role in deciding what type of pleasant internal scenario the patient can focus on. The patient can elicit a personal picture that he or she believes is the most effective calming device. The dental practitioner then will create a mental detail using as many senses as possible, including smells, sights, sounds and textures. If, for example, the imagery is an ocean, the dental practitioner guides the patient to the feeling of warmth and sand, the sound of waves and the smell of salt in the air.

With these types of techniques—muscle relaxation, breathing or guided imagery—the dental practitioner's aim is to build rapport with the patient by matching verbal and nonverbal communication. However, the dental practitioner should also note before implementing any relaxation techniques to ask the patient whether he or she has developed any coping techniques or mechanisms. Most anxious or fearful patients have their own way of coping with stressful events and learning new mechanisms will only add stress.34

**Advanced Techniques**

Advanced techniques, like systemic desensitization and hypnosis, are complex and should only be administered by a dental practitioner who has been formally trained in their use. Dental practitioners should check with their state and local governing body about the rules and regulations on administering these types of behavioral techniques.

The behavioral technique, systemic desensitization, gradually exposes patients to things and situations that cause them fear. This involves creating a hierarchy of fear-producing situations, starting from the least feared and gradually ascending to the most feared situation. For example, if a patient fears the periodontal probing treatment, the individual would be first exposed to the probe on a finger, then watch as a person’s teeth are being probed, then watch in a mirror while the dental practitioner probes a tooth, eventually moving on to one quadrant and entire dentition. The patient stays at each level until completely relaxed when confronting the experience, before progressing to the next experience.15

Hypnosis is an altered state of mind in which suggestions are accepted more readily and acted on more powerfully than in the fully conscious state.29 This technique serves as a means of providing relaxation and decreased anxiety without the need for drug administration.37 The disadvantages to this technique, other than additional training and certification requirements, are that it requires considerable time to induce a trance and public misconceptions about what that trance state entails.

**Conclusion**

Fear and anxiety are primary reasons why individuals avoid visiting the dental practitioner. Therefore, it is extremely important that the dental practitioner understand the physiologic, psychological and behavioral effects of dental fear and anxiety and be equipped to apply techniques to manage fearful and anxious patients. The dental practitioner should also understand that applying behavioral techniques helps to induce the patient’s relaxation, reduce anxiety and also reduce the need for analgesics with their potential side effects.

**Queries about this article can be sent to Dr. Dincer at edincer@hostos.cuny.edu.**

**REFERENCES**

Use of Twin Block of Clark in Management of Angle’s Class II Division I Malocclusion

Case Report

Gerald Ikenna Isiekwé, B.D.S., F.M.C.D.S.; Oluranti Olatokunbo daCosta, B.D.S., F.W.A.C.S.

ABSTRACT
A case report on the orthodontic management of a 10-year-old female patient with Angle’s Class II Division I malocclusion, 12 mm overjet, incompetent lips, a deep bite and a lower midline shift to the right using the Twin Block of Clark is presented. Treatment objectives included reduction of the overjet and overbite, obtaining a Class I molar and canine relationship, and improving the patient’s profile. After a thorough patient assessment, a two-phase orthodontic treatment plan was chosen with myofunctional therapy using the Twin Block constituting the first phase of treatment. Second phase of treatment was to be carried out using a preadjusted edgewise appliance system. Active treatment with the Twin Block lasted for nine months. Patient’s compliance with the appliance was good, and an overjet reduction to 4.5 mm was achieved with an improvement in facial profile after the first phase of treatment. The Twin Block of Clark is a very good treatment alternative in managing selected cases of Angle’s Class II Division I malocclusion.

Class II malocclusion presents in a wide variety of skeletal and dental configurations. The most consistent diagnostic finding in these patients is mandibular skeletal retrusion. Several treatment options are available for managing Class II malocclusions; among these is the use of functional appliances. Functional appliances encompass a range of removable and fixed devices that are designed to alter the position of the mandible, both sagittally and vertically, to induce supplementary lengthening of the mandible by stimulating increased growth at the condylar cartilage.

The Twin block (TB) appliance, originally developed by Clark, is a widely used functional appliance for the management of Class II malocclusion. Its popularity is attributed to its high patient adaptability and ability to produce rapid treatment changes. The appliance consists of maxillary and mandibular acrylic plates with bite blocks, which interlock at a 70-degree angle on closure, while posturing the mandible forward.

Two main schools of thought exist with regard to the timing and choice of orthodontic treatment for children presenting with Angle’s Class II Division I malocclusion. One advocates an early or two-phase treatment in which the first phase commences in the mixed dentition using appliances such as the TB or other functional appliances to achieve growth modification while a second phase of treatment commences in the permanent dentition using fixed appliance therapy. The other school of thought advocates a one-phase or delayed/late treatment in which treatment is delayed until the early permanent dentition, when fixed appliance
therapy is used. A two-phase treatment plan reduces the risk of maxillary incisor trauma and need for orthognathic surgery at a later stage. In addition, the time spent in fixed appliance therapy is much shorter in children who undergo the two-phase treatment.8-10

This case report demonstrates management of a patient with a Class II Division I incisal relationship, using a two-phase treatment plan, with successful completion of the first phase of treatment using the TB appliance.

Case Report
The patient is a Pakistani girl, aged 10 years, 7 months. She was referred to the orthodontic clinic of the Child Dental Health Department of the Lagos University Teaching Hospital, Iidi-araba. Her chief complaint was that she was unhappy with her teeth, as the top ones “stuck out.”

On extraoral examination, the patient presented with a skeletal base II. She had a convex soft tissue profile with mandibular retrusion. Her lips were grossly incompetent (Jackson’s classification 1/0) with a prominent mentolabial depression. There was no transverse asymmetry when viewed frontally (Figure 1).

On intraoral examination, the patient was in mixed dentition. The oral hygiene was fair. She had a Class II Division I incisor relationship, while her molar relationship was Angle’s Class II Division I, sub-division left. She had a 12 mm overjet, and her overbite was incomplete and increased. She presented with mild spacing of the upper labial segment (4 mm) and very mild crowding of the lower labial segment (1 mm). The upper and lower posterior segments were in normal alignment. With respect to the arch width, the upper arch was constricted, while the lower arch was normal; however, there were no crossbites. Both maxillary canines were mesiopalatally rotated, and she had a lower midline shift to the right of 3 mm (Figure 2). The upper right first maxillary molar was carious. The patient had a digit sucking habit, which she started when she was toddler, but stopped when she was 4 years old.

Cephalometric findings were compared to normal values for a Pakistani population.11 The cephalometric analysis confirmed the clinical finding of a Class II skeletal base relationship with a retrusive mandible and ANB of 9 degrees. Both upper and lower incisors were proclined (Table 1).

Teeth present: 6E4321 | 123456
6E4321 | 1234E6

Treatment Objectives
- Restoration of carious lesion on the upper right first maxillary molar.
- Reduce the overjet.
- Reduce the overbite.
- Improve the facial profile.
- Improve lip competence.
- Correct the spacing in the upper labial segment.
- Resolve the crowding in the lower labial segment.
- Correct the lower midline shift.
- Obtain Class I molar and canine relationships.

**Treatment Alternatives**
- Commencing treatment immediately using “2-by-4” fixed appliance therapy (preadjusted edgewise system) while waiting for exfoliation of the second primary molars.
- Delaying treatment for a few months, after which comprehensive fixed appliance therapy is commenced with two-unit extraction and reinforced anchorage in the upper arch.
- Two-phase treatment consisting of removable appliance (Roberts retractor with an anterior bite plane) and then fixed appliance therapy using the preadjusted edgewise system.
- Two-phase treatment consisting of functional appliance and then fixed appliance therapy.

**Treatment**
After consultation with the patient, the last option, two-phase treatment with functional appliance and fixed appliance therapy, was selected. The carious lesion on the upper right maxillary molar was restored and oral prophylaxis carried out.

The following treatment records were obtained: clinical photographs, study and working models (Figures 1-3). Occlusal registration for construction of the TB (squash bite) was obtained using a wax wafer of 4 mm thickness, with the mandible in a protruded position and the incisors biting edge-to-edge. Working models were sent to the lab with the squash bite in place.

The appliance was fitted satisfactorily and post-insertion instructions were given. The patient was advised to wear the appliance for 24 hours a day and while eating, if possible (Figure 4).

**Treatment Progress**
A gradual reduction in the overjet was observed after a period of time, with an average overjet reduction of 1 mm per month commencing from the first month of treatment. The bite planes of the TB appliance had to be trimmed intermittently to allow for eruption of the lower first mandibular molars.

After nine months of treatment, the following was achieved (Figures 5, 6):
- Overjet reduction to 4.5 mm.
- Normal overbite achieved.
- Improvement in patient’s facial profile.
- Appliance left in the mouth for retention, pending commencement of second phase of treatment.

**Discussion**
This case shows a good treatment outcome for the first phase of treatment, which was achieved with the TB appliance. The success can be attributed to three factors, namely, proper patient selection—pubertal growth spurt, timing of treatment and patient compliance.

Current wisdom suggests that any attempt at growth modification should be undertaken at the peak of the pubertal growth spurt. The optimum timing for functional/orthopedic treatment of Class II malocclusion is during or slightly after the pubertal growth spurt. From the point of view of occlusal development, this period correlates in most patients with the late mixed or early permanent dentition. The patient in this case was in the late mixed dentition and, thus, at an ideal age to commence treatment.

Considering the fact that the TB appliance worn by the patient was a removable appliance, patient compliance was also a key factor to treatment success. A major advantage of the TB appliance is its relatively smaller size—it comes in two parts rather than as a mono bloc—compared to other functional appliances.

<table>
<thead>
<tr>
<th>MEASUREMENT</th>
<th>PATIENT</th>
<th>NORMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>80°</td>
<td>82°</td>
</tr>
<tr>
<td>SNB</td>
<td>71°</td>
<td>80°</td>
</tr>
<tr>
<td>ANB</td>
<td>9°</td>
<td>2.4°</td>
</tr>
<tr>
<td>UI to Frankfort plane</td>
<td>127°</td>
<td>111.5°</td>
</tr>
<tr>
<td>LI to Mandibular plane</td>
<td>106°</td>
<td>95.4°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEASUREMENT</th>
<th>PRE-TREATMENT</th>
<th>NORMAL</th>
<th>POST-TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>80°</td>
<td>82°</td>
<td>78°</td>
</tr>
<tr>
<td>SNB</td>
<td>71°</td>
<td>80°</td>
<td>72°</td>
</tr>
<tr>
<td>ANB</td>
<td>9°</td>
<td>2.4°</td>
<td>6°</td>
</tr>
<tr>
<td>UI to Frankfort plane</td>
<td>127°</td>
<td>111.5°</td>
<td>115°</td>
</tr>
<tr>
<td>LI to Mandibular plane</td>
<td>106°</td>
<td>95.4°</td>
<td>107.5°</td>
</tr>
</tbody>
</table>
This may also enhance patient compliance and minimize speech disturbance.\textsuperscript{14}

The positive outcome at the end of treatment can be attributed to skeletal and dentoalveolar changes produced by the TB appliance. Post-treatment, the patient experienced an increase in the SNB angle by one degree, from 71 degrees to 72 degrees; this was most likely a result of increased mandibular growth. In contrast, the patient experienced a slight inhibition of forward maxillary growth as the SNA reduced to 78 degrees at the end of treatment, from the pre-treatment value of 80 degrees (Table 2). This reduction in the SNA angle can be attributed to the “headgear effect” produced by the TB appliance.\textsuperscript{10} Mills and McCulloch,\textsuperscript{13} in a cephalometric study of the treatment effects of the TB appliance, reported a 1.9-degree increase in the SNB angle of the treatment group as compared to almost no change (0.3-degree increase) in the control group, while a 0.9-degree reduction was observed in the SNA, as compared to a +0.1-degree increase in the control subjects.

Post-treatment, a lingual tipping of the maxillary incisors was observed in this patient, with a reduction of incisor proclination from 127 degrees to a post-treatment value of 115 degrees (Table 2). This lingual tipping may be due to the labial bow in the TB appliance, which comes in contact with the maxillary incisors during sleep, causing them to retract.\textsuperscript{15} Others have also attributed it to the contact of the lip musculature during treatment.\textsuperscript{16} Lund and Sandler\textsuperscript{17} achieved significant maxillary incisor retraction by incorporating a maxillary labial bow in the TB appliance, in contrast to Mills and McCulloch,\textsuperscript{14} who did not use a labial bow and found little change in the maxillary incisor position. Thus, the labial bow in the TB appliance plays an important role in the lingual tipping of the maxillary incisors.

A slight degree of mandibular incisor proclination was observed (2.5 degrees), with an increase in angulation from 106 degrees to a post-treatment value of 107.5 degrees (Table 2). This proclination is probably due to the mesial force on the mandibular incisors produced by protrusion of the mandible.\textsuperscript{1,16} Toth and McNamara\textsuperscript{16} reported a comparable value of mandibular incisor proclination of 2.8 degrees. Other authors\textsuperscript{24,17} have also reported values of 3.8 degrees and 7.9 degrees, respectively, after TB appliance therapy. However, lower incisor proclination, although helpful in achieving the initial overjet correction, is not a goal of functional appliance treatment. The more the lower incisors are proclined, the less possibility there is for skeletal correction of the overjet. In addition, labial tipping of lower incisors is not stable over the long term and is liable to relapse.\textsuperscript{8} For these reasons, lower incisor proclination is considered a limitation of using the TB appliance.

The reduction in overjet from 12 mm to 4.5 mm (Figure 8) can be attributed to the skeletal and dental changes highlighted above. Active treatment for this patient lasted for nine months, which is comparable to that reported in the literature of 6 to 15 months.\textsuperscript{8,14,38} The appliance was left in place for three months following treatment to act as a retainer, pending commencement of the second phase of treatment. At the end of the first phase of
treatment, due to the asymmetric molar relationship present at the start of treatment, the patient had a Class 1 molar relationship on the right, but was tending toward a Class III molar relationship on the left. This would be corrected during fixed appliance therapy in the second phase of treatment.

A second phase of treatment, using fixed appliance therapy, would be necessary to correct all other occlusal irregularities present and to obtain minor detailing of the occlusion. However, the use of a TB appliance in the first phase of treatment has reduced the expected duration of fixed appliance therapy in the second phase of treatment. The high risk of fracturing the maxillary incisors has also been reduced, while the patient’s facial aesthetics have been greatly improved within a reasonably short period of time without having to delay treatment until the early permanent dentition. In addition, the risk of external apical root resorption, which has been reported to be higher in one-phase than in two-phase treatments, has been reduced.9,19 Furthermore, the need for a two-unit extraction in the upper arch as part of the fixed appliance therapy or orthognathic surgery has been eliminated.

Conclusion
This case has demonstrated the successful management of the first phase of treatment of a patient with Angle’s Class II Division I malocclusion using the Twin Block of Clark.

Queries about this article can be sent to Dr. Isiekwe at ikisiekwe@yahoo.com.

REFERENCES
ABSTRACT

Communication between the organ transplant team and dentist is important in formulating individualized care plans to reduce the incidence of pre- and post-transplant complications. Periodontal diseases and other oral infections may present serious risks that could compromise the success of a solid organ transplant. This article reviews why dentistry is an important component of total transplant care while the patient is on the waiting list for a transplant and after the transplantation. Recommendations regarding the care of the organ transplant patient are given.

Dental clearance is the action or process of removing all acute dental disease and chronic dental conditions that can become acute. Dental clearance includes conducting pre- and post-treatment, comprehensive oral and radiographic examinations and providing a full written report that the patient has been treated. This report will be required by the medical team to inform its members that the patient’s dental status should have no effect on his or her medical treatment.

There are several important factors to be considered by both the organ transplant team and the dentist before a patient can undergo a major organ transplant, including heart, kidney, lung, liver, intestine and pancreas. Patients who are immunosuppressed due to the antirejection medications needed for successful organ transplant surgery may be at greater risk of developing systemic complications and transplant rejection relating to odontogenic inflammation and infections.1-3 Histologically, gingival connective tissue in patients taking cyclosporine, an antirejection drug, has been reported to have high levels of interleukin-6 (IL-6), which is a destructive pro-inflammatory cytokine produced by cells in the presence of inflammation.1 It has been documented that renal transplant recipients with chronic periodontitis had significantly higher serum IL-6 levels.2 Thus, inflammation and elevated serum IL-6 levels may increase the risk of organ transplant dysfunction. The dentist becomes an important part of the transplant team in controlling the cause of the inflammation (e.g., infection) before and after the surgery.

Compared to being on dialysis, having a kidney transplant decreases long-term mortality and improves the quality of life.4 Therefore, it is strongly advocated for transplantation as soon as possible unless there is a direct contraindication.5 Chronic inflammation is not a direct contraindication and does not need to be eliminated before the actual transplant surgery, but it is more important to the organ’s future survival. Thus, based on the time of the actual transplant surgery, the dentist must first expedite elimination of active acute inflammation (e.g., periodontal and endodontic abscesses) by performing periodontal surgery, endodontics or extraction, and then, as best as possible, in the re-

Medical and Dental Standardization for Solid Organ Transplant Recipients

maining time, eliminate chronic inflammation (e.g., dental caries, periodontal disease). In addition, long-standing deep caries must be treated to prevent an acute dental “flare-up.” Knowing the relative timeframe for the impending transplant surgery will help the dentist formulate a care plan so that any acute inflammation can be eliminated as soon as possible.

The main concerns of a transplant physician are whether the patient can tolerate the surgery and whether he or she is at risk for any severe infections immediately post-transplant.4,6 A care plan must be developed while the patient is on the wait list and following transplant surgery. This is universal in terms of chronic inflammation and disease. For example, transplant patients with active chronic hepatitis C and even HIV have an improved survival as compared to patients remaining on dialysis.7,8 However, although patients with chronic disease benefit from transplantation, this benefit may be less than if they did not have a chronic disease.

Currently, a patient on a waiting list for an organ transplant must be evaluated by the dental professional for diagnosis and treatment of oral disease, with the objective of stabilizing his or her oral health prior to transplantation.9 Unfortunately, there is no definitive criteria assessment between the physician and the dentist regarding the level of inflammatory disease of the patient and the scope of therapy required to eliminate or reduce oral inflammation in the pre- and post-transplant patient.10,11

Criteria must be standardized so that all transplant centers/clinics and dentists can communicate effectively with each other. Unfortunately, it may be years after the initial exam that the transplant physician will see the patient again. The minimal level of dental health must be defined and achieved so that medical treatment can be started. Additionally, the physician must assess whether the dental evaluation meets the requirements for transplant surgery. Currently, there are no definitive criteria for physicians and dentists to follow to determine the level of dental care needed for individual patients both pre- and post-transplant surgery.

Organ-specific Dental Considerations

Pre-transplant patient

Dental care for the pre-transplant patient differs from that of the post-transplant patient. General dentists also need to be cognizant of the specific underlying end-stage disease in the pre-transplant patient and how to deal with it. Consultation with the patient’s physician is necessary if antibiotics or anti-inflammatory/analgesics have to be prescribed to a patient with end-stage liver or kidney disease. Several of these medications may require a decrease in dosage or an increased dosing interval, and some drugs, such as NSAIDs, should be avoided in patients with chronic kidney disease and liver cirrhosis to prevent renal failure. In addition, narcotics should be avoided or prescribed with limitations to prevent encephalopathy.12 The amount of acetaminophen should be limited to less than or equal to 2 to 3 g/d in patients with liver disease (cirrhosis) but without renal failure, and these patients monitored for adverse drug events.12

The severity of chronic kidney disease is determined by the glomerular filtration rate (GFR). These values are obtained from the patient’s physician. There may be comorbid systemic diseases that the dentist has to be aware of before rendering dental care. Dentists must take into consideration the compromised health and immune system in pre-transplant patients, which places them at increased risk for systemic and oral infections.

Managing oral health before organ transplantation involves obtaining a medical consultation from the patient’s medical team regarding the need for antibiotic prophylaxis to prevent systemic infections from dental procedures. Dental management involves obtaining a dental and medical history and a dental and periodontal examination. It is best to avoid procedures that cause bleeding until a physician’s consult is obtained. The pre-transplant patient is usually taking several medications, including anticoagulants such as warfarin and antihypertensives such as beta blockers or calcium channel blockers. The dentist should know all the adverse effects of these medications, including xerostomia, orthostatic hypotension, gingival enlargement (with calcium channel blockers) and drug interactions and be prepared to avoid and manage
them. INR (international normalized ratio) and platelets values must be obtained in anticoagulated patients or in patients with end-stage liver disease within 24 but not more than 72 hours of performing invasive dental procedures to determine if the dental procedure can be done without complications of bleeding.

After formulation of a treatment plan, any active infections must be eliminated if time allows; periodontal treatment, including surgeries, should be completed before transplantation and extraction of unrestorable teeth. The patient should be instructed about the importance of maintaining optimum oral hygiene. If the patient is undergoing hemodialysis, it is recommended that the patient have dental treatment one day after dialysis. Sometimes surgical procedures may have to be performed in a hospital setting.

**Post-transplant Patient**

Dental care of the post-transplant patient is different from that of the pre-transplant patient. Essentially, all dental treatment, except for emergencies, must be avoided for at least three and up to six months following organ transplantation, as well as in patients with organ rejection. This is the time it takes for the graft to be stabilized and the immune system to partially recover. If emergency dental treatment is needed before the six months are up, the patient must have antibiotic prophylaxis. The impact of organ transplantation on the general health status, including systemic low-grade inflammation, must be recognized in the post-transplant patient.

The post-transplant patient will be taking many immunosuppressive medications, including cyclosporine, tacrolimus, prograf, azathioprine and corticosteroids. Cyclosporine, an immunosuppressive drug, may cause gingival enlargement, which makes oral hygiene more difficult for the patient. Additionally, patients taking a calcium channel blocker for hypertension may further aggravate the gingival enlargement. There are a few dental drug interactions with cyclosporine. These are: 1. erythromycin, clarithromycin (biaxin) and fluconazole (Diflucan) may increase cyclosporine levels and can cause toxicity; 2. carbamazepine (Tegretol) may decrease cyclosporine levels; and 3. nonsteroidal and anti-inflammatory drugs such as ibuprofen should be avoided with cyclosporine because of kidney damage.

Dental drug interactions with tacrolimus include erythromycin and clarithromycin, which may increase tacrolimus levels, and nonsteroidal anti-inflammatory drugs, which may cause oliguria or anuria. Tacrolimus has not been documented to cause gingival enlargement.

Azathioprine (Imuran) is an antimetabolite that can cause bone marrow suppression by inhibiting the production of bone-forming cells. Azathioprine causes leukopenia (inhibits production of white blood cells) and thrombocytopenia (decreased platelets). The complete blood count (CBC) value must be known before the start of dental treatment.

Over the years, the rate of organ transplant success has increased due to improved screening and evaluation, as well as to newer surgical procedures and immunosuppressive drugs. However, oral infections can be a cause of patient morbidity and transplant dysfunction. The importance of treating inflammatory periodontal and dental diseases cannot be overemphasized. Knowing the degree of immunosuppression of the patient, the

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**TABLE 1**

Pre-treatment Transplant Questions (answered by transplant team when assessing an organ recipient patient for referral to the dentist)

<table>
<thead>
<tr>
<th>1. What type of transplant is the patient being listed for?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(   ) No</td>
</tr>
<tr>
<td>(   ) Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. What is the cause of organ failure?</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>3. List chronic medical conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Does the patient have any known contraindications to anesthesia or dental procedures?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(   ) No</td>
</tr>
<tr>
<td>(   ) Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. How imminent is the transplant surgery?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(   ) Less than 1 year</td>
</tr>
<tr>
<td>(   ) Greater than 1 year</td>
</tr>
<tr>
<td>(   ) Unknown</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. The highest risk for infections will be during:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(   ) 1-6 months</td>
</tr>
<tr>
<td>(   ) Up to 1 year</td>
</tr>
<tr>
<td>(   ) Indefinitely</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. The level of immunosuppression of this patient posttransplant will be:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(   ) Low</td>
</tr>
<tr>
<td>(   ) Moderate</td>
</tr>
<tr>
<td>(   ) High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. After transplantation the medical status of the patient will allow dental care:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(   ) Immediately</td>
</tr>
<tr>
<td>(   ) After post-transplant month</td>
</tr>
<tr>
<td>(   ) Unknown</td>
</tr>
</tbody>
</table>

Exceptions to treatment:____________________________________________________________________|

<table>
<thead>
<tr>
<th>9. After transplantation the necessary medical precautions to be taken prior to dental treatment will include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(   ) Prophylactic antibiotic therapy suggested medication:</td>
</tr>
<tr>
<td>(   ) Corticosteroid supplementation:</td>
</tr>
<tr>
<td>(   ) Medications to be stopped:</td>
</tr>
<tr>
<td>(   ) Limitations on the use of local anesthetics:</td>
</tr>
<tr>
<td>(   ) Limitations on the use of epinephrine:</td>
</tr>
<tr>
<td>(   ) Other suggestions:</td>
</tr>
</tbody>
</table>

| 10. Other suggestions:                                                                      |

---
nature and severity of the oral inflammation present and the amount of time before the transplant surgery will help the dentist develop a dental treatment care plan. For example, if a patient is going to die in a few months if a transplant is not performed, or if finding a compatible donor is becoming very tenacious, then a compromise must be reached where oral disease may not be totally eliminated. Some patients may require a high level of dental treatment, including periodontal surgery and extractions, whereas other patients may require a less invasive level of care, including scaling and root planing, local drug delivery and antimicrobial mouthrinses.20

Once it has been established that the patient’s graft is stable, the following steps should be performed:13

1. The dentist must obtain a medical consultation from the patient’s transplant team to ascertain the patient’s immunosuppressive state, adrenal suppression and bone marrow suppression. There is a definite risk for infection with bone marrow suppression, and an appropriate antibiotic may be necessary after consultation with the patient’s physician. The patient usually will be taking steroids, such as prednisone, which is an immunosuppressant that prevents the body from rejecting the transplanted organ and could result in adrenal insufficiency, especially with stressful surgical procedures. Symptoms of an adrenal crisis include weakness, nausea and vomiting, and hypertension. This is a medical emergency and can be avoided with a comprehensive medical consultation. Laboratory blood values are important in evaluating the patient’s immune system and risk for infection due to immunosuppression and bone marrow suppression. Important lab values consist of:

- Total white blood cell count (WBC)
  - Normal: 4,000-10,000/mm³
  - Leucopenia: < 4,000/mm³
- Absolute neutrophil count (ANC)
  - Normal: 1,500-7,200 cells/mm³
  - Values below 1,500 cells/mm³ predict the risk for infection

2. Obtain INr and platelet values to determine the risk of bleeding. The patient is usually taking anticoagulants.

- International Normalized Ratio (INR)
  - Normal (not on an anticoagulant): INR 1
  - In order to perform invasive dental procedures the INR must be < 3.5.
- Platelet count21
  - Normal: 150,000-400,000/mm³
  - For dental procedures: > 50,000/mm³

3. The patient’s blood pressure should be monitored before and after dental treatment.

4. The patient should bring in all medications taken, including over-the-counter, to avoid any potential adverse event.

5. Check for any drug interactions that could occur with the medications the patient is taking. In addition, many medications given to an organ transplant patient or patients with end-stage renal or liver dysfunction can cause further organ damage. Consult with the patient’s physician before prescribing any antibiotic, analgesic or anti-inflammatory agent that may require a dosage adjustment either in the amount or increase in the interval of administration. Most infections during the first month post-transplant are associated with surgical complications. Opportunistic infections usually occur from the second to the sixth month post-transplant. Beyond six months or during the late post-transplant phase, transplantation recipients suffer from the same infections seen in the general community.22 Fever secondary to odontogenic infections following successful renal transplantation has been reported.23 Complications and failures after renal transplant may be due to active viral infections.24 Nowzari et al. found the presence of cytomegalovirus (CMV) in saliva and gingival crevicular fluid of these patients with associated periodontal disease.25 Controlling oral inflammation is also important during the post-transplant period to improve organ survival.26

How to Use Data Collection Worksheets

The physician should follow specific guidelines and criteria relating to the patient’s pre-transplant inflammatory state and then forward the results to the treating dentist. This information will help the dentist formulate an individualized treatment plan for the patient. Furthermore, the dentist can then inform the physician about the patient’s post-transplant dental/periodontal inflammatory condition and how the patient can be maintained.

Periodontal inflammation is extremely important in controlling both the morbidity and mortality rates in patients on hemodialysis as well as in post-transplant patients.27,28 This is accomplished by identifying the inflammatory oral risk factors and other non-oral risk factors, such as heart conditions, obesity and tumors.29 The dentist needs to know how much inflammatory disease is acceptable for the surgery to proceed and what is the level of disease or what level of dental health can be attained that is acceptable for medical treatment. In order to answer these questions a risk assessment must be performed. We are proposing a series of easy-to-follow care plan recommendations for the pre- and post-transplant patient that are based on the medical and dental expertise of the authors of this article. These recommendations should be utilized for clinical assessment and as guidelines by the organ transplant team and referring general dentists and periodontists.

Physicians generally do not have the same in-depth understanding of dental disease and how to treat it as dentists do. Therefore, they may have difficulty relaying to the dentist their pre- and post-medical/dental requirements. These care plan recommendations are designed to bridge this gap. They will provide...
the dentist with knowledge of what the physician feels is the minimal dental health the transplant patient may have prior to transplant surgery, the timeframe the dentist has to work within and the medical restrictions placed on the dental treatment. Once a dentist has this information, he or she will be able to develop a tailored treatment plan for the patient. If the physician’s expectations cannot be attained, then further consultation with the physician and dentist is necessary.

Table 1 lists specific questions that are answered by the transplant coordinator and sent with an introductory referral letter to the dentist. Table 2 contains selective questions that need to be filled out by the dentist and sent back to the transplant coordinator. The answers to these questions will determine the care plan while the patient remains on the wait list and post-transplant. Additionally, a standardized form (Table 3) pertaining to dental care for the post-transplant patient should be recorded by the dentist and communicated to the transplant team.

Conclusions
Prudent management of transplant patients is essential prior to their surgery, postsurgically and over the remainder of their lives. Currently, there is no definitive guidance from the transplant physician and dentist regarding the dental needs of transplant patients. The development of care plan recommendations will enable more comprehensive medical and dental treatment of immunosuppressed patients through better communication between the transplant physician and dentist. These recommendations will help treating doctors formulate a comprehensive patient management program.

The guidelines presented here were developed in response to a lack of direction with regard to the dental needs of transplant patients. The forms are based upon our clinical experiences and the result of communication between dentists and transplant physicians. To date there are no studies linking patients’ dental health and complications with transplants. At this time we really do not know what constitutes “clearance” for these patients or how much inflammation is tolerable. Future work needs to be done, including surveying multiple transplant centers to better understand what the transplant physician is asking for. We need to educate physicians as to what is practical for the dentist to accomplish.

A recent article found that there was a major concern regarding underutilization of preventive dental services in medically transplant children undergoing renal and liver transplants.15 Many dentists may not feel comfortable in pre- and postoperative monitoring and treating these patients as well as other transplant patients. The intent of these forms is to ease the responsibility of the dentist and improve preventive care by providing better communication with the physician and by giving the physician a better understanding of what the dentist must accomplish during patient care.

It is just as important to recognize that when the dentist is communicating with the physician, the dentist is actually requesting a

### Table 2
Pre- and Post-transplant Patient Assessment. To be filled out by the dentist (check in the box after procedure is completed) and sent to the transplant physician.

1. **Recommended therapies prior to transplantation:**
   a. 
   b. 
   c. 
   d. 

2. **Expected time until completion of treatment:**

3. **Recommended ongoing care for patient (pre- or post-transplant):**
   a. 
   b. 
   c. 
   d. 

☐ Full mouth radiograph taken: date:

**Treating Acute Dental Disease**

Presence of dental caries:
   Tooth number and surface:
   Treated (tooth # & restoration):
   Endodontically treated?

Endodontically involved teeth (e.g., acute or chronic abscess)
   Tooth number:
   Treated:

 Teeth requiring extraction #

**Treating Chronic Dental Disease**

Root caries
   Tooth number:
   Treated (tooth # & treatment):

Ailing, failing or failed implants
   Tooth number:
   Treated:

**Periodontal Diseases**

Treating Acute Periodontal Conditions
Necrotizing ulcerative gingivitis or necrotizing ulcerative periodontitis
Periodontal abscess

**Treating Chronic Periodontal Conditions**

Chronic gingivitis (localized or generalized; severity: mild, moderate or severe)
   Circle: plaque-induced, medication-induced, systemic disease-induced
   Treatment:
   Is patient adherent to plaque control
   ( ) NO
   ( ) YES

Periodontal abscess
   Chronic periodontitis
   Circle: localized or generalized
   Circle: severity: mild, moderate or severe
   risk factors
   Circle all that apply: plaque-induced, smoking, diabetes or other treatment
   Is patient adherent to plaque control
   ( ) NO
   ( ) YES

   Aggressive periodontitis
   Circle: localized or generalized
   Circle: severity: mild, moderate or severe

☐ Status of third molars
   Impacted third molars should be extracted
   List tooth number:
   Treatment:
medical consultation rather than a medical clearance from the transplant physician. Essentially, the dentist needs to know about the patient and how well he or she will be able to get through a dental procedure. These recommendations or guidelines give the dentist an idea of the patient’s medical status, timelines and postsurgical needs prior to the transplant surgery. The dentist will be able to assess whether he or she can meet the physician’s expectations. If not, then further communication needs to be initiated between the dentist and the physician. Once the transplant physician and dentist come to a consensus, they will be able to inform the transplant patient what is expected of them both before and after transplant surgery.

Post-transplant dental care is often overlooked. These guidelines give the dentist follow-up guidelines for postsurgical care. Periodontal diseases and dental caries must be monitored in these patients to lessen the incidence of life-threatening postsurgical infections. Furthermore, post-transplant patients are usually severely immunsuppressed from medications taken to prevent rejection of the organ.

Queries about this article can be sent to Dr. Segelnick at EperiaDr@aol.com.

### TABLE 3

Dental Care Guidelines for Post-transplant Recipients

<table>
<thead>
<tr>
<th>1. Medical history</th>
<th>a. Consult with transplant physician</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Medications (e.g., cyclosporine, calcium channel blockers)</td>
<td></td>
</tr>
<tr>
<td>c. Antibiotic prophylaxis for periodontal maintenance visits</td>
<td>□ Medication usage</td>
</tr>
<tr>
<td>□ Presence of medication-induced gingivitis</td>
<td></td>
</tr>
<tr>
<td>Circle:</td>
<td></td>
</tr>
<tr>
<td>cyclosporine, nifedipine, tacrolimus, sirolimus</td>
<td></td>
</tr>
<tr>
<td>Dosage:</td>
<td></td>
</tr>
<tr>
<td>□ Antibiotic prophylaxis required</td>
<td></td>
</tr>
<tr>
<td>□ Yes</td>
<td></td>
</tr>
<tr>
<td>Antibiotic &amp; dosage:</td>
<td></td>
</tr>
<tr>
<td>□ No</td>
<td></td>
</tr>
</tbody>
</table>

| 2. Radiographs as needed | |

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Good</td>
<td></td>
</tr>
<tr>
<td>c. Improving</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Reinforce oral hygiene</th>
<th>a. Devices used (e.g., soft-bristled toothbrush, interdental)</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Technique (e.g., modified Bass)</td>
<td></td>
</tr>
</tbody>
</table>

| 5. Gingival and periodontal assessment (gingival evaluation, bleeding, probing depths) | |

<table>
<thead>
<tr>
<th>6. Caries assessment</th>
<th>a. Fluoride application</th>
</tr>
</thead>
</table>

| 7. Prescribe antimicrobial mouthrinse, if needed | |

| 8. Three-month maintenance schedule | |

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**REFERENCES**

Surgical Exposure and Crown Lengthening for Management of Complicated Fractures of Maxillary Anterior Teeth

A Case Report


A B S T R A C T

When a tooth fracture occurs, the fracture line can extend in a variety of directions, and the direction of the fracture line often dictates the treatment plan. In cases where fracture lines extend apical to the gingival margin, exposure of fractured margins becomes necessary. And management of such tooth fractures often requires an interdisciplinary approach involving endodontic, periodontic and restorative procedures. This article describes a case in which severely traumatized maxillary anterior teeth were managed by a combined approach involving surgical exposure and crown lengthening, endodontic and restorative procedures.

Dental injuries are a common occurrence in patients who have suffered trauma to the middle-third of the face. These injuries to the teeth can range from minor craze lines in enamel to avulsion of the tooth. The most commonly affected teeth are usually the maxillary incisors.1

When fracture of a tooth occurs, the fracture line may extend in a variety of directions, and the direction of the fracture line often dictates the treatment plan. A crown fracture with a subgingivally located fracture line poses a significant challenge to the dentist. This is because a subgingival fracture presents problems in completing endodontic and restorative procedures.2 Problems encountered in endodontic therapy include difficulty in establishing adequate isolation, which, in turn, can affect the cementation of endodontic posts. Moreover, as preparation of adequate margins for a crown becomes difficult in cases of a subgingival fracture, such a fracture may contribute to future periodontal breakdown if the margins of the restorations are placed apical to the gingival margin. Hence, in cases where fracture lines extend apical to the gingival margin, exposure of fractured margins becomes necessary and management of such tooth fractures often requires an inter-disciplinary approach involving endodontic, periodontic and restorative procedures.

Exposure of tooth margins can be achieved by various techniques. These include surgical crown lengthening,2-4 orthodontic extrusion,2,5-8 and surgical repositioning.2,9,10 Crown lengthening is a periodontal resective procedure that removes supporting periodontal structures to expose sound tooth structure coronal to the alveolar crest level. Traditionally, endodontic, crown lengthening and restorative procedures are performed in a staged manner, with the crown-lengthening procedures usually performed after completion of endodontic treatment and prior to finalization of tooth preparation. However, in situations where the fracture lines are entirely subgingival, the execution of the endodontic treatment may be difficult unless the tooth margins are exposed by surgical procedures.
Crown-lengthening procedures are performed in cases of subgingival tooth fractures to expose the tooth margins and, also, in situations in which a tooth has a short clinical crown considered inadequate for the retention of cast restorations. This report describes a case in which surgical exposure and crown lengthening were performed prior to endodontic treatment for management of fractured maxillary anterior teeth.

Case Report
A healthy 24-year-old male patient was referred to the Department of Periodontics from the Department of Oral and Maxillo-Facial Surgery of the Government Dental College, Trivandrum, India, with the complaint of fractured maxillary anterior teeth. The injury had occurred as a result of an alleged assault seven days prior. Clinical examination revealed complicated crown fractures of the maxillary right first premolar, canine, lateral and central incisors, and maxillary left central incisor, with complete loss of coronal tooth structure (Figures 1, 2). The fracture lines were located entirely subgingivally. The maxillary left lateral incisor had been stabilized to the adjacent canine with a stainless steel wire splint at the Department of Oral and Maxillo-Facial Surgery. Radiographic examination revealed the extent of the fracture lines and the level of the alveolar crest (Figure 3).

The patient was informed about the prognosis of the teeth and the available treatment options. After having been given the options of either an inter-disciplinary approach to retain the teeth or extraction of fractured teeth followed by prosthetic replacement with removable or implant-supported prostheses, the patient opted for the former. Hence, after consultation with the Department of Conservative Dentistry and Endodontics, a treatment plan was arrived at that included surgical crown lengthening for exposure of the fractured margins, followed by endodontic and restorative treatment procedures. The patient was informed in detail about the treatment plan, and written consent was obtained prior to initiating the treatment procedures.

Crown lengthening was performed under local anesthesia. After removal of the stainless steel wire splints, sulcular and vertical incisions were placed and a full thickness flap was raised on the labial aspect in relation to the fractured teeth (Figure 4). On the palatal aspect, an internal bevel incision was placed to resect the gingival tissue to obtain adequate exposure of the fracture margins. Ostectomy and osteoplasty were performed using rotary instruments to achieve exposure of sufficient tooth structure coronal to the alveolar crest to facilitate placement of the restoration without violating the zone of supra-crestal gingival tissues. Bone removal was performed on the labial and palatal aspect of the roots, as well as from the inter-dental regions (Figure 5). The labial flap was displaced apically (Figure 6), and the flaps were sutured at the level of the alveolar crest with interrupted silk sutures (Figure 7). The surgical site was covered with a periodontal dressing, and the patient was prescribed postoperative systemic antibiotics (amoxicillin 500 mg three times a day for 7 days), analgesics
(combination of aceclofenac 100 mg and paracetamol 500 mg twice daily for 5 days) and 0.2% chlorhexidine gluconate oral rinse for two weeks. The patient was also advised to avoid brushing at the surgical site until the removal of sutures, which was done 10 days after the surgery. Adequate exposure of the tooth structure to perform endodontic and restorative procedures was achieved (Figure 8). Following the crown-lengthening procedure, the teeth had become mobile. However, this mobility subsided four weeks after surgery.

Endodontic treatment was performed on the teeth, and the root canals were obturated with gutta-percha by the sectional technique. Due to the subsequent development of a periapical abscess, endodontic treatment was performed on the maxillary left lateral incisor also. Following endodontic treatment, the teeth were restored with cast post and core restorations (Figures 9-11), and vitallium crowns with ceramic facings were placed four months after surgery (Figures 12-14). Favorable tissue healing had occurred and there was no mobility or pocket formation in relation to the restored teeth. The patient was satisfied with the results of the treatment.

**Discussion**

Traumatic injuries with loss of tooth structure in the incisor region are common, especially among children and young individuals. In certain situations, the fracture line may extend apical to the gingival margin or crest of the alveolar bone. In these instances, in order to facilitate proper restoration of the teeth, surgical intervention in the form of a crown-lengthening procedure is required. Other treatment options for exposure of the fracture lines include orthodontic extrusion and surgical repositioning.

Anterior teeth with coronal fractures can be managed without surgical invasion if the biologic width of the tooth is not violated by the apical extent of the fracture, provided the residual root structure possesses an adequate ferrule. In such clinical situations, orthodontic extrusion can be employed to expose the fractured margins. Orthodontic extrusion has also been termed forced eruption, orthodontic eruption and assisted eruption. It can be achieved with either fixed or removable appliances. It is a conservative procedure that, unlike surgical crown lengthening, does not involve loss of bone or periodontal support and does not require application of tractional forces in all regions of the periodontal ligament to simulate marginal apposition of crestal bone. When a root is orthodontically erupted, the attachment apparatus and gingiva may follow to a further coronal position at the adjacent teeth. This may necessitate periodontal surgical procedures to correct any discrepancy in the levels of periodontium at adjacent teeth. In rapid extrusion, where higher forces are used, the coronal migration of the supporting tissues may be reduced. But this carries the risk of injury to the periodontium and root resorption.

Surgical extrusion refers to repositioning of the root to the desired position coronally and securing it with simple sutures in
the soft tissues. The limitations of this procedure include the difficulty of surgically luxating a fractured tooth without damaging the periodontal ligament, as any damage to the periodontal ligament on the root surface may prevent reattachment.

Orthodontic or surgical extrusion can be performed in cases of isolated tooth fractures. When multiple adjacent teeth are involved, clinical crown-lengthening procedures need to be performed to expose sufficient tooth structure for restorative purposes. In the case presented here, the patient was given an alternative option of extraction and prosthetic replacement of the teeth. As the patient opted not to undergo extraction, a treatment plan was formulated involving exposure of tooth structure, followed by endodontic and restorative procedures. As multiple teeth were involved in the esthetic zone, a decision was made to perform crown lengthening to achieve the desired exposure of tooth structure.

Crown lengthening is a periodontal resective procedure aimed at removing supporting periodontal structures to gain sound tooth structure coronal to the alveolar crest. Crown-lengthening procedures are performed in cases of subgingival or subcrestal root fracture; perforations of the root at the coronal third; carries with subgingival extension; excessive wear of the dentition; or presence of previous subgingival margins of restoration.

Clinical crown lengthening is indicated in these situations to gain additional tooth structure to meet the mechanical need of the restorative procedures. Besides these functional and biological reasons, crown-lengthening procedures can be performed for esthetic reasons in cases where there are short clinical crowns, excessive wear, uneven gingival contours or an excessive gingival display.

Although crown-lengthening procedures are usually performed after completion of endodontic treatment, as in the case here, where the fracture lines are entirely subgingival, surgical exposure and crown lengthening can be performed as the initial procedure to facilitate both endodontic and restorative procedures.

Periodontal health is of paramount importance for all teeth, both sound and restored. Crown-lengthening procedures are based on biologic principles that can be determinants for successful treatment. These procedures enable the clinician to develop an adequate area for crown retention without extending the crown margins deep into the periodontal tissues, an area referred to as the biologic width, the portion of the root surface occupied by the junctional epithelium and gingival connective tissue. Gargiulo et al., in their study of human cadavers, reported that the connective tissue attachment occupies 1.07 mm of space coronal to the crest of the alveolar bone and that the junctional epithelium occupies another 0.97 mm of space coronal to the connective tissue attachment. Vacek et al. reported the dimension of epithelial attachment to be 1.14 mm and that of the connective tissue attachment to be 0.77 mm. According to their study, the biologic width of the anterior teeth was 1.75 mm; for premolars it was 1.97 mm; and for molars it was 2.08 mm. If the restoration margin is placed into this area, the crestal bone will be lost to re-establish the biologic width. It may also lead to gingival inflammation and pocket formation.

Crown-lengthening procedures enable the clinician to expose adequate clinical crown in order to prevent the placement of the crown margin into the area of the biologic width.

Besides the biologic width, prevention of violation of a zone known as supracrestal gingival tissue (SGT) is also considered important. SGT refers to the tissues located coronal to the alveolar crest extending up to the gingival margin, that is, connective tissue attachment, junctional epithelium and sulcular tissue. Gargiulo et al. reported in their study that the sulcular depth was approximately 0.69 mm. When combined with the biologic width, the dimension of the SGT comes out to be approximately 2.73 mm. Vacek et al. reported the value of SGT to be approximately 3.23 mm. In a recent study to determine the dimensions of SGT among 100 dental students, Barboza et al. reported that the dimensions of the SGT ranged from 1 mm to 6 mm, with a mean value of 3.3 mm (3.4 mm in males and 3.2 mm in females). They also reported that there were no significant differences between contra-lateral measurements, suggesting that the SGT dimension at a fractured tooth can be determined preoperatively by examining the contra-lateral tooth. Causes for the violation of the SGT include root fracture, restorative procedures and dental caries. As violation of SGT can result in gingival inflammation and bone loss to re-establish this dimension, prevention of this violation is critical to the maintenance of a healthy periodontium.

Although gingivectomy can be performed to eliminate the soft tissue that forms the pocket or sulcus wall, it cannot increase the clinical crown length, as no bone removal is done. The fact that traumatically fractured teeth usually have a healthy periodontium makes it difficult to achieve crown lengthening by a simple gingivectomy. Hence, bone margin must also be removed to achieve lengthening of the clinical crown. As a minimum width of attached gingiva is desirable for the long-term success of the restored tooth, care should also be taken to preserve the width of attached gingiva. This can be performed by a flap surgery where ostectomy can be performed for crown lengthening in combination with an apically displaced flap. Thus, crown-lengthening procedures aid in bone removal and apical repositioning of soft tissues to permit formation of a new SGT complex.

Bone removal can be done using rotary instruments in the presence of copious irrigation. During the osseous recontouring, care should be taken to establish a positive osseous architecture. Requirement for bone removal is often greater in the inter-proximal areas than on the buccal and lingual surfaces, and this inter-proximal bone height reduction should be accompanied by reduction of bone height on the buccal and lingual surfaces so that
bone levels in these areas will remain apical to the inter-proximal bone level. The amount of bone removal required depends upon the future position of the restoration margins and the SGT dimension for that particular patient. A sufficient amount of bone has to be removed to create a 3 mm zone of SGT around the tooth to be restored.

Herrero et al., in a study to compare the actual amount of supracrestal tooth length obtained during surgical crown-lengthening procedures with the presurgically desired amount, reported that a proposed minimally desired 3 mm distance from planned restoration margin to alveolar crest was not routinely achieved, irrespective of the experience of the clinician. However, in a 12-month radiographic study evaluating the results of crown-lengthening surgery, Diniz et al. reported that the overall mean distance from the restorative margin to the alveolar crest achieved after osseous resection was 3.28 mm at mesial and 2.81 mm at distal sites. They also reported that no significant radiographic changes in the bone crest were observed during a 12-month healing period.

The time interval between the surgical procedure and final preparation and placement of restoration is also critical. It is determined by the stability of the postsurgical position of the marginal periodontal tissues. Pontoriero and Carnevale, in a 12-month clinical study of wound healing following surgical crown lengthening, reported that the marginal periodontal tissue showed a tendency to grow coronally from the level defined at surgery. The postsurgical growth of the gingival margin at various time intervals after surgery was more in the inter-proximal region than at buccal or lingual sites. The postsurgical coronal displacement of the gingival margin observed at both sites was statistically significant when compared to the level achieved after surgery. It has also been reported that the closer the flap margin is sutured to the alveolar crest, the greater the tissue rebound during the postsurgical period. Studies have shown that there is a significant tissue rebound following crown-lengthening surgery; the amount of tissue rebound seems related to the position of the flap relative to the alveolar crest at suturing. Hence, it is important that proper crown height be established during surgery without over-reliance on flap placement at the osseous crest.

Although it is recommended that preliminary preparation of the teeth with placement of temporary restorations be performed prior to the crown-lengthening procedure, it has also been suggested that, on account of this postsurgical coronal growth of the marginal periodontium, the final preparation and restoration be delayed for 12 months after the crown-lengthening procedure and that any intermediate preparations be delayed for at least six weeks after surgery. In situations where the final restorations cannot be delayed, it has been recommended that,
during the first three to six months of the postsurgical period, the restoration margins can be placed minimally coronal to the gingival margin so that when the tissues grow coronally, the restorations margins may be located at an acceptable subgingival position. A technique of crown lengthening with simultaneous tooth preparation has been suggested as a method for a more accurate placement of the restoration margin in relation to the alveolar crest. This technique also offers the additional advantage of reducing the treatment time. In the case presented here, because of the complicated nature of the tooth fractures, which necessitated surgical exposure to facilitate endodontic treatment, crown lengthening was also performed as an initial procedure without any preliminary tooth preparation or placement of temporary restorations.

Potential complications of crown-lengthening procedures include the possibility of furcation involvement in the case of molars and migration of teeth. Although crown lengthening is a useful technique in managing teeth with short clinical crowns, decisions regarding use of this approach should be made judiciously. Due to the invasive and irreversible nature of the procedure, this approach should be used with caution. Crown-lengthening procedures are contraindicated in teeth with deep carious lesions or fractures that result in nonrestorable situations, in teeth with unfavorable crown-to-root ratio because of short roots or reduced bone support, and in posterior teeth where exposure of the furcation region may occur as a result of the procedure. Since crown lengthening is a surgical procedure, other factors to be considered include the potential for damage to surrounding anatomic structures, as well as the systemic health of the patient.

Conclusion

Proper management of fractured teeth with extensive loss of coronal tooth structure often requires an interdisciplinary approach. The location of the fracture line, as well as the periodontal status of the involved teeth, play important roles in proper treatment decisions. In cases of multiple tooth fractures occurring apical to the gingival margin, crown-lengthening procedures are a valuable treatment approach for exposure of the fracture lines. In an interdisciplinary approach, although the various treatment procedures are generally performed in a staged manner, which usually involves endodontic therapy followed by crown lengthening and finally restorative therapy, the sequence of treatment may be altered in accordance with the clinical situation. As in the case presented here, when surgical exposure and crown lengthening are performed as initial procedures, they will enable the clinician to perform endodontic and restorative procedures properly and contribute to the long-term retention of such teeth.

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REFERENCES

New York State after Last Recession
Dentists and Dental Establishments

H. Barry Waldman, D.D.S., M.P.H., Ph.D.; Aaron G. Segal, D.D.S.

A B S T R A C T

Data from the U.S. Census Bureau and the New York State Office of the Professions indicate an increase in emigration and immigration, resulting in slowing in the overall growth of New York State’s population, with accompanying modifications in the numbers of dentists and dental establishments in state counties. In addition, ADA data suggest that per capita dental spending has not rebounded since the end of the last recession. While there have been many changes at the county level, there does not seem to have been dramatic changes in the overall state numbers of dental practitioners and establishments through the early years of the current decade.

As a result of a decline in fertility rates and the aging of the post-World War II baby-boom generation, the nation as a whole got older between 1990 and 2010. New York State got older, too, but with striking regional variations. While the median age of the nation’s population rose 4.3 years between 1990 and 2010, it increased by 1.9 years in New York City, 5.2 years in downstate suburbs and 6.6 years upstate.³ These dramatic demographic changes are occurring at a time when the country continues to struggle out of the last recession, which officially ended almost four years ago.

“The Business Cycle Dating Committee of the National Bureau of Economic Research…determined that the recession that began in December 2007… had ended) in June 2009. The recession lasted 18 months, which makes it the longest of any recession since World War II.”⁴

Specifically, Dentistry

In 2013, the ADA’s Health Policy Resources Center suggested “…very strongly that the dental economy is in a major transition… Dental spending has not rebounded since the end of the Great Recession and has been stagnant, on a per capita basis, since 2008… the declines in both dental spending and visits predate the economic crisis of 2008.”⁵

Dentists, Residents and Economics

A previous article in the NYSDA News indicated that between 2000 and 2006 (prior to the last recession), the number of registered dentists decreased in 27 New York counties. The greatest decrease occurred in the counties of Albany, Bronx, Niagara, Suffolk and Westchester.⁶

Regional Differences

Reports for 2012 from the New York State Office of the Professions emphasized a continuing decrease in the overall number...
of dentists in the state, in New York City and in the rest of the state. The combination of these decreasing numbers of dentists and changes in the population in different sections of the state resulted in slight increases in the number of residents per dentist in New York City and in the rest of the state. Nevertheless, the population per dentist remained greater in New York City than in the rest of the state (Table 1).

County Differences
In 2012, reflecting the changing population numbers and the decrease in the number of dentists, there were dramatic differences in New York State counties in terms of the number of residents per dentist. These differences range from fewer than 1,000 residents per dentist in New York (Manhattan), Nassau, Westchester and Rockland counties, to more than 4,000 residents per dentist in Allegany, Washington, Lewis, Hamilton and Tioga counties. In most counties, however, the number of residents per dentist ranged between 1,000 and 2,999 residents per dentist (Table 2).

Economics
While there are a great range of factors that enter into consideration when selecting practice and living locations, one issue can be a critical factor in the final determination, that is, the economics of a community. In this computer age, these data are readily available. For example, in 2010, while the average per capita income of New York State residents was $30,948, it ranged from $17,575 in Bronx County, $19,807 in Franklin County and $20,058 in Allegany County, to $41,387 in Nassau County, $47,814 in Westchester County and $59,149 in New York County (Manhattan). More locally, among more than 1,000 locations, the per capita income ranged from $4,355 in Kiryas Joel in Orange County, to $113,320 in Hewlett Bay Park in Nassau County.11

In terms of expenditures for dental services, at the end of the recession in 2009, national per capita spending for dental care was $333, ranging from $223 in Mississippi, to $507 in Washington State. New York State ranked 28th (1= lowest, 51= highest) in per capita income of New York State residents was $30,948, it ranged from $17,575 in Bronx County, $19,807 in Franklin County and $20,058 in Allegany County, to $41,387 in Nassau County, $47,814 in Westchester County and $59,149 in New York County (Manhattan). More locally, among more than 1,000 locations, the per capita income ranged from $4,355 in Kiryas Joel in Orange County, to $113,320 in Hewlett Bay Park in Nassau County.11

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Dental Establishments
In a series of previous reviews in The NYSDJ, the increasing numbers and size of dental establishments (1) in New York State were reported, with emphasis on the decreasing proportion of facilities with fewer than five employees.13-17 This trend continued through 2007, prior to the recession, with the proportion of “smaller” establishments (fewer than five employees) continuing to decrease. (Employees may include dentists, dental hygienists, dental assistants, office staff, etc.) In 2011, after the recession:

- 51.9 thousand individuals were employed in New York State dental establishments.
- 52.2 percent of New York State establishments had fewer than five employees, compared to 40.7 percent in the United States.
- The “average” New York City dental establishment had 4.6 employees, compared to 6.3 employees in the “average” dental facility in the rest of the state. Overall, there were 5.6 employees statewide in the “average” establishment, compared to 6.5 employees in the “average” establishment in the United States.12
- The “average” full-time dental establishment employee’s annual salary was $42,100 in New York State, compared to $45,200 in the United States.19

Between 2007 and 2011:
- There was a statewide increase of 162 dental establishments, reflecting an increase in each of the New York City counties and gains and losses in the number of dental facilities in other state counties, including larger decreases in Erie and Monroe counties and large increases in Onondaga and Westchester counties (Table 3).

### TABLE 1.
Population per New York State Dentists by Region: 2007, 20127,10

<table>
<thead>
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<th>Year</th>
<th>New York City</th>
<th>Rest of State</th>
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<tr>
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<td>2012</td>
<td>8,337</td>
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### TABLE 2.
Number of Dentists

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<th>New York State</th>
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</thead>
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<td>2012</td>
<td>6,298</td>
<td>8,982</td>
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### TABLE 3.
Population per Dentist

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<tr>
<td>2012</td>
<td>1,323</td>
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<td>1,280</td>
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Note: Location reflects licensee’s primary mailing address on record with Office of Professions and is not necessarily licensee’s practice location or is in active practice. In addition, 2,903 registered dentists are in residence in other states, 34 out of U.S.

(1) An establishment is a single physical location where services are performed. It is not necessarily identical to a company or enterprise, which may consist of one or more establishments. In addition, one or more practitioners may be present in an establishment. Throughout this presentation, except where specified, the term “dental establishment” refers to those facilities 1. with employees and 2. subject to federal income tax. Government agency programs (hospitals and health department clinics) are not included.18

(2) While there is no such thing as an “average” dental establishment, comparisons between averages (over time and between locales) do provide a picture of the evolving practice of dentistry. The “average” number of employees in New York State was determined by dividing the total number of dental employees (51,908) by the number of dental establishments (9,237). The “average” salary was determined by dividing the total annual state payroll figure for dental establishment employees ($2,187,415,000) by the total number of employees (51,908 individuals).19
“New York lost 2.9 million residents to other states between 1990 and 2010—the biggest domestic outflow, relative to population, of any state during the 20-year period. An influx of foreign immigrants, mainly to New York City and its suburbs, reduced the state’s net migration loss during that period ....”

- There was a decrease in population per establishment in New York City and an increase in population per dental establishment in the rest of the state (Table 4).

### Dental Establishments with No Employees

In 2010, there were an additional 4,420 (an increase from 4,373 in 2007) New York dental establishments that were subject to federal income tax but with no employees. These non-employee dental facilities represented almost one-third (32.5%) of the total number of dental establishments in the state that year (i.e., 9,181 dental establishments with employees and 4,420 establishments with no employees).

Between 2007 and 2010, there was no change in the proportional representation of establishments with any employees among all dental establishments in the state. The New York dental facilities with no employees in 2010 reported a total of $344 million in gross receipts ($77,850 per establishment). Nationally, in 2010, there were 40,897 (an increase from 39,455 in 2007) dental establishments with no employees that reported more than $3.1 billion in gross receipts (an annual average of $75,800 in gross receipts per establishment).

In 2010, more than half (52%) of dental establishments in New York State (2,310 facilities) with no employees were located in New York City, compared to 58% in 2007. The combination of the number of no-employee facilities in New York City and those in Nassau County (679) and Suffolk County (352) on Long Island represented 76% of all non-employee facilities in the state, compared to 83% in 2007. In 2010, there were 363 dental establishments with no employees in Westchester County, 84 in Erie County and 89 in Monroe County.

During 2010, in New York State, most non-employee dental establishments were individual proprietorships with average annual gross receipts of $69,800. A smaller number of corporate arrangements facilities had average annual gross receipts of $139,800; partnerships had average annual gross receipts of $254,800.

Given the increasing numbers of employees per dental establishment with employees, how does one account for the great number of facilities with no employees? It was suggested in the previous NYSDJ review that non-employee establishment arrangements might include:

### Table 2.

Population per Licensed and Registered Dentist in New York State Counties: 2012

<table>
<thead>
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<th>Pop. per Dentist</th>
<th>County</th>
<th>Pop. per Dentist</th>
<th>County</th>
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<tbody>
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<td>(897)</td>
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<tr>
<td></td>
<td>Chemung</td>
<td></td>
<td>Delaware</td>
</tr>
<tr>
<td></td>
<td>Clinton</td>
<td></td>
<td>Orleans</td>
</tr>
<tr>
<td></td>
<td>Jefferson</td>
<td></td>
<td>Seneca</td>
</tr>
<tr>
<td></td>
<td>Kings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Montgomery</td>
<td>4,000-4,490</td>
<td>Allegany</td>
</tr>
<tr>
<td></td>
<td>Oneida</td>
<td></td>
<td>Washington</td>
</tr>
<tr>
<td></td>
<td>Ontario</td>
<td></td>
<td>Lewis</td>
</tr>
<tr>
<td></td>
<td>Orange</td>
<td>&gt;4,500 (4,537)</td>
<td>Hamilton</td>
</tr>
<tr>
<td></td>
<td>Putnam</td>
<td>(4,778)</td>
<td>Tioga</td>
</tr>
<tr>
<td></td>
<td>Tompkins</td>
<td>(6,309)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ulster</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,000-2,499</td>
<td>Cayuga</td>
<td>Total New York State</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chautauqua</td>
<td>Population – 19,501,616</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Columbia</td>
<td>Dentists – 15,280</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Essex</td>
<td>Pop. per dentist – 1,280</td>
<td></td>
</tr>
</tbody>
</table>
|                  | Livingston              | Note: Location reflects licensee’s primary mailing address on record with Office of Professions & is not necessarily licensee’s practice location or is in active practice. In addition, 2,903 registered dentists are in residence in other states, 34 out of U.S.
|                  | Madison                 |                         |
|                  | Niagara                 |                         |
|                  | Otsego                  |                         |
|                  | Rensselaer              |                         |
|                  | Steuben                 |                         |
|                  | Sullivan                |                         |
“Although New York State grew by 87,092 people in the 15 months after the 2010 census, 37 upstate counties lost population...”

“Because its population growth did not keep pace with other regions of the United States, New York State lost two congressional seats following the 2010 census.”

Table 3.
New York State Dental Establishment by County: 2007, 2011

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total State</td>
<td>9,075</td>
<td>9,237</td>
<td>162</td>
</tr>
<tr>
<td>New York City</td>
<td>3,684</td>
<td>3,869</td>
<td>185</td>
</tr>
<tr>
<td>Bronx</td>
<td>265</td>
<td>273</td>
<td>8</td>
</tr>
<tr>
<td>Kings</td>
<td>875</td>
<td>917</td>
<td>42</td>
</tr>
<tr>
<td>New York</td>
<td>1,374</td>
<td>1,438</td>
<td>64</td>
</tr>
<tr>
<td>Queens</td>
<td>980</td>
<td>1,031</td>
<td>51</td>
</tr>
<tr>
<td>Richmond</td>
<td>190</td>
<td>210</td>
<td>20</td>
</tr>
<tr>
<td>Rest of State</td>
<td>5,391</td>
<td>5,368</td>
<td>-23</td>
</tr>
</tbody>
</table>

Other counties
>100 establishments in 2007

<table>
<thead>
<tr>
<th>County</th>
<th>2007</th>
<th>2011</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany</td>
<td>137</td>
<td>136</td>
<td>-1</td>
</tr>
<tr>
<td>Dutchess</td>
<td>142</td>
<td>133</td>
<td>-9</td>
</tr>
<tr>
<td>Erie</td>
<td>438</td>
<td>421</td>
<td>-17</td>
</tr>
<tr>
<td>Monroe</td>
<td>342</td>
<td>323</td>
<td>-19</td>
</tr>
<tr>
<td>Nassau</td>
<td>1,083</td>
<td>1,079</td>
<td>-4</td>
</tr>
<tr>
<td>Onondaga</td>
<td>191</td>
<td>204</td>
<td>13</td>
</tr>
<tr>
<td>Orange</td>
<td>147</td>
<td>137</td>
<td>-10</td>
</tr>
<tr>
<td>Rockland</td>
<td>211</td>
<td>211</td>
<td>0</td>
</tr>
<tr>
<td>Suffolk</td>
<td>773</td>
<td>782</td>
<td>9</td>
</tr>
<tr>
<td>Westchester</td>
<td>657</td>
<td>676</td>
<td>19</td>
</tr>
</tbody>
</table>

Total >100 estab./county

<table>
<thead>
<tr>
<th>County</th>
<th>2007</th>
<th>2011</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total &gt;100 estab./county</td>
<td>4,121</td>
<td>4,102</td>
<td>-19</td>
</tr>
<tr>
<td>Counties (&lt;100 estab. in 2007)</td>
<td>1,270</td>
<td>1,266</td>
<td>-4</td>
</tr>
</tbody>
</table>

Table 4.
Population per New York State Dental Establishments by Region: 2007, 2011

<table>
<thead>
<tr>
<th>Year</th>
<th>New York City</th>
<th>Rest of State</th>
<th>New York State</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>2,246</td>
<td>2,044</td>
<td>2,126</td>
</tr>
<tr>
<td>2011</td>
<td>2,131</td>
<td>2,094</td>
<td>2,109</td>
</tr>
</tbody>
</table>

Overview
The April 2013 lead article in the ADA News highlighted the finding that,

“...our results suggest very strongly that the dental economy is in a major transition. Dental spending has not rebounded since the end of the Great Recession and has been stagnant on a per capita basis since 2008.”

(sic)
Data from the U.S. Census Bureau and the New York State Office of the Professions indicate an increase in emigration and immigration, resulting in the slowing of the overall growth of New York State’s population, with accompanying modifications in the numbers of dentists and dental establishments in state counties. While ADA data suggest that per capita dental spending has not rebounded since the end of the last recession, there does not seem to have been dramatic changes in the overall numbers of New York State dental practitioners and establishments through the early years of the current decade.

Queries about this article can be sent to Dr. Waldman at h.waldman@stonybrook.edu.

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15. Waldman HB. Stabilizing the number of NY State dental establishments. NYSDJ 2004:70:34-36.


The Relationship between Smoking and Periodontal Disease
Review of Literature and Case Report


A B S T R A C T
Cigarette smoking has been associated with tooth loss from periodontal disease for a long time. Smoking cessation has been shown to reverse these effects. The purpose of this paper is to review the current literature regarding the possible mechanisms for destruction of the periodontium caused by smoking and to present a protocol for the implementation of a smoking cessation program at New York University College of Dentistry.

Periodontal disease is the most common cause of tooth loss among adults.1 Risk factors for periodontitis include smoking, genetic predisposition, probably psychosocial stress, diabetes and several uncommon systemic diseases.2 Of all the environmental factors known to be associated with periodontitis, cigarette smoking may be the most important, as it has been shown to significantly increase the risk of tooth loss.3 Papapanou outlined the manner in which this occurs as follows:

Evidence for the role of smoking in periodontitis includes 1. Increased prevalence and incidence of disease with increased amounts of smoking; and 5. Biologically plausible mechanisms that can explain how smoking is involved in the destruction of periodontal tissues.4

A review of the literature over the past 20 years has demonstrated a positive correlation between cigarette smoking and a higher risk for periodontal disease. Mullally noted that as long ago as 1848, John Burdell, an American dentist, described the oral changes associated with tobacco chewing and commented on the difficulties he had experienced in providing dentures for this group.5

Van Winkelhoff has suggested that smoking is a determining factor for the composition of the subgingival microflora in adult patients with periodontitis and may select for a specific cluster of periodontal pathogens, notably, Bacteroides forsythus, Peptostreptococcus micros, Fusobacterium nucleatum and Campylobacter rectus. Antibiotic therapy may be effective against smoking-associated periodontal bacteria.6 Kubota has demonstrated in smokers a statistically significant association between having a probing pocket depth of greater than or equal to 4 mm and detection of T. denti-cola, P. intermedia, T. forsythia or C. rectus.7

Haffajee concludes that the relationship between cigarette smoking and the composition of the subgingival microbiota is not clear. The major difference between the subgingival microbiota in subjects with different smoking history was in the prevalence of species rather than the counts or proportions. The greater extent of colonization in smokers appeared to be due to greater colonization at pocket depths

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less than 4 mm.\textsuperscript{8,9} Fullmer found that microbial profiles differed significantly between smokers and quitters at 6 and 12 months following smoking cessation. The microbial community in smokers was similar to the baseline, while quitters demonstrated significantly more divergent profiles. Changes in bacterial levels contributed to this shift. These findings reveal a critical role for smoking cessation in altering the subgingival biofilm and suggest a mechanism for improved periodontal health associated with smoking cessation.\textsuperscript{10}

**Early Evidence of Damage**

Cigarette smoking has been shown to be associated with a greater increase in probing depth and attachment loss, as well as greater tooth loss at an earlier age. Mullally found a high prevalence of cigarette smoking among young individuals with aggressive periodontitis and that tobacco use increases the risk of periodontal destruction most significantly in young populations.\textsuperscript{11}

It is clear from the evidence that environmental exposure to cigarette smoking has been associated with two- to three-fold increases in the odds of developing clinically detectable periodontitis.\textsuperscript{12}

The noxious effect of smoking has been shown to be dose-dependent and to be particularly marked in younger individuals. Baljoon notes that cigarette smoking is associated with increased prevalence and severity of destructive periodontal disease in terms of periodontal pocketing, bone and tooth loss. The destructive effect of smoking on periodontal bone may be of the horizontal and vertical “angular” pattern.\textsuperscript{13} Preshaw has demonstrated the importance of smoking cessation in that it has a beneficial effect in reducing probing depths following nonsurgical treatment.\textsuperscript{14}

Current literature identifies the harmful effects of smoking, including interference with the vasculature and immunologic reactions. This results in a destruction of the supportive functions of the periodontal tissues. The local host response to bacteria, which initiates periodontitis, includes the recruitment of leukocytes and the subsequent release of inflammatory mediators and cytokines such as interleukin (IL-1,6,8,10,12) and tumor necrosis factor (TNF- alpha). Researchers have tried to examine a possible relationship between smoking, stress and cytokine production. Giannopoulou studied cytokines in the pathogenesis of periodontal disease and suggests they may be used as markers in its diagnosis. His data implies that in smokers, higher levels of crevicular interleukins IL-1beta and IL-8 levels reflect the activity of periodontal destruction, whereas, conversely, nonsmokers have higher levels of IL-4 but lower amounts of IL-8.\textsuperscript{15,16}

Erdemir evaluated the effects of smoking on clinical parameters such as plaque index (PI), gingival index (GI), bleeding on probing (BOP), probing depth (PD) and clinical attachment loss (CAL). Gingival crevicular fluid samples were collected for IL-6.
and TNF-alpha in patients with chronic periodontitis. Results show that only attachment loss was significantly higher at the third month among smokers compared with nonsmokers. GI and BOP were higher in nonsmokers than in smokers. The study demonstrated that cigarette smoking increases the amount of dental plaque over time in smokers and does not influence GCF contents of IL-6 and TNF-alpha. Better oral hygiene must be applied, as well as initiation of nonsurgical periodontal therapy.17

Kamma concluded that smoking influences host-related factors, including the cytokine network; however, the relative importance of smoking and stress-related alterations and their precise mode of action in increasing the risk of aggressive periodontitis remain to be elucidated.18 Leide studied salivary proteolytic enzyme activity and found that smoking may significantly lower both general proteolytic enzyme activity and matrix metalloproteinase-8 (MMP-8) levels in saliva when smokers who had quit were compared with those still smoking. The data suggests that periodontal status and oral mucosa are better in those who have quit compared to current smokers.19 Johnson cites evidence that smoking has a negative effect on host response, such as neutrophil function and antibody production. An encouraging finding is that periodontal disease progression slows in patients who quit smoking and that these individuals have a similar response to periodontal therapy as nonsmokers.20

In summary, even though there may be conflicts in the research, especially regarding smoking's effect on the microflora, there is very strong evidence of more severe dose-related periodontal destruction among smokers and a return to a healthier status once periodontal therapy and smoking cessation counseling have been given and accepted.

Johnson, in 2004, recommended the use of the five A's as follows:
- Ask—identify tobacco users.
- Advise—advise them to quit.
- Assess—evaluate the patient’s readiness to quit.
- Assist—offer assistance in cessation.
- Arrange—follow up on the patient’s cessation efforts.

The addition of pharmacotherapy to the behavioral therapy, including nicotine replacement therapy (NRT) and bupropion (Wellbutrin), can increase cessation rates. The most popular form of NRT is the patch; its use has been shown to double cessation rates compared to behavioral therapy alone. Use of bupropion in combination with NRT may be particularly helpful for heavy smokers or smokers who have experienced multiple failed attempts at cessation.21 During the last several years, tobacco cessation counseling has become a standard part of treatment planning at New York University College of Dentistry (NYUCD) with all patients who are current smokers.

**Case Report**

The female patient, JT, presented to NYUCD in September 2011. She is 27 years old, 5-feet, 3-inches tall and weighs 130 pounds. Her blood pressure was measured at 128/89, with a pulse of 87. JT reports she has been smoking about five or six cigarettes daily since the age of 16 and drinks alcohol socially, less than one drink a day. She presented with poor periodontal health, including multiple
Figure 3. Charting of dental findings.
sites of pocket depths measuring 5 mm, especially in the maxilla. There was mild plaque buildup, some recession, clinical attachment loss, generalized bleeding on probing, as well as moderate radiographic bone loss. This is the first time she has been to see a dentist in a while, so it is unclear how long the periodontal disease has been present. Based on clinical findings and history, she was categorized as having chronic generalized moderate periodontitis.

A review of the medical history shows that the patient has had asthma since childhood. It is well controlled and attacks are rare, the last occurring more than five years ago. She carries an albuterol inhaler in case of an unexpected attack. Smoking cigarettes places her at high risk for chronic lung diseases, including the possibility that her asthma could take on a more severe form. She is also at risk for cardiovascular disease and stroke, especially with her family history of high blood pressure. The risk of cancer, oral and lung cancer in particular, is increased. The risk of periodontal disease is confirmed by findings of bleeding upon probing, periodontal pocketing and bone loss. JT’s dental examination revealed that teeth #4, #17, #18 and #19 were missing due to odontal disease.

Treatment includes scaling and root planing, followed by a re-evaluation in four to six weeks. The treatment plan also includes asking about smoking cessation at every visit; restoration of the carious lesions; and reinforcing oral hygiene, including the proper way to brush with the modified Bass technique and the use of dental floss. Prevident 5000-plus toothpaste will be prescribed, along with MI paste, to promote remineralization to prevent future caries. The patient will be placed on a three-month recall to monitor her oral health status.

**Smoking Cessation Protocol**

The importance of a smoking cessation program should not be underestimated. Quitting smoking is not only critical for one’s overall health and well-being, it is also specifically beneficial with regard to one’s dental and periodontal health. Smoking cessation therapy is broken up into the “5 A’s”: Ask, Advise, Assess, Assist and Arrange. Smoking cessation begins with “asking” patients about their smoking habit. This includes how much and how often they smoke, when they started smoking and have they ever thought about quitting. After “advising” the patient to quit smoking, the patient’s readiness to quit is “assessed.” For example, is the patient thinking of quitting, as in the “contemplation stage?” Or has he or she not even thought about it—the “pre-contemplation stage?” Is the patient motivated and confident? Or has he or she tried, failed and even given up hope? Patients who have failed or give up hope should be encouraged to try to quit again. Proper “assistance” is provided to the patient. Patients receiving some form of assistance have a greater likelihood of success in quitting.

At NYUCD, all patients who smoke receive information enabling them to contact the New York State Smokers Quitline (1-866-NY-QUITS), which provides free telephone counseling and a free starter kit for NRT. In addition, all patients are referred to the NYU Nurse Faculty Practice for the option of face-to-face personal or group counseling and assistance if that better suits the patient’s needs. It is important to get the patient to commit to a program of tobacco cessation at the moment he or she indicates interest. Offering counseling and putting the information in their hands is helpful, but providing NRT with dentist-supplied instruction at that moment further increases the chance the patient will actually quit. Patients who smoke 10 to 15 cigarettes a day qualify for NRT in the dental clinic. They are started on either the 14 mg patch for two weeks or the 4 mg gum or lozenge every one to two hours for two weeks. If cravings persist, the patch may be increased to 21 mg, or the frequency of the gum or lozenge can be increased.

If patients smoke more than 15 cigarettes a day, combination therapy should be instituted. This means they should be started on the 21 mg patch, along with either the gum or the lozenge. The use of NRT is very safe, but it is not recommended for people with underlying cardiovascular disease, pregnant women or children under the age of 18.

Another route to assist in quitting smoking, especially for patients who have tried NRT unsuccessfully, is non-nicotine pharmacotherapy. The two drugs that are recommended are varenicline and bupropion. For varenicline, the prescription is to dispense a 12-week supply of 0.5/1mg tablets. The patient should start with 0.5 mg once a day for the first three days, then 0.5 mg twice a day for the next four days, then 1 mg twice a day after that. Varenicline binds with high affinity to specific nicotinic acetylcholine receptors and, in effect, reduces symptoms of nicotine withdrawal and cravings.

For bupropion, the prescription is to dispense a 7- to 12-week supply of 150 mg tablets. The patient should begin taking the medication one to two weeks prior to the quit date. For the first three days it should be taken once a day. After that it should be taken twice a day. Bupropion is a type of anti-depressant that affects the levels of dopamine and norepinephrine in the brain.

Despite their benefits, these drugs do have contraindications. Bupropion is not recommended for patients with seizure disorders or patients taking certain anti-depressants. Varenicline is contraindicated in patients with renal impairment and who have been associated with mood changes, including suicidal ideation. Whichever smoking cessation therapy is instituted, it should be one designed for the specific patient and his or her needs. The final step is to “arrange” for follow-up. This is to make sure that the smoking cessation program the patient is on is suitable and is...
providing the help and support needed to make the transformation from an addicted state to one of health and well-being.

Conclusion
The existing evidence shows that individuals with a smoking habit will eventually damage their periodontium and immune systems. Implementation of periodontal treatment, home care instruction and smoking cessation guidance can overcome and reverse the destructive effects of smoking. During their dental school education, dental and hygiene students should be taught these skills in order for them to be better equipped to provide optimum care in dental practice. Toward this end, we have prepared a protocol for treatment at New York University College of Dentistry that we expect will become a standard for instruction globally.

Queries about this article can be sent to Dr. Sherwin at gshedds@nyu.edu.

REFERENCES
Role of Topical Drugs in Treatment of Oral Mucosal Diseases

A Literature Review

Soheyl Sheikh, M.D.S.; Deepak Gupta, M.D.S.; Shambulingappa Pallagatti, M.D.S.;
Isha Singla, M.D.S.; Rajesh Gupta, M.D.S.; Varun Goel, M.D.

ABSTRACT

Few topical formulations have been designed specifically to treat oral mucosal diseases. Local drug delivery may provide a more targeted and efficient option than systemic delivery for diseases of the oral mucosa. The permeability to the topical drugs differs according to the thickness of the epithelium and the extent of keratinization. The loss of the permeability barrier in the oral mucosa, due to ulceration or erosion, leads to rapid diffusion of the drug into tissues as compared to the intact areas of the mucosa. Oral mucosal delivery has the potential to treat many different conditions and diseases, such as pre-malignant lesions, mucositis, lichen planus, herpes simplex, candidiasis, recurrent aphthous stomatitis, vesiculo-bullous diseases, neuropathic pain and salivary dysfunction.1 There are few topical formulations that have been designed specifically to treat oral mucosal diseases. Most topical therapies currently used by oral medicine specialists are those that are used to treat dermatological conditions.1 Still, mucosal therapy requires distinct penetration and drug retention profiles in order to optimize treatment and minimize side effects.1 The permeability to these topical drugs differs according to the thickness of the epithelium and the extent of keratinization.2 Keratinized tissues display a lower permeability than non-keratinized tissues because of the lipid composition of the membrane-coating granules in keratinized tissues rather than the presence of keratin alone.3

However, the permeability of topically applied agents is greater in the sublingual region.2 But its surface is constantly washed by saliva and tongue activity, which makes it difficult to keep the dosage form in contact with the mucosa. The buccal mucosa is also a useful route for the treatment of either local or systemic therapies. It is more tolerant of potential allergens, which have a reduced tendency to irreversible irritation or damage. But the palatal mucosa is keratinized and intermediate in thickness with less permeability.3

In this review, we discuss the potential for using topical drugs in the treatment of oral mucosal diseases and the possible reduction in drug side effects.
Local Drug Delivery and Therapeutics for Specific Oral Diseases

Potentially Malignant Oral Diseases

Potentially malignant oral disease is morphologically altered tissue that is present on clinical examination in which cancer is more likely to occur than in normal tissue. It is recognized that occasionally non-dysplastic lesions may turn into cancer, while not all dysplastic lesions become malignant.

Over the years, many topical medications have been used to treat potentially malignant oral diseases. Piattelli et al., in 1999, advocated 13-cis-Retinoic acid (iso-tretinoin) to induce remission of oral leukoplakia and to prevent the development of cancer in patients with oral leukoplakias. It inhibits the development of second primary tumors in patients with previous head and neck cancer. All patients treated with the active medication showed a significant improvement of the oral lesions, and no side effects from use of the gel were observed.

5-aminolevulinic acid (ALA) is the only photosensitizer that can be given orally or applied topically. All other photosensitizers have to be given intravenously. In 1998, Kubler et al. used 20% ALA cream applied to the leukoplakia lesion of the oral mucosa for two hours. During the healing period, none of the patients felt any pain. During nine months of follow-up, no changes in the clinical appearance of the treated lesions were observed. ALA-PDT seems to be a promising means of treating oral leukoplakia, with long-term follow-up.

Epstein et al., in 1999, evaluated the use of topical 1% bleomycin in dimethylsulfoxide for the treatment of dysplastic oral lesions. It was applied once daily for 14 consecutive days to lesions of the oral mucosa in 19 patients. Immediate post-treatment biopsies and the clinical response were evaluated. The results revealed that topical bleomycin may prevent the potential progression of leukoplakia through dysplasia to carcinoma.

There are other drugs that can also be used to treat oral leukoplakia with limited effects. Epstein et al., in 1999, used topical 0.05% vitamin A (tretinoin) acid gel four times a day for the treatment of oral leukoplakia. In case of local oral tissue sensitivity and burning sensation, a less concentrated gel (0.01% vitamin A acid gel) was prescribed.8 The use of topical vitamin A acid showed a limited effect in controlling oral leukoplakia.

Aggressive treatment regimens associated with significant morbidity are used to treat later stage oral cancers. There are no reliable treatments to prevent malignant transformation of dysplastic lesions or the development of recurrent/new disease in patients with a history of oral cancer. The difficulty in developing such a reliable treatment is that each cancer is unique, carrying its own blend of mutations and, thus, not all patients will benefit from the same therapy.

Oral Mucositis

Oral mucositis is a common complication of cancer treatments such as chemotherapy and radiotherapy. It is characterized by erythema, inflammation, pain and ulceration, which can occur in up to 100% of patients undergoing stem cell transplantation, radiotherapy to the head and neck, and chemotherapy. Labial and buccal mucosa are most commonly affected by chemotherapy; the uvula and soft palate respond more intensely to irradiation.

Benzydamine hydrochloride is a non-steroidal drug that has topical anti-inflammatory, analgesic, anesthetic and antimicrobial activities. The effectiveness of benzydamine hydrochloride for managing oral mucositis was assessed mainly in patients undergoing radiotherapy for head and neck cancer.

In 1989, Prada et al. proved that the topical application of benzydamine resulted in a reduced incidence and significant alleviation of symptoms associated with radiotherapy- and chemotherapy-induced oral mucositis, as compared with a placebo.

In 2001, Epstein et al. used 0.15% benzydamine oral rinse to prevent the oral mucositis that occurs during radiation therapy in patients with head and neck cancer. Subjects were asked to rinse with 15 mL for two minutes four to eight times daily before and during radiation therapy, and for two weeks after completion of therapy. The results revealed that benzydamine oral rinse was effective, safe and well tolerated for prophylactic treatment of radiation-induced oral mucositis.

Franzen et al. and Allison et al., in 1995, found a statistically significant reduction in the severity of oral mucositis in patients who were using topical sucralfate during radiotherapy.

Immunologically Mediated Diseases

Immunologically mediated diseases constitute one of the most common groups of disorders to affect the oral mucosa. They include oral lichen planus; those centering upon the B-cell involve pemphigus and mucous membrane pemphigoid.

Oral lichen planus: Oral lichen planus is a chronic inflammatory condition that is probably of multifactorial origin, often idiopathic, with an immunopathogenesis involving T-cells. A range of treatments have been proposed for oral lichen planus. They include topical and systemic corticosteroids; topical cyclosporine; topical and systemic retinoids; antimicrobials; azathioprine; photochemotherapy; and surgery. In recent years, tacrolimus ointment 0.1% and cream 0.1% have received approval from the U.S. Food and Drug Administration on the basis of their demonstrated efficacy in the treatment of atopic dermatitis refractory to conventional
treatment. Tacrolimus is an immunosuppressive agent. This substance is produced by Streptomyces tsukubaensis, which belongs to the macrolide family. It has a greater capacity to penetrate the mucosa. In 2002, Morrison et al. conducted an open-label study with six patients administered topical tacrolimus. This treatment proved to be effective in controlling the symptoms of erosive lichen planus.

Triamcinolone acetonide is among the most commonly used topical corticosteroids for the treatment of immunologically mediated diseases. The concentration ranges between 0.05% and 0.5%, and is applied 3 to 10 times a day for a period of 3 to 5 minutes.

Laeijendecker et al., in 2006, compared the efficacy of topical tacrolimus ointment versus triamcinolone acetonide 0.1% ointment. The most commonly reported side effect in both groups was temporary burning or stinging at the site of application. Topical tacrolimus 0.1% ointment induced a better initial therapeutic response than triamcinolone acetonide 0.1% ointment.

Pimecrolimus is a derivative of the macrolide ascomycin that was developed specifically for the treatment of inflammatory disorders of the skin. Dissemont et al., in 2004, prepared this ointment by mixing 1% cream 1:1 with a hydrophilic adhesive gel base. It was applied twice daily. It represents a new topical selective inflammatory cytokine-release inhibitor. Pimecrolimus binds to macrophilin-12 and inhibits the calcium-dependent phosphatase calcineurin. By blocking the transcription of early cytokines and thus down regulating synthesis of both T-helper 1- and 2-type cytokines, pimecrolimus inhibits T-cell activation.

In 2007, Gorouhi et al. and in 2008, Volz et al. carried out a study showing pimecrolimus cream at a concentration of 1% results in a significant reduction in oral erosions. According to Sardella in 1998, Carbone in 1999, Muzio in 2001 and Gonzalez-Moles in 2006, Clobetasol propionate, in the form of orabase ointment or aqueous solution, has been effective in the treatment of oral lichen planus. Lozada et al., in 1994, and Carbone et al., in 1999, using concentration ranges between 0.025% -0.05%, applied two to three times day for three to five minutes, induced vasoconstriction followed by a reduction of the inflammation due to an alteration of histamine levels and to the effects of the catecholamines on peripheral blood vessels. Clobetasol has demonstrated superior therapeutic effects compared to other topical corticosteroids. For severe erosive gingival lesions, Clobetasol-17- propionate orabase paste 0.05%, plus 100,000 IU/ml of nystatin, is efficacious treatment.

Flucinonide is considered to be a moderate to high potency corticosteroid. Lozada et al., in 1994, used this drug at concentrations ranging between 0.025% and 0.05%. The medication is applied 5 to 10 times a day for 3 to 5 minutes. It is a milder topical corticosteroid than clobetasol propionate and is less effective in reducing pain. When used at a 0.025% concentration, a complete resolution of lesions is achieved in 25% of patients with oral lichen planus.

In symptomatic oral lichen planus, Carbone et al., in 1999, using 0.025% fluocinonide in an adherent vehicle, produced complete remission of lesions and symptoms in 25% of patients.

Hydrocortisone hemisuccinate in aqueous solution is often of little benefit in treating oral lichen planus. Fluticasone propionate spray and betamethasone sodium phosphate mouthrinse have been used effectively in the short-term management of symptomatic oral lichen planus.

**Pemphigus:** Pemphigus vulgaris is the most common form of oral mucosal pemphigus. Topical agents are likely to have a role in management of this oral disease, although this will depend upon the severity of disease.

Topical corticosteroids may suffice for a time if there are only localized oral lesions with low titre serum antibodies; otherwise, systemic immunosuppressants are essential. Systemic corticosteroids are the first-line therapy for severe oral and/or cutaneous Pemphigus vulgaris. These corticosteroids remain the mainstay of therapy for patients with oral lesions, transforming an invariably fatal disease into one whose mortality is now below 10%.

But, in such cases, if steroidal topical ointments are used in conjunction with the systemic steroids therapy, it will lead to a reduction in side effects of systemic drugs by reducing dosage.

**Mucous membrane pemphigoid (MMP):** Mucous membrane pemphigoid is a chronic autoimmune subepithelial disease that primarily affects the mucous membranes of patients over the age of 50, resulting in mucosal ulceration and subsequent scarring. In patients who are at low risk and with lesions confined only to the oral mucosa, topical corticosteroids, such as 0.1% triamcinolone acetonide, 0.05% fluocinolone acetonide or 0.05% clobetasol propionate in orabase, are applied 3 to 4 times a day for 9 to 24 weeks to resolve the lesion.

**Recurrent apthous stomatitis (RAS):** Recurrent apthous stomatitis is a common condition characterized by multiple, recurrent, small, round or ovoid ulcers with circumscribed margins, erythematos haloes, and yellow or gray floors. It appears first in childhood or adolescence.

Topical corticosteroids are the mainstay of RAS treatment in most countries. Several different topical corticosteroids may reduce symptoms and hasten healing.

The most common treatment involves the use of topical agents to provide symptomatic relief. These include antibiotics, analgesics, non-steroidal anti-inflammatory drugs and immunosuppressants. The most common topical therapy involves use of glucocorticoids—including hydrocortisone—triamcinolone, flucinonide, betamethasone and flumethasone. These medications can reduce symptoms and will not cause hypothalamic-pituitary-adrenal axis suppression when used for less than three weeks.
Of all the topical agents available to treat recurrent aphthous ulceration, amlexanox appears to be one of the best. It is 2-amino-7-isopropyl-5-oxo-5H-(1) benzopyrano-(2,3-b)-pyridine-3-carboxylic acid, a topical anti-inflammatory and anti-allergic drug. It is available as a 5% paste in the U.S. for the treatment of RAS. According to Greer et al., in 1993, and Khandwala et al., in 1997, 5% amlexanox paste is very useful in the management of recurrent aphthous ulceration.

In 2005, Murray et al. showed that 5% amlexanox paste is more effective in accelerating the healing of ulcers and resolving pain.

Alternative regimens include dexamethasone 0.05 milligrams/5 mL rinse three times a day, or a high-potency topical corticosteroid such as clobetasol ointment 0.05 percent in Orabase (1:1). Fluocinonide ointment 0.05 percent in Orabase (1:1) can also be used.

Orofacial Neuropathic Pain

Neuropathic pain is defined as a condition that is initiated or caused by a primary lesion or by dysfunction in the nervous system. In the orofacial region, pain can be caused by traumatic neuroma, trigeminal or glossopharyngeal neuralgia. Neuropathic pain has a severe psychosocial impact on the quality of life and mood of affected patients and causes substantial societal costs.

### Topical Drugs for Recurrent Apthous Stomatitis

<table>
<thead>
<tr>
<th>Topical corticosteroids</th>
<th>Antimicrobials</th>
<th>Topical analgesics</th>
<th>Other topical anti-inflammatory agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrocortisone hemisuccinate (pellets)</td>
<td>Chlorhexidine gluconate (mouthrinse)</td>
<td>Benzylamine hydrochloride (spray or mouthrinse)</td>
<td>Amlexanox, Sodium cromoglycate (lozenges)</td>
</tr>
<tr>
<td>Triamcinolone acetonide (in adhesive paste)</td>
<td>Triclosan (mouthrinse)</td>
<td>Topical tetracyclines (e.g. aureomycin, chlortetracycline, tetracycline)</td>
<td>Carbenoxolone sodium mouthrinse, Azalestine</td>
</tr>
<tr>
<td>Flucinonide (cream)</td>
<td>Topical tetracyclines (e.g. aureomycin, chlortetracycline, tetracycline)</td>
<td>Topical anaesthetics (gel)</td>
<td>Human alpha-2-interferon (cream)</td>
</tr>
<tr>
<td>Betamethasone valerate (mouthrinse)</td>
<td>Clobetasol propionate (cream)</td>
<td></td>
<td>Ciclosporin (mouthrinse)</td>
</tr>
<tr>
<td>Betamethasone-17-valerate (mouthrinse)</td>
<td>Mometasone furoate (cream)</td>
<td></td>
<td>Topical 5-aminosalicylic acid, Piroxicam (gel)</td>
</tr>
<tr>
<td>Flumethasone pivolate (spray)</td>
<td></td>
<td></td>
<td>Aspirin mouthrinse</td>
</tr>
<tr>
<td>Beclomethasone dipropionate (spray)</td>
<td></td>
<td></td>
<td>Diclofenac in hyaluronase</td>
</tr>
</tbody>
</table>
## Topical Drugs for Fungal Diseases

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Form</th>
<th>Indications Overall</th>
<th>Dosage</th>
<th>Recommended Treatment</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphotericin B</td>
<td>Lozenge, 10 mg Oral suspension</td>
<td>Topical (systemic)</td>
<td>Slowly dissolved in mouth three to four times a day after meals Placed in mouth after food and retained near lesions four times a day</td>
<td>3-4 weeks</td>
<td>Gastrointestinal disorders</td>
</tr>
<tr>
<td>Nystatin</td>
<td>Cream Pastille, 100,000 units Oral suspension, 100,000 units</td>
<td>Topical only</td>
<td>Apply to the affected area three to four times a day Dissolve one pastille slowly after meals 4X/day Apply after meals four times a day.</td>
<td>3 weeks</td>
<td>Gastrointestinal disorders Hypersensitivity</td>
</tr>
<tr>
<td>Clotrimazole</td>
<td>Cream Solution</td>
<td>Topical only</td>
<td>Apply to affected area two to three times daily 5 ML three to four times daily.</td>
<td>2 weeks</td>
<td>Gastrointestinal disorders</td>
</tr>
<tr>
<td>Miconazole</td>
<td>Oral gel Cream</td>
<td>Topical (systemic)</td>
<td>Apply to affected area three to four times daily Apply twice per day.</td>
<td>2 weeks</td>
<td>Gastrointestinal disorders Burning</td>
</tr>
</tbody>
</table>

## All Antiviral Drugs with Mechanism of Action

<table>
<thead>
<tr>
<th>Antiviral Drugs</th>
<th>Mechanism of Action</th>
<th>Virus Affected</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acyclovir</td>
<td>Metabolized to acyclovir triphosphate, which inhibits viral DNA polymerase.</td>
<td>Herpes simplex, varicella– zoster, cytomegalovirus</td>
<td>Gastrointestinal disturbances, headache, rash</td>
</tr>
<tr>
<td>Valacyclovir</td>
<td>Metabolized to valacyclovir triphosphate, which inhibits viral DNA polymerase.</td>
<td>Herpes simplex, varicella– zoster, cytomegalovirus</td>
<td>Gastrointestinal disturbances, headache, rash</td>
</tr>
<tr>
<td>Ganciclovir</td>
<td>Metabolized to ganciclovir triphosphate, which inhibits viral DNA polymerase.</td>
<td>Cytomegalovirus</td>
<td>Renal insufficiency, fever, headache</td>
</tr>
<tr>
<td>Penciclovir</td>
<td>Metabolized to penciclovir triphosphate, which inhibits viral DNA polymerase.</td>
<td>Herpes simplex</td>
<td>None</td>
</tr>
<tr>
<td>Famciclovir</td>
<td>Metabolized to famciclovir triphosphate, which inhibits viral DNA polymerase.</td>
<td>Herpes simplex, varicella– zoster</td>
<td>Headache, nausea, diarrhea</td>
</tr>
<tr>
<td>Lamivudine</td>
<td>Inhibition of viral DNA polymerase and reverse transcriptase.</td>
<td>Hepatitis B, human immune-deficiency virus type 1</td>
<td>Anemia, skin and eye irritation, bronchospasm.</td>
</tr>
<tr>
<td>Amantadine</td>
<td>Blockage of M2 protein ion channel and ability to modulate intracellular pH.</td>
<td>Influenza A</td>
<td>Nausea, anorexia, CNS dysfunction</td>
</tr>
</tbody>
</table>
Topical agents offer specific advantages, such as the absence of drug interactions and few systemic side effects. Currently, topical formulations of capsaicin (cream) and lidocaine (patch) are available for treating neuropathic pain in humans. Capsaicin is a neuropeptide extract from hot peppers and acts initially as a stimulator of the heat-sensitive vanilloid receptors (VR1/TRPV1) on sensory nociceptive C or A-Delta fibers, then depletes substance P from the terminals of unmyelinated C fibers. Capsaicin application produces degeneration, followed by reinnervation of epidermal nerve fibers. A 5% lidocaine patch has been approved by the FDA for postherpetic neuralgia.

The treatment for neuropathic pain in most cases is pharmacological with medications that include antidepressants, analgesics and antiepileptics. Topical amitriptyline alone or combined with ketamine relieves peripheral neuropathic pain. Topical medications include carbamazepine 4%, lidocaine 1%, ketoprofen 4%, ketamine 4% and gabapentin 4% in a Pluronic lecithin organogel and anhydrous gel base. These should be applied four to six times a day to the affected area.

According to Heir et al., in 2008, topical medication as a single treatment or in combination with systemic medications can reduce orofacial neuropathic pain severity, but systemic pharmacologic treatment is often accompanied by unpleasant side effects, such as sedation, dizziness and drug interactions.

Infections
Infectious agents targeting the oral mucosa include viral, fungal and bacterial species. Host exposure to infectious agents, changes in the oral environment, interactions with the oral microbiome and reduced host defenses all potentially contribute to development of opportunistic and non-opportunistic infections of the oral mucosa.

There have been many changes in the range and efficacy of medications designed to manage fungal infections over the past 20 years. Antifungal drugs: Commonly delivered topically to the oral mucosa to treat oral candidiasis, antifungal drugs fall into two categories: polyenes and azoles. Polyenes affect the plasma membranes and lead to increased cellular permeability. They include Nystatin, which is used only topically as tablets, pastilles or suspension, and Amphotericin B, which is not absorbed from the intestinal tract but can be administered intravenously for systemic candidiasis and topically for superflcial oral candidiasis.

The principal mechanism of action of theazole compounds is inhibition of cytochrome P-450 enzymes, thereby blocking steroid synthesis in the fungal cell membrane. Interference with the synthesis of the steroid ergosterol leads to a defective cell membrane with increased permeability. In this, clotrimazole, econazole, fenticonazole, isoconazole, miconazole, sulconazole and tioconazole are used for topical treatment. Ketoconazole, fluconazole and itraconazole are used both for local and systemic candidiasis.

Antiviral drugs: There are 11 drugs approved by the FDA for the treatment of viral infection. Topical acyclovir (ACV) is a synthetic acyclic analogue of 2’-deoxyguanosine with inhibitory activity against HSV-1 and other herpes viruses. It came into use in the 1980s. When 5% ACV cream was applied five times a day for five days at the earliest onset of the prodrome, there was a significant reduction in the duration of vesicles, the time to crust formation and the duration of lesions.

Topical penciclovir is used in the form of a cream. 1% cream is applied to skin or lips every two hours during waking hours for four days in Herpes labialis.

Conclusion
Local drug delivery may provide a more targeted and efficient option than systemic delivery for treating diseases of the oral mucosa. Topical delivery of drugs for the treatment of mucosal diseases can reduce side effects and improve treatment outcomes. Currently used dermatological topical treatments have not been designed for oral applications. Further research targeted to oral
medicine applications is needed in order to improve treatment outcomes for the diseases and disorders discussed here.

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REFERENCES


