Access to care is a big problem in the United States. Many people go without needed dental care for a variety of reasons. There are no dentists in their area who accept their insurance. They don’t understand the importance of good dental health to their overall health. They are on Medicaid and the dentists around them do not accept Medicaid patients. They live in an undesirable area. They can’t afford care. And the list goes on.

What can we do to ameliorate this crisis? We all have established our practices in areas where we want to live, for better or for worse. We can’t just uproot our practices and take them to areas where dentists are in short supply to meet the need for care. We may be able to accept Medicaid patients, but that is an economic model that is fraught with danger. We could donate our time at a local charitable dental clinic. New graduates could be lured to areas where shortages exist through economic incentives ranging from low-interest/no-interest loans to student loan forgiveness. Collaborative agreements with hygienists could be instituted to get oral hygiene instruction and care to those in need. Mid-level providers could provide palliative care until the patient can secure treatment with a dentist.

Another way the dental profession has tried to address this situation is through the Mission of Mercy, or, MOM. Begun in 2000 by America’s Dentists Care Foundation, MOM events provide free dental care to under-served patients. So far, MOM has furnished over $50 million in free dental care. This is an extensive undertaking, as people line up hours in advance of the event for the chance at treatment. Each state participating in MOM has its own rules and regulations as to what can be accomplished during that state’s mission. However, most provide cleanings and oral hygiene instruction, restorations and extractions. Some even provide endodontic services.

On June 13 and 14, 2014, NYSADA and the New York State Dental Foundation will be sponsoring its own MOM at Hudson Valley Community College in Troy. This will be a massive undertaking and volunteers are needed. This clinic, like others
across the country, will provide oral hygiene care and instruction, dental restorations and extractions. The main goal is to alleviate pain. Information for establishing a dental home will also be provided. Twenty-three states are official MOM states. Three states are MOM-affiliated states. New York is an official MOM state.

This is an event where you can make a real difference in someone’s life. Reports from other MOM events show patients are truly grateful and appreciative of the care they receive. They marvel when they are free from pain and on the road to dental health. But these MOM events also increase awareness among dental professionals of the toll dental disease takes on those who can’t afford treatment. As private practitioners, we tend to get lost in our offices, concerned with our own little world and the problems we face daily. There is a much bigger world out there and, sometimes, we need a little push to get us to see it.
The New York State Mission of Mercy is our chance to get out of our comfort zones for a few days and help people in need. It is an opportunity to see what will truly make a difference in someone’s life, someone we may have never met before and, most likely, will not meet again. But someone, who, for just that short time we interact with and who will appreciate all that we do. Someone who may not be able to afford the best dental care, but who needs our best for that day.

If New York’s MOM is like others around the country, patients will be turned away because the number of people seeking care will exceed the mission’s ability to treat them. If it is like the other missions, the patients who will be treated will be eternally grateful for the care they receive. Search the Internet for stories about other MOMs and see for yourself the joy these patients express. It is truly astounding that so many people can be helped in such a short period of time.

But it won’t be just the patients who are impacted. Every report I have read or heard details the positive influence a mission has on the providers of care as well. Each person is touched in his or her own way and says what a rewarding experience it was to have taken part in the mission. Each individual reports it is an experience he or she will never forget and how glad he or she was to have taken part in it.

Registration for the New York State Mission of Mercy is now open at www.nysmom.org. By the time you read this, I will have registered. As an orthodontist, I know I won’t be able to treat any patients. But I am sure there are many things I will be able to do to contribute to the success of this mission. You can volunteer for as many shifts as you like. There will be two shifts on each of the two days. Each shift lasts six hours. Those may be the most rewarding hours of your dental career.

This mission will show that the dentists in New York do care about those in need. It will be a win-win situation for all. So, get involved and make this mission a resounding success. It is only through your efforts that this will occur. It’s time to take charge and give back to your community. This is the perfect opportunity for that!

D.D.S.

NEW YORK STATE MISSION OF MERCY
Volunteer Registration is now open

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.

SAVE THE DATE
Date: June 13 & 14, 2014
Edward F. McDonough Sports Complex
Hudson Valley Community College
Troy, New York
Lauro Medrano-Saldana, D.D.S., a pediatric dentist from Brooklyn, is the 2013 recipient of the Pierre Fauchard Academy Distinguished Service Award, presented by the New York Section of the academy. Dr. Medrano-Saldana received his award at the group’s annual luncheon in May at the Grand Hyatt Hotel in New York City. Also honored at the luncheon was Chad P. Gehani, an endodontist from Queens, who served as president of NYSDA in 2011-2012. Dr. Gehani received the academy’s Honor Award.

During the luncheon, which was held in conjunction with the NYSDA Annual Meeting, 14 dentists were inducted as fellows of the academy.

Dr. Medrano-Saldana is an attending in pediatric dentistry at Lutheran Medical Center in Brooklyn and in private practice at Sunset Pediatric Dentistry, also in Brooklyn. He is president elect of the Second District Dental Society and Second District Component Chair, Empire Dental Political Action Committee. He is a member of the NYSDA House of Delegates and sits on the NYSDA Council of Governmental Affairs. Previously, Dr. Medrano-Saldana served as president of the Puerto Rican Dental Association USA.

As outreach chairman for the Greater New York Dental Meeting in 2012, Dr. Medrano-Saldana helped facilitate the organization and hosting of an international Pierre Fauchard Academy event at the GNYDM.

Dr. Medrano-Saldana received bachelor’s and doctoral degrees from Universidad Interamericana de Puerto Rico and his dental degree and certificates in general and pediatric dentistry from New York University College of Dentistry.

Dr. Gehani is an associate clinical professor of endodontics at NYU, chairman of endodontics at Flushing Hospital Medical Center and a consultant member of the International Accreditation Team of Manipal Dental School in India. He is in private practice in Queens.

A graduate of Government Dental College and Hospital (University of Bombay), Dr. Gehani has been active in efforts to improve the status of foreign-trained dentists. He is a past president of the Indian Dental Association; the International College of Dentists, New York Section; and the Queens County Dental Society. Currently, he serves on the NYSDA Council on Awards, is an at-large member of the Empire Dental Political Action Committee, a member of the New York State Dental Foundation Board of Trustees and an alternate delegate to the ADA House. In June, he was elected to serve as the next ADA Second District Trustee.

Dr. Gehani completed a two-year dental practice residency at Beekman Downtown Hospital in New York City and postgraduate work in endodontics at Columbia University College of Dental Medicine.

**New Members Inducted**

The Pierre Fauchard Academy seeks to educate dental professionals about the latest techniques in dentistry and to foster a sharing of ideas to improve the profession. Amarilis Jacobo, Bronx County, is section chair. Edward Feinberg, Ninth District, is section vice chair. This year’s inductees include:

Leonard Brenner, Second District; James Fitzgerald, Nassau County; Joseph Giovannone, Fifth District; John Guaraglia, Suffolk County; Donald Hills, Nassau County; Anthony Ienna, Nassau County; Kerry Lane, Suffolk County; Rosa Martinez, Ninth District; Fabiola Milord, Nassau County; Janice Pliszczak, Fifth District; Sari Rosenswein, Second District; Christopher Salerno, Suffolk County; Stuart Segelnick, Second District; and Nicholas Tucci, Nassau County.
As Peter Drucker said, “Management is doing things right; leadership is doing the right things.”

In my own professional and personal experiences, as a board member and as chairman of the New York State Dental Foundation Board of Trustees, I’ve observed that successful boards need to add to this theory how to effectively govern. This includes the ability to work together collaboratively, to think strategically and to always seek better solutions.

As I write this, we are in the midst of the Foundation’s annual nominations process. This year’s nominations chair, David C. Schirmer, approaches everything with meticulous attention to detail. David, working with fellow trustees Brian Kennedy, Ray Williams, Executive Director Laura Leon and ex officio trustee Mark Feldman, will review and select trustees who have experience and who have demonstrated qualities that meet the leadership needs of the Foundation. Gone are the days, if they ever existed, when boards were the figurative happy hunting ground for members whose terms of office in other capacities had ended and who weren’t quite ready to retire.

Nowadays, Board members typically have three hats, while wearing only one at a time. There’s the governance hat, which is worn during our meetings and when we’re making decisions related to furthering our mission. Then there’s the implementation hat, which is donned when a Board member accepts an assignment to serve on a task force or to help with a specific project, such as developing a course or coordinating a screening. Finally, there’s the volunteer hat, something that plays an increasingly larger role as we move closer to the 2014 Mission of Mercy. In addition to providing dental treatment, our Board members can be expected to assist with fund-raising, promotion, patient management, even set up and take down.

Fortunately, the Foundation board comprises a very skilled, very cohesive group. I’d like to take a few moments to acquaint you with them. My vice chair is Don Fager, who many of you may know in his capacity as CEO of Medical Liability Mutual Insurance Company. Underneath Don’s quiet exterior is a razor-sharp mind, expert at getting to the heart of matters. The fact that he’s a Mets fan never enters into the equation.

Bob Doherty, former NYSDA president, noted for his comedic prowess, is our treasurer. And while he may joke that he’s not qualified, his efforts have helped staff to develop pretty “dead-on” budgets for the last few years. Bob’s attention to detail is something to behold, as I can attest, having been with him in comprehensive pre-Board financial meetings.

Our secretary, Mark Feldman, has himself worn many hats in organized dentistry. His steady presence helped sustain our Board during transitions.

As already mentioned, Dave Schirmer commits himself 110% to the various roles he has played, including heading up not just the Nominations Committee, but two of our current task forces.
Another Board member who always seems to find himself on one task force or another is Mike Breault, who masterfully balances whatever assignments we throw his way with the demands of a busy practice. Like Dave and Mike, Brendan Dowd has had his share of committee and task force work, which he accomplishes with energy and efficiency.

Terry Thines is our go-to person on educational matters and for coordinating dental screenings at the New York State Fair. Another expert at dental screenings is Madeline Ginzburg, who spearheaded our Harlem Week efforts over the course of two very hot summers.

I have no idea how Brian Kennedy finds the time and energy to devote to Mission of Mercy, for which he and Mark Bauman serve as co-chairs. I think one secret to his success is his military background.

We are extremely fortunate to have had two deans of New York State dental schools—Ira Lamster, former dean of Columbia University College of Dental Medicine, and Ray Williams, dean of Stony Brook University School of Dental Medicine—provide thoughtful analysis of the various issues we encounter.

For those of you who had the pleasure of attending either or both of the last two Foundations of Excellence luncheons, held in conjunction with the Annual Session of the NYSDA House of Delegates, you have Paul Leary to thank. Paul has served as chair of this event since 2012 and, undoubtedly, his work has really paid off.

New to the Board this year is Lorna Flamer-Caldera, who has already impressed us with her quick understanding and thoughtful analysis of the issues we deal with.

We are indeed fortunate to have former NYSDA president (and our liaison) Chad Gehani return to the fold as a trustee. Chad has helped us with many projects over the years, lending his enthusiasm, not to mention connections. Seriously, is there anybody Chad doesn’t know?

Our Board is greatly strengthened by the presence and marketing expertise of Steve Kess from Henry Schein, Inc. Steve always has a new idea, and it’s usually something none of us had ever considered, but which makes perfect sense.

And this year, at the suggestion of NYSDA Immediate Past President P. Deborah Weisfuse, we began inviting an ASDA member to participate in our meetings. Keren Etzion, who attends Stony Brook School of Dental Medicine, is a true find—keenly intelligent, enthusiastic about the Foundation’s mission and full of great ideas.

Finally, our director and fellow trustee, Laura Leon, is responsible for achieving the goals within the guidelines established by the Board and for overseeing management and operations.

Of course, we are fortunate to have as our NYSDA liaison the Association’s current president, Joel Friedman. In the past year, we have benefitted from the support of first, Deborah Weisfuse and now, Joel Friedman. The ties that bind NYSDA and the Foundation have been considerably strengthened by their leadership.

These are the people who sit on your Foundation’s Board of Trustees, who maintain trust and credibility with our various constituencies, including our stakeholders and beneficiaries. They are well-informed, honest, diligent and proactive members of the same team, of which I, too, am proud to be a part.

Dr. Gleason is chairman of the New York State Dental Foundation Board of Trustees.
Impact of Residency Requirement for Dental Licensure
An Update

H. Barry Waldman, D.D.S, M.P.H, Ph.D.; Mary Rose Truhlar, D.D.S, M.S.

Abstract
As of 2007, New York State Education Law requires successful completion of dental school training and completion of an approved dental residency program for dental licensure. In a transitional period, from 2003-2006, a dental licensure applicant could select the path of an approved residency program or the New York State-recognized regional standardized clinical examination. By contrast, in 2007, the state of Connecticut adopted and continues to abide by regulations that permit licensure by either completion of an approved residency program or passage of the recognized regional standardized clinical examination. A review of the changing number of dentists licensed in these two adjoining Northeastern states under new licensure guidelines is considered in terms of the possible relationship to the new licensing process.

A 2007 report in the NYSDA News detailed a pronounced increase in the annual number of newly licensed dentists in New York State during the transitional years 2003-2006, when passage of the North East Regional Board (NERB) standardized examination or completion of an approved residency program was recognized by New York State for licensure in the dental profession. Legislation was passed in 2002 modifying New York State Education Law, Section 6604 (subdivision 3 and 4), which allowed (during 2003-2006) voluntary substitution of the completion of a Commission on Dental Accreditation (CODA) approved dental residency program for the traditional standardized regional clinical examination requirement for dental licensure. “The residency program shall be a postdoctoral clinical dental residency program in either general dentistry, or a specialty of dentistry...” Effective Jan. 1, 2007, the option of completion of a regional standardized clinical examination by applicants for dental licensure was eliminated, thereby requiring all applicants to complete a recognized accredited residency program for licensure.

In 2007, the state of Connecticut also initiated a change in its dental licensure procedures. Under the new regulations, the regional standardized clinical examination requirement for licensure could be satisfied by completion of a CODA-approved dental residency program or passage of the clinical test administered by the American Board of Dental Examiners (ADEX). This includes the North East Regional Board (NERB), Southern Regional Testing Agency, Central Regional Dental Testing Service, or Western Regional Examining Board. (Personal communication, S.Carragher, Connecticut Office of Healthcare Practitioner Licensing and Investigation, September 25, 2012) In addition, the states of California, Minnesota and Washington offer licensure...
applicants the option of completing an accredited postgraduate education program, at least one year in length, in lieu of a regional standardized clinical examination.3

Rationale for Change
In New York state, numerous reasons were cited for eliminating the traditional clinical examination and mandating the fifth-year requirement for licensure, including: the necessity of patients in the testing process and allegations of unethical patient treatment; complaints of examination unfairness; lack of relevance and validity of the test given the ever-increasing complexity of delivering dental services in the rapidly evolving realities for the delivery of care; and the “snapshot” assessment nature of the examination.4,5 “Few would argue today that the current clinical examination has any connection to contemporary practice or protects the public from substandard dental care.”6

Concerns
Conflicting views regarding the residency pathway to licensure include the following:
- “Residents practice under the close supervision of attending staff and faculty...”4 but “...licensure by completion of a residency ...restricts the new dentist to practice only in New York and a limited number of states that accept this pathway...” since licensure granted by a residency route is not yet acceptable in the majority of licensing jurisdictions.5
- “...how (will the) mission of further education relate to a fair, unbiased assessment of critical competency required for licensure?”5
- Will the requirement of an additional year of training and the delay of the entrance of dentists into practice, thus postponing the individual’s income, limit the number of dentists who remain in state and thereby worsen access to care issues? In addition, concern is raised whether “...residencies (will) become a 'dumping ground,' allowing schools to absolve themselves of what to do with the bottom of the class?”5 By extension, the question may be raised, whether New York State now attracts dental school graduates who are unwilling to attempt or who are unable to successfully pass other states’ clinical examination for licensure.

Table 1.
Persons Licensed and Registered as Dentists in New York and Connecticut by Residency or Board Examination: 1990-20127-9, Connecticut Office of Licensing

<table>
<thead>
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<th>Year</th>
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<tr>
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<tr>
<td>2012</td>
<td>18,130</td>
<td>3,393</td>
<td>597</td>
<td>180</td>
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<td>2011</td>
<td>18,131</td>
<td>3,325</td>
<td>542</td>
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<td>2010</td>
<td>18,017</td>
<td>3,262</td>
<td>601</td>
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<td>2009</td>
<td>17,911</td>
<td>3,253</td>
<td>502</td>
<td>185</td>
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<td>2008</td>
<td>17,987</td>
<td>3,197</td>
<td>497</td>
<td>153</td>
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<tr>
<td>2007</td>
<td>19,190</td>
<td>3,157</td>
<td>392</td>
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<tr>
<td>2006</td>
<td>18,267</td>
<td>3,121</td>
<td>765</td>
<td>133</td>
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<td>2005</td>
<td>17,961</td>
<td>3,134</td>
<td>760</td>
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<td>17,692</td>
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<td>NERB** or Residency</td>
<td>Regional Board</td>
<td>NERB** or Residency</td>
<td>Regional Board</td>
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<tr>
<td>2002</td>
<td>17,181</td>
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<td>490</td>
<td>132</td>
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<td>2001</td>
<td>16,927</td>
<td>-</td>
<td>581</td>
<td>-</td>
</tr>
<tr>
<td>2000</td>
<td>17,026</td>
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<td>422</td>
<td>-</td>
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<tr>
<td>1995</td>
<td>17,168</td>
<td>-</td>
<td>390</td>
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</tr>
<tr>
<td>1990</td>
<td>17,000</td>
<td>-</td>
<td>431</td>
<td>-</td>
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</table>

* Includes North East Regional Board, Southern Regional Testing Agency, Central Regional Dental Testing Service, Western Regional Examining Board.
** North East Regional Board.

Notes: Totals include numbers of dentists with primary out-of-state or foreign mailing address. As result of annual influx of recent licensed practitioners, number of dentists varies in different reports based upon time of year covered.
ratio of 58 dentists per 100,000 population.” However, there is wide regional variation in the distribution of dentists in the state, ranging from over 106 dentists per 100,000 population on Long Island, to 54 and 53 per 100,000 in the upstate, Adirondack and Catskill regions.10

**Connecticut**

Between 2002 and 2006 (the period prior to institution of an approved dental residency program for the clinical component of the licensing process), there was a slight increase in the number of licensed dentists in the state, from approximately 3,000 to 3,100 individuals. During the period between 2007 and 2012, the number of licensed dentists increased to almost 3,400 individuals, with only a moderate increase in the dentist-to-population ratio, from 89 to 94 dentists per 100,000 population,11 Connecticut Office of Licensing (Table 1). 

**New Licensees New York**

In most years between 1990 and 2000, between approximately 400 and 500 new individuals were licensed annually as dentists in New York State. In the period between 2003 and 2006 (when New York State was the only state with a NERB examination or a residency program as a route to licensure), there was a progressive increase in the annual number of newly licensed dentists in the state, with more than 700 new dental licensees each year, reaching 765 individuals in 2006 (Table 1). The comments made in the earlier review, in 2007, on the burgeoning annual numbers of new licensees during this period were that “...it is difficult to determine whether the optional residency route for licensure was a magnet during the 2003-06 period for the state to: 1. become a “dumping ground” of graduates at the “bottom of the class”; or 2. attract graduates who were unwilling to attempt or who were unable to complete successfully the clinical examination for licensure.”

Commencing in 2007 and continuing to 2012—with adoption of the mandatory graduate residency program requirement—the number of new licensees decreased to a level slightly greater than the general level when passing the NERB examination was required for licensure (Table 1).

**Connecticut**

In the years between 2002 and 2006, there were limited changes in the number of new licensees, between approximately 130 and 150 individuals. In the period between 2007 and 2012—after adoption of the residency program alternative route for licensure—the annual number of new licensees increased, reaching almost 250 in some years (Table 1). Nevertheless, during this period, there were limited changes in the dentist-to-population ratio.12,13

**Commentary**

The reality is that, to some degree, the greater numbers of new New York State dental licensees during the transition period prior to the mandating of an additional year(s) was a reflection of increased numbers of individuals from other jurisdictions who may have considered the possibility of future practice in the state. Many recent graduates complete both the clinical examination (i.e., the ADEX, North East Regional Board examination and the residency, in an effort to: 1. maintain their options to practice in other states that may or may not grant a license by reciprocity for those individuals who secured a license by completion of residency; or 2. “moonlight” during the period of the residency. (Note: a license based on a residency is granted upon completion of the full term of the residency, which may last several years, particularly for the various specialties.)

During the past years, since adoption of the residency programs for licensure in New York State, there has been some decrease in the proportion of graduates from Stony Brook University School of Dental Medicine taking regional board clinical examinations for licensure. By contrast, responses from the dental schools of Columbia University, University at Buffalo, New York University and the University of Connecticut indicate limited changes in the proportion of graduates taking regional examinations.

Based on new licensee data since institution of the completion of a mandatory graduate residency for license in New York State and an elective graduate residency programs for licensure in the State of Connecticut, it would appear that the fears have not been borne out that these two states would become either wholesale “dumping grounds” of graduates at the “bottom of the class” from other states or an attraction for other state graduates who were unwilling to attempt or who were unable to complete successfully a clinical examination for licensure. 

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

**REFERENCES**

Dental Management of Parkinson’s Disease

A Case Report

Preeti Agarwal Katyayan, M.D.S.; Manish Khan Katyayan, M.D.S.; Babitha Nugala, M.D.S.

Disease Management

ABSTRACT

Parkinson’s disease is an idiopathic, slowly progressive disorder of the central nervous system characterized by resting tremor, muscular rigidity, slow and decreased movement (bradykinesia), and postural instability. Oral healthcare providers can expect to be called upon to care for patients with this progressively debilitating disease. To provide competent care to patients with Parkinson’s disease, clinicians must understand the disease, its treatment and its impact on the patient’s ability to undergo and respond to dental care. The successful prosthodontic management of a 74-year-old completely edentulous Parkinson’s disease patient is presented, with the conclusion that a prosthodontic intervention may contribute to improvement in the quality of life of a Parkinson’s disease patient.

PD is the second most common neuro-degenerative disorder, after Alzheimer’s disease. It affects primarily the elderly. It is estimated that about 1% of the population above the age of 65 and about 5% above the age of 80 suffer from PD. In India, with an estimated population of more than one billion, more than 700 million people will be above the age of 65 years, of which approximately more than 7 million suffer from PD. Oral healthcare providers can expect to be called upon to care for patients with this progressively debilitating disease. To provide competent care to patients with PD, clinicians must understand the disease, its treatment and its impact on the patient’s ability to undergo and respond to dental care.

PD symptoms are classified as motor and non-motor (Table 1). It is a very individual condition, with each person experiencing different symptoms. However, the three cardinal signs of PD are motor-related. They are:

- Dyskinesia—tremor or involuntary movement.
- Bradykinesia—slow movement.
- Akinesia—muscular rigidity.

Oral Manifestations of Parkinson’s Disease

Oral Motor and Sensorimotor Impairment: In PD, tremor is an early sign and generally affects the hands, lips and tongue. Bradykinesia is also a common feature and often involves the orofacial muscles. It has been noted that tremor and rigidity of the orofacial musculature may induce orofacial pain, temporoman-
tober 2013

Effects of Parkinson’s Disease

TABLE 1

<table>
<thead>
<tr>
<th>Non-Motor Symptoms</th>
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<tbody>
<tr>
<td>Motor Symptoms</td>
</tr>
<tr>
<td>‘Mask-like’ face (lack of facial expression)</td>
</tr>
<tr>
<td>Drooling</td>
</tr>
<tr>
<td>Quiet, monotone voice</td>
</tr>
<tr>
<td>Slurring of speech</td>
</tr>
<tr>
<td>Tremor</td>
</tr>
<tr>
<td>Slow reactions and responses</td>
</tr>
<tr>
<td>Short, shuffling steps and gait instability</td>
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</table>

Dysphagia: An inability to effectively swallow is reported by as many as 50% of patients with PD. Tongue and pharyngeal motor deficits result in an inability to form an adequate bolus, hesitancy in initiating swallowing and disruption of peristaltic movement, which can result in silent aspiration. Aspiration may contribute to the development of bronchopneumonia, a common cause of death in patients with PD. Slowed swallowing can further contribute to ptyalism, which, in turn, can lead to angular cheilosis and further angular irritation by frequent blotting of the lips and mouth.

Xerostomia: The incidence of xerostomia among patients with PD is reported to be as high as 55% (versus 20% in the general elderly population). Reduced qualitative and quantitative changes in salivary flow are generally related to the parasympatholytic or antimuscarinic effects of the many drugs administered to these patients and not to the PD itself. Chronic xerostomia may result in painful (burning) oral soft tissue problems and poor tissue adaptation to prostheses. The patient may experience difficulties with mastication, swallowing and speech. The reduced buffering capacity of the saliva also contributes to an increased incidence of dental caries, exacerbates periodontal disease and may affect the sensitivity of taste buds, contributing to dysgeusia. In addition, xerostomia may predispose the patient to esophageal injury and contribute to nutritional deficiencies and weight loss.

Burning mouth: Burning mouth is reported by up to 24% of patients with PD. This represents a five-fold increase when compared to similar symptoms reported by the general population. Burning mouth syndrome has been associated with vitamin and mineral deficiencies, hormonal imbalances, xerostomia, candidal infections, denture design faults, parafunctional activity and depression. In patients with PD, an additional factor may be treatment with levodopa, which is known to promote parafunctional or purposeless chewing. In one study, 77% of patients with PD and 96% of those with burning mouth were taking levodopa. None of these patients had a history of burning mouth prior to treatment for PD.

Difficulty Wearing Complete Dentures: PD patients have great difficulty adjusting to the use of complete dentures. The success of wearing complete dentures depends, to a large extent, on the wearer’s ability to control the dentures with his or her oral musculature. It also relies on the presence of an adequate amount and quality of saliva. Thick, “ropey” or “frothy” saliva in an abundant quantity has the same detrimental effect on denture retention as does dry mouth. The muscle incoordination, rigid facial muscles and xerostomia of PD conspire to jeopardize denture retention and control. This is particularly true in the case of complete upper and lower dentures and some acrylic partial dentures. For some people this will mean they are not able to cope with dentures. Other people will require the use of a denture fixative/adhesive to increase denture retention and denture-wearing confidence.

Dental Management of Parkinson’s Disease

When providing oral healthcare to patients with PD, the goals are to develop and implement timely preventive and therapeutic strategies that are compatible with the patient’s physical, cognitive and behavioral ability to undergo and respond to dental care and with the patient’s social and emotional needs and desires. Clinicians must exercise empathy, congruence, a positive attitude and strive to reach these goals with the same ethical, moral and professional standards of care as may be appropriate in the management of any other patient.

Preventive Strategies

Oral Hygiene Maintenance: Rigidity and tremor can contribute to poor oral hygiene. Dental management plans for patients with PD should include appropriate preventive strategies, which take into consideration the patient’s physical and cognitive deficiencies. As the physical and mental condition of the patient deteriorates, the patient may become incapable of carrying out some of or the entire dental hygiene regimen. In these cases, the education of a family member and/or caregiver is essential. It is important that the patient’s caregivers receive appropriate training to enable them to understand and implement the preventive...
plan. Information should be included on the proper positioning of the patient to safely implement home-care activities; the technique for inserting, removing and caring for prostheses; and the technique for oral cancer screening. However, caregivers should only perform those oral hygiene procedures that the patient cannot. The need for professional supervision, consisting of frequent communication with the patient’s caregiver, in concert with frequent recall and office-based preventive care, should be stressed.

**Plaque Removal:** It has been reported that even with average dexterity, no specific manual toothbrush design has been shown to be superior for plaque removal.

In both short-term and long-term studies, electromechanic and ultrasonic brushes have been shown to be more effective than conventional brushes in reducing plaque and gingivitis in all age groups.

Regardless of the toothbrush design (manual, electromechanic or ultrasonic/electromechanic), care must be taken to instruct the patient and/or caregiver in its proper use to prevent unwanted soft-tissue laceration or periodontal tissue trauma. With decreasing muscle coordination and increasing motor difficulty, modification of oral hygiene aids such as toothbrush, proxybrush and floss handles may also be recommended. The handles of these oral hygiene aids may be lengthened or thickened with acrylic, aluminum foil or a tennis ball. An elastic or velcro handle can be applied to the handle to facilitate its proper use. Patients with removable prostheses can have their denture brushes replaced with a nailbrush attached by suction cups to a sink. This enables patients to clean their denture with one hand. The goal of these modifications is to allow the patient to maintain self-care as long as possible.

**Topical Rinses:** The use of topical agents, such as chlorhexidine gluconate, is useful to combat gingivitis and other periodontal pathoses that result from plaque accumulation. However, these products require the use of a swish-and-spit technique that may be beyond the capabilities of patients with PD. In such cases, a small spray bottle filled with the therapeutic rinse may be used to gently spray the product on the oral tissues either by the patient or the caregiver and the excess suctioned off. When the potential for silent aspiration is a concern, a chlorhexidine gel may be applied with a toothbrush, a sponge applicator or a cotton swab.

**Fluorides:** As previously indicated, the incidence of xerostomia among patients with PD is reported to be high. Since xerostomia can lead to increased caries activity, preventive modalities, such as dietary analysis, dietary counseling and prophylaxis, should be combined with over-the-counter home fluoride use. A topical fluoride—1% sodium fluoride (NaF)—in the form of a brush-on gel is more appropriate than topical solutions, since patients with PD may not be able to adequately swish and expectorate to minimize ingestion. The use of a topical fluoride gel in a carrier is another alternative; however, more patient and caregiver cooperation is required. The application of topical fluorides, including a 5% fluoride varnish, should be part of office-based preventive care. The effectiveness of chemoprevention, using both chlorhexidine and a fluoride, has been demonstrated in patients at high risk for caries and periodontal disease. To maximize therapeutic efficacy, it is suggested that the chlorhexidine be used first, followed 50 minutes later by application of the fluoride gel.

**Use of Sialagogues:** Qualitative and quantitative changes in saliva lead to reduced lubrication; antibacterial, antiviral and antifungal activity; loss of mucosal integrity; loss of buffering capacity; reduced lavage and cleansing of oral tissues; interference with normal remineralization of teeth; and altered digestion, taste and speech. Patients with xerostomia whose salivary glands can respond to stimulation may benefit from simple dietary measures, such as eating carrots or cel-

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**TABLE 2**

Managing Xerostomia

<table>
<thead>
<tr>
<th>Key Action</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand underlying cause</td>
<td>Ask GP if alternative medications without xerostomic effects are available.</td>
</tr>
<tr>
<td>Keep mouth moist</td>
<td>Advise:</td>
</tr>
<tr>
<td></td>
<td>• Sipping water or other non-sugar-containing drinks throughout day, and have water available at meal times and at night</td>
</tr>
<tr>
<td></td>
<td>• Rinsing mouth after meals</td>
</tr>
<tr>
<td></td>
<td>• Using oral moisturiser</td>
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<tr>
<td>Replace saliva</td>
<td>Advise use of a salivary substitute, particularly useful before eating, talking or socializing</td>
</tr>
<tr>
<td>Stimulate salivary flow</td>
<td>This can be achieved by:</td>
</tr>
<tr>
<td></td>
<td>• Chewing sugarfree/xylitol-containing gum</td>
</tr>
<tr>
<td></td>
<td>• Use of Salivix</td>
</tr>
<tr>
<td></td>
<td>• Use of prescribed drugs such as prilocarpine</td>
</tr>
<tr>
<td></td>
<td>• Acupuncture</td>
</tr>
<tr>
<td>Avoid anything that increases xerostomia</td>
<td>Advise avoidance of:</td>
</tr>
<tr>
<td></td>
<td>• Alcohol</td>
</tr>
<tr>
<td></td>
<td>• Smoking</td>
</tr>
<tr>
<td></td>
<td>• Caffeine</td>
</tr>
<tr>
<td>Prevent caries exacerbation due to xero-</td>
<td>Instigate rigorous preventive regime tailored to needs</td>
</tr>
</tbody>
</table>

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ery, and from chewing sugarless or xylitol-containing gums. Saliva substitutes, oral moisturizers and artificial saliva may provide some, if inadequate, relief for xerostomia. However, the prescription of cholinergic agonists such as pilocarpine hydrochloride and cevimeline hydrochloride should be avoided because of an underlying parasympathetic predominance associated with PD.\(^{11}\)

**Managing Xerostomia:** Over the past decade, medications used to treat patients with PD have greatly improved their quality of life and lengthened their years of independent living. However, these medications, either directly or indirectly, may cause xerostomia, nausea, vomiting, constipation, nervousness, agitation, anxiety, heartburn, confusion, depression, fatigue, loss of sense of smell and taste, loss of appetite, anorexia or sleep disruption. Adverse drug effects can exacerbate dental caries, periodontal disease and chemical erosion of teeth; cause dystonic muscle movements, which can result in significant and rapid changes in the occlusion; and further influence food intake, oral hygiene and the patient’s self-care ability (Table 2).

**Therapeutic Strategies**

**Communication in PD:** Communication is jeopardized by the “mask-like,” expressionless face that robs the individual of much of his or her nonverbal communication; the monotone, quiet speech that makes a person both difficult to hear and to listen to; and the slowness of response that can lead to the person being labeled incorrectly as cognitively impaired. Depression or dementia can further erode the ability to communicate. These communication difficulties can affect the ability to access dental services and to voice needs and wants.

**TABLE 3**

<table>
<thead>
<tr>
<th>Class and Drug</th>
<th>Reason Used</th>
<th>Adverse Effects</th>
<th>Dental Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANTICHOLINERGIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Trihexyphenidyl HCl (Artane)</td>
<td>Blocks effect of another brain transmitter (acetylcholine) to resemble its levels with dopamine.</td>
<td>Sedation, urinary retention, constipation</td>
<td>Dry mouth</td>
</tr>
<tr>
<td>2. Benztropine mesylate (Cogentin)</td>
<td>Provides drug that is metabolized into dopamine (dopamine replacement).</td>
<td>Dyskinesia, fatigue, headache, anxiety, confusion, insomnia, orthostatic hypotension</td>
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</tr>
<tr>
<td><strong>DOPAMINE PRECURSOR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Levodopa</td>
<td>Mimics action of dopamine.</td>
<td>Dopaminergic effects: Psychosis (hallucinations, delusions), orthostatic hypotension, dyskinesia, nausea</td>
<td></td>
</tr>
<tr>
<td>2. Carbidopa (Sinemet CR, Madopar CR)</td>
<td>Used along with levodopa. This medication blocks enzyme (COMT), to prevent levodopa breakdown in intestine, thus allowing more levodopa to reach brain.</td>
<td>Potentiate levodopa effects: dyskinesia, psychosis, or orthostatic hypotension, nausea and diarrhea, abnormal taste</td>
<td>Caution with use of vasoconstrictors. Monitor vital signs during and after administration of first capsule, limit dose to 2 capsules containing 1,000,000 epinephrine (36µg) or less, depending on vital signs and patient response; aspirate to avoid intravascular injection.</td>
</tr>
<tr>
<td><strong>DOPAMINE AGONIST</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Bromocriptine mesylate (Parlodel)</td>
<td>Mimics action of dopamine.</td>
<td>Dopaminergic effects: Psychosis (hallucinations, delusions), orthostatic hypotension, dyskinesia, nausea</td>
<td></td>
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<tr>
<td>2. Pramipexole (Mirapex)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3. Ropinore HCl (Requip)</td>
<td></td>
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</tr>
<tr>
<td><strong>CATECHOL-O-TRANSFERASE (COMT) INHIBITOR</strong></td>
<td>Used along with levodopa. This medication blocks enzyme (COMT), to prevent levodopa breakdown in intestine, thus allowing more levodopa to reach brain.</td>
<td>Potentiate levodopa effects: dyskinesia, psychosis, or orthostatic hypotension, nausea and diarrhea, abnormal taste</td>
<td>Caution with use of vasoconstrictors. Monitor vital signs during and after administration of first capsule, limit dose to 2 capsules containing 1,000,000 epinephrine (36µg) or less, depending on vital signs and patient response; aspirate to avoid intravascular injection.</td>
</tr>
<tr>
<td>1. Tolcapone (Tasmar)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Entacapone (Comtan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MONOAMINE OXIDASE B INHIBITOR</strong></td>
<td>Prevents metabolism of dopamine within brain.</td>
<td>Dizziness, orthostatic hypotension, nausea</td>
<td>Select adrenergic agents (i.e., amphetamine, pseudoephedrine, and tyramine) may cause increased pressor response. However, this does not appear to occur with ephinephrine or levonardephrine.</td>
</tr>
<tr>
<td>1. Selegline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NEUROTRANSMITTER INHIBITOR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Amantadine</td>
<td>Has anticholinergic properties that enhance dopamine transmission.</td>
<td>Sedation, urinary retention, peripheral edema, nausea, constipation, confusion</td>
<td></td>
</tr>
</tbody>
</table>
The Parkinson’s Disease Society leaflet carries the title “Just a little more time,” and this is one of the main requirements of people with PD in the dental setting. Sufficient time avoids the sense of rushing, which will only delay communication further. Waiting for a response is important, as asking the question again may incur a further time lag in response. The use of questions that require “yes” or “no” responses can both aid the flow of information and reduce the time taken to obtain it. The time required by some people with PD is best accommodated by the use of a salaried dental service.6

The treatment plan for a patient with PD should be compatible with the patient’s physical and cognitive ability to undergo and respond to dental care. Tremor and rigidity may cause problems getting into and out of the dental chair and interfere with the patient’s ability to cooperate. To minimize these limitations, patients with PD should be seen at a time of day when their medications produce their maximum effect. The peak efficacy of most antiparkinsonian drugs begins within 60 to 90 minutes of the time of administration. When it is not possible or it is not in the best interest of the patient to receive treatment in a dental chair, an outpatient surgical suite or a hospital operating room should be chosen to provide for the patient’s comfort and safety while allowing for the delivery of the highest quality dental care. If the patient is confined to a wheelchair, wide parking spaces and entrance ramps, as well as the removal of other impediments to access of care must be considered.

Urinary incontinence and temperature intolerance are common complicating factors in patient management. Shorter appointments can lessen the possible embarrassment of incontinence; however, at the same time, anticipate that these patients may take longer to comply with instructions and more time may be required to perform therapeutic procedures. The issue of temperature intolerance can easily be dealt with by simply adjusting the ambient temperature to patient comfort. Clinicians should also recognize that while patients with PD have no sensory dysfunction, they may be slow in responding to nociceptive stimulation, are unable to recoil from pain as quickly as normal patients, and require implementation of appropriate pain control methods.

Muscle tremor and rigidity affecting the lips, tongue, jaw and facial muscles can greatly affect the clinician’s access to the operating field, compromising the quality of care. This issue may be minimized with the use of mouth props during treatment. Dysphagia may further affect the clinical process. It creates a pooling of saliva, prompting the patient to request frequent stops so that he or she can swallow. Loss of sensation from anesthesia can compound swallowing difficulties and increase the risk of aspiration. High-volume oral evacuation is a must during most dental procedures. Predetermined hand signals for breaks will give the patient a greater sense of control and comfort.11

**Positioning the Patient:** As PD progresses, muscular rigidity and hypokinesia lead to an open mouth, difficulty swallowing and ptyalism (lack of salivary control), characterized by dribbling and drooling. The patient with a lack of salivary control should be positioned in a semi-reclined position (45-degree angle) to avoid pooling of the saliva, airway obstruction and/or aspiration. It is interesting to note that the tendency for a stooped posture when standing seems to disappear when the patient is reclined slightly, but many patients with PD object to a fully reclined position. This reluctance probably relates to their inability to swallow effectively. Orthostatic hypotension, related to autonomic dysfunction and a potential adverse drug effect, is often encountered in patients with PD and must be given special consideration at the end of the appointment. The dental chair should be raised slowly, and the patient should be allowed adequate time to adjust to the upright sitting position before being instructed to rise slowly from the chair. Orthostatic hypotension and balancing problems or dis-equilibria upon standing should be anticipated to minimize the potential of a fall.11

**Prosthetic Considerations:** When patients are able to insert, remove and maintain their prostheses, or when caregivers are available to provide these services, removable prostheses are appropriate to restore function. To minimize problems with adaptation, ill-fitting “old friend” prostheses should be modified or improved when possible. The use of tissue conditioners are recommended for functional relines where vertical dimension has to be changed. In some cases, there may be no alternative but to construct a new prosthesis. Patients and caregivers must be informed that success with dentures depends to a large degree on appropriate muscle function, which controls and stabilizes the prosthesis during periods of rest and use. The tongue may dislodge the mandibular denture, and facial muscles that are rigid or uncontrollable may prevent a maxillary denture from maintaining a retentive seal. Even with the best technique, removable prostheses cannot be guaranteed to function properly because of the diminishing adaptive skills of patients with PD. If the dental practitioner is providing replacement complete dentures for a person with PD, a copy/duplication technique should be used to retain the learned muscle control of the familiar dentures. If planning to provide dentures for the first time, the use of overdentures should be considered, as they help to retain proprioception and to maintain jaw control.11

For the person with early PD who requires dentures, consideration should be given to the possible role of implants or implant-retained overdentures. Although this is an expensive option, it may well be cost-effective in the long term, providing the individual with security and helping him or her to preserve self-esteem and social contacts. As PD progresses, an inability to narrow the vocal tract contributes to difficulties in pronunciation of consonants, especially “k, g, f, v, s, z.”10 Before prosthetic rehabilitation is initiated, the potential for such changes in speech
must be explained to the patient, family members, and/or caregiver to avoid unrealistic expectations.

Case Report
A 45-year-old completely edentulous patient reported to the Department of Prosthodontics for a set of complete dentures. A detailed case history was recorded, which revealed that the patient suffered from PD and was on medication. He also presented with signs and symptoms indicative of the disease, such as mask-like appearance, stare, drooling saliva (Figure 1), gait with rapid, short, shuffling steps and reduced arm swinging. The patient had lost all his teeth due to periodontal disease, which correlated with a history of difficulty in maintaining oral hygiene.

Keeping the patient’s medical condition in mind, a comprehensive prosthetic treatment was planned, and the following steps were taken:
1. The patient was given early morning appointments, two to three hours after medication.
2. The patient was asked to be accompanied by a family member, preferably his wife, for psychological comfort.
3. The patient was assisted into and from the dental chair each time he underwent treatment.
4. An alginate primary impression was made with warm impression compound to reduce patient discomfort.
5. Peripheral molding was completed in a single step with a putty consistency of additional silicone (Figure 2) and wash impression with light body consistency of the same material (Figure 3). This was done to reduce chairside time and because the material is more patient-friendly than the green stick compound and zinc oxide eugenol paste combination for a final impression. (Green stick compound needs to be heated and used in multiple steps; and eugenol paste is an irritant to oral tissues.)
6. Before the wash impression, the patient was asked to rinse his mouth with chlorhexidine gluconate because the mucous salivary secretion from the palate can cause voids. Rinsing with chlorhexidine gluconate also reduces the likelihood of gagging.
7. The challenge with this patient was the establishment, recording and verification of his maxillomandibular relationship records. While anatomical landmarks, such as paralleling of the residual alveolar ridges, measurements of the face height, phonetics and esthetics, were helpful in establishing an estimated occlusal vertical dimension, his excessive elliptical mandibular movement patterns made jaw verification records quite tenuous. While the needed verification was possible at an individual appointment, it was rarely reproducible at a subsequent one. Considerable patience, time and empathy were necessary before a final decision could be made regarding what was judged to be the optimal jaw records for the patient. Jaw relations were recorded tentatively and transferred onto a mean value articulator. Ultimately, a lingualized occlusal scheme was designed in an effort to permit a definitive and maximal intercuspal position with a bilateral balance in excursive movements.
8. Non-anatomic teeth (Figure 4) were selected to overcome the problem of a definite centric jaw relation.
9. The neurocentric concept of complete denture occlusion was adopted and teeth were arranged accordingly.
10. The trial denture was waxed and contoured in harmony with the orofacial musculature.

11. At the try-in appointment, the trial dentures were checked for esthetics, phonetics, border extensions, and stability and jaw relations were verified.

12. The denture was acrylized with a denture base resin having high-impact strength, as the patient’s muscle rigidity and tremors increase the chances of accidental denture fracture.

13. The dentures were inserted in the patient’s mouth and necessary adjustments to the dentures were done (Figure 5). Post-insertion instructions were given to the patient. The patient was also given a denture cleaning brush with a handle modified with acrylic resin that would enable him to have a better grip when cleaning the denture surfaces.

**Discussion**

The effects of the combination of edentulism and PD can be devastating. Speech can be virtually unintelligible and mandibular movement patterns embarrassing. Therefore, in the absence of robust evidence regarding the possible benefits of routine prosthetics management, a case should be made for the inclusion of preventive dental programs and routine dental care as an integral part of the regimen of all patients at risk for PD development. The condition is medically mandated, but the dental clinician may very well be the first health professional to identify the uncontrolled movements that may suggest PD, especially those involving the orofacial complex. A frank discussion with the patient and referral to his or her physician can lead to an early diagnosis and effective management of this movement disorder. Above all, edentulism should be prevented whenever possible.

The success of a denture depends, to large extent, on the wearer’s ability to control it with the orofacial musculature (cheek, tongue, and lips). Also important is the presence of an adequate quality and quantity of saliva to act as an adhesive. Adequate denture retention and control is threatened by a combination of lack of muscle coordination, muscular paralysis or rigidity, and/or xerostomia in this group of patients. Denture problems can affect dietary intake, dietary enjoyment, sense of self-worth and social acceptance. Providing stable, retentive and aesthetically pleasing dentures can be quite a struggle.

The regimen described above appears to be a useful adjunctive treatment in edentulous PD patients and may be considered for patients with diseases similarly affecting motor skills.

**Conclusion**

Proper diagnosis of the challenging predicament of PD, combined with proper, albeit palliative, prosthetics management, may be of inestimable help to such a patient. This particular case history endorses such an approach. 

Queries about this article can be sent to Dr. Preeti Katyayan at drkatyayan@ymail.com.
Restoring Unfavorably Positioned Implants in Anterior Maxilla
Case Report


Abstract
This article describes a clinical case involving a unique solution to restoring implants placed in an unfavorable, labial location in the anterior maxilla. Background information is provided with regard to avoiding compromised situations from the outset, as well as a discussion of issues of restorability, with an emphasis on dental implants. Different treatment options are explored. To complete the case presented, a custom cast framework resembling traditional veneer preparations was selected, with porcelain veneers to cover abutment screw access channels.

For the patient, the tooth is the gold standard by which they will compare a replacement prosthesis. And a dental implant is the closest approximation to what the patient lacks. In dentistry, we are faced daily with attempting to satisfy our patients within the realm of what is possible, bearing in mind the concept of restorability. Thankfully, due to the efforts of leading clinicians, implant dentistry has evolved such that the final restoration dictates implant placement, and questions of restorability arise infrequently.1

The concept of restorability is germane to the practicing dentist; however, a search of the literature and of relevant texts revealed little has been written or researched on this particular concept. Restorability depends upon a multitude of factors, including; projected or expected longevity of a restoration; available materials; operator skill; esthetics; and patient expectation. In implant dentistry, factors such as angulation, bone quality, availability of appropriate restorative components, tissue health, occlusal load and maintainability are critical to success. Proper planning and surgical execution are paramount to ensuring a restorable implant. The goal should be proper placement to help ensure that a shortcoming will still meet the standard of care.

Surgical miscues can be the result of incorrect implant selection, number of implants placed, encroachment on vital structures, vertical orientation, inadequate intra-arch distance, angulation and inadequate spacing.2 In the anterior maxilla, implants are often misangled and bodily positioned to the palatal, since bone resorption occurs in this direction.3 Angle-corrected abutments are often necessary because of the orientation of available bone for implant placement. They allow for an incisal screw access in cement-retained restorations and palatal access for screw-retained prostheses. With the advent of socket preservation or site augmentation techniques, and the use of angle-corrected abutments, implants in the anterior maxilla are readily restored.

Unfavorably positioned implants can be dealt with in several ways. They can be removed and replaced, surgically repositioned, restored (in a vast array of creative ways), or they can be left unrestored and buried subgingivally.
Trephination and removal of integrated implants, followed by grafting and subsequent replacement, involves at least two additional surgeries. Each surgery visit has a certain degree of morbidity associated with it and the potential for pain, bleeding, swelling, infection, failure of implant integration, rejection or loss of graft, and loss of crestal bone. One must also take into consideration the time and expense involved in this treatment and weigh it against the prospect of having a much more ideal treatment outcome.

One possible option to deal with malpositioned osseointegrated implants is the technique defined as distraction osteogenesis. Distraction osteogenesis was first reported in orthopedics by Ilizarov in the late 1980s, and has been used in dentistry to reposition implants or ankylosed teeth or to increase alveolar crest height. The basic premise involves intentional separation of a section of bone, slight movement of the section and subsequent fixation. New bone will form in between the segment and its source as the bone is “stretched.” With regard to an unfavorably positioned implant, an osteotomy can be made around the block of bone in which it is integrated. The block is then repositioned to create a situation that is more readily restored and then orthodontically or otherwise mechanically fixated. Treatment time and expense may be reduced, but the surgery is more complex, and is not without morbidity as well.

Leaving a dental implant unrestored is a difficult decision to make and would seem to defeat the purpose of placing it in the first place. There may be times, however, when the risks associated with more surgery or a severely compromised restoration do not outweigh the benefits. For example, a decline in a patient’s health status, limited availability, financial limitations or a patient’s acceptance of interim treatment as a long-term solution might preclude other treatment options.

Creative restorative solutions to unfavorably positioned implants are abundant in the literature. Angled abutments, CAD-CAM custom abutments, preparable abutments and UCLA-type cast-to-abutments are among the more common solutions when a prefabricated straight abutment will not be effective. Pink porcelain or composite and bars used as a substructure are also valuable tools to employ when a case hasn’t been properly planned or did not proceed according to plan. Magne described a planned technique whereby a porcelain veneer was used to restore screw access in an area with limited interocclusal space. All of these solutions are not an excuse for improper planning or execution, and they each have limitations, but when the benefits outweigh risks associated with additional surgery, they represent a substantial armamentarium available to the restoring clinician. In fact, these solutions have become so common, and diagnostic tools so
precise, we may be experiencing another paradigm shift back to placing implants in available, native bone.

Case Report

A 67-year-old male patient presented to the Advanced Education in General Dentistry clinic at the University at Buffalo School of Dental Medicine for restoration of NobelReplace Straight Groovy RP implants in sites #8 and #9. A review of his medical history found the patient was in very good health, with 81 mg of aspirin intake daily, his only medication. The patient was also free of any known risks factors for implant dentistry, such as smoking and poor oral hygiene.

The dental history revealed an account of external resorption on his maxillary central incisors. Tooth #9 had been extracted 10 years prior, and a ridge preservation procedure was performed. A three-unit resin-bonded, fiber-reinforced fixed partial denture served as an interim prosthesis for eight years, until tooth #8 was extracted, the socket grafted with DFDBA and a resorbable collagen barrier membrane placed. The patient was restored with an interim maxillary partial denture replacing the central incisors; implants were placed the following year.

Upon clinical examination, it was apparent that the implants had been placed more labially than what is ideal. The denture teeth on his interim RPD were set labially to the rest of the arch, yet the healing abutments were clearly visible with the prosthesis in place (Figures 1, 2). The patient was told that the implant position was compromised and that further investigation was necessary to develop a course of treatment. It was at this time that he expressed his desire to finish the case in as timely a manner as possible, since he would be away for six months during the approaching winter.

A closed tray technique was used to make a fixture level impression. The goal at this point was to use the resulting model for diagnostic purposes and to provide the patient with either a diagnostic model or, perhaps, even a provisional restoration to evaluate. The patient’s interim restoration was already esthetically compromised and it was possible that he would be accepting of a less-than-ideal definitive treatment as well. The working model was the subject of much deliberation. It was decided to re-appoint the patient for evaluation and to present him with the treatment options discussed above regarding misplaced implants, with removal and replacement as, perhaps, the ideal choice.

The patient was given the options of removal, grafting and re-implantation, distraction osteogenesis and attempting restoration. The patient did not consider leaving the implants unrestored, because he had been wearing the removable appliance for almost two years and was not satisfied with this as a long-term solution. Distraction osteogenesis was given little consideration because the patient would be leaving town in two months for an extended time and follow-up wouldn’t be feasible.

Removal of the implants would allow for ideal positioning at a later time. The patient was willing to go through with this, and his schedule would allow time for removal and grafting, with placement of new implants the following spring, and, it was hoped, restoration the next fall before the patient’s next planned hiatus out of town for the winter. For the patient, the main drawback would be the additional year of treatment.
Restoration of the implants was still questionable at this point, but the patient was eager to proceed in this way. Function was more important to him than esthetics. And even at his largest smile, the patient displayed only the incisal half of his maxillary anterior teeth, so a collaborative decision was reached to explore restorative possibilities. If a suitable solution was not possible, then the implants would be removed.

Collaboration of the restorative team led to two possible solutions. The implants were not angulated sufficiently to allow for a palatal screw access, so angle-corrected abutments were ruled out. The technician made a diagnostic mock-up of a custom substructure, which essentially resembled two connected veneer preparations. It was fabricated using PEAK temporary abutments, pattern resin and wax and could be torqued into the implants through the labial screw access channels. Composite resin or porcelain veneers would then be cemented to cover the screw access (Figure 3). The alternative option was to fabricate a bar substructure to torque into the implants that would feature additional, palatally located screw channels. These would allow for a definitive restoration to be screwed into place. This option was discounted for two reasons: the palatal screw access would be spatially very difficult to access; and another microgap could lead to bacterial contamination and, possibly, a negative odor or taste.

The patient was appointed to present and discuss the treatment plan and to make decisions regarding composite or porcelain and the use of pink or tooth-color in the gingival area. Composite veneers were presented as an option that would be easier to repair chairside, but with the drawback that they might lose surface luster over time. Porcelain veneers would likely need replacement if a fracture occurred, but would provide more consistency in appearance over the long term. The use of pink porcelain would allow for final veneers that would appear to have a more ideal length. The use of a pink opaquer to cover the gingival portion of a metal abutment was explored and, given space limitations, it would not have been possible to build in enough layers to make it look real. The other options were to have a long crown or to have “root” exposure. This was a moot point for the patient, since he does not naturally display this area and given the technician’s concerns, pink porcelain would not be used.

In fabricating the framework, the type of abutments to use was also a consideration. One possibility was to use a CAD-CAM titanium abutment, which would likely need to be cut back in the gingival portion and then veneered with titanium-compatible porcelain to make the veneer “preps.” The other possibility would be to use a UCLA-type cast-to abutment, which could be waxed up and cast, cut back in the gingival area and veneered with porcelain to form the “preps.” This method was chosen, and the patient was appointed for a try-in (Figures 4, 5).

At the try-in, an 810 nm diode laser (Odyssey, Ivoclar Vivadent) was used to recontour tissue to allow full seating of the framework (Figure 6). UCLA abutments engage an implant’s internal connection and, as such, there was some concern that they would need to be adjusted to allow seating of the restoration. The impression transfer was accurate, as shown radiographically (Figure 7). Proximal contacts were adjusted and verified, and shade selection was confirmed. The angle from the long axis of the implant to that of the restoration was measured at less than 20 degrees. The patient was informed that a slight enameloplasty of an opt-
posing mandibular incisor might be advantageous to maintain even protrusive contact.

The final appointment was scheduled before the patient left town for the winter. Healing abutments were removed, and the framework was torqued into place. The eMax Press veneers (Ivoclar Vivadent) were tried in with transparent Variolink Veneer try-in (Ivoclar Vivadent) paste, since the veneers exhibited little translucency, and the underlying shade was ideal. Fermit (Ivoclar Vivadent), a composite, provisional restorative material was placed into the screw access holes. The patient approved the esthetics of the restorations, which were subsequently cleaned, silanated and cemented with Variolink veneer (Ivoclar Vivadent). The cement was light cured, the restorations polished with Astropol polishers (Ivoclar Vivadent), and the occlusion checked and adjusted slightly. The patient left with a pleasing final result in a situation that might have been deemed unrestorable (Figures 8-10).

Discussion

This case, with malpositioned implants, presented to our clinic as potentially unrestorable. As dental school faculty we are routinely asked whether a case is “restorable.” In some cases, a theologian could provide more insight than a dentist, since the answer is often more complex than “yes” or “no.” Our literature has very little that explores this concept, and there certainly is no text available to determine what is or is not restorable. There is, however, a great knowledge base among clinicians and technicians within the profession, and case reports can be invaluable in their contribution.

In some respects, this case was “unrestorable.” Prefabricated parts to restore it don’t exist. Crown shapes and gingival contours would not allow success for the esthetically demanding patient and, most importantly, had members of the restorative team not had some knowledge of how to handle the case, viable implants may have been removed.

In the end, the case was “restorable.” Materials were available that could be modified for use. The patient’s expectations were primarily related to function. He had stable implants, healthy tissue and the ability to maintain his prosthesis for a long period of time. Reviews are available in the literature like the one presented by Holst et al., 13 which attempt to summarize restorative options for the implant dentist. It remains critical, however, for the clinician to stay well informed, since our ability to “restore” something is constantly changing.

Summary

Dental implants are perhaps the closest treatment option for a patient who just wants “teeth.” They must be planned and managed carefully, and they require close communication between the surgeon, the restoring dentist, the patient and the laboratory technician. The case presented here demonstrates a method for restoring labially misplaced dental implants in the anterior maxilla by using porcelain veneers to cover the screw access channels of a custom-cast subframe.

As dental implantology evolves, cases like this one should occur less frequently, as great care should be taken to place the implant in a position driven by the final restoration. It is reassuring to know, however, that there is a great knowledge base within the profession that should similar circumstances arise in the future.

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REFERENCES

Providing Oral Health Care to Underserved Population of Pregnant Women
Retrospective Review of 320 Patients Treated in Private Practice Setting

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ABSTRACT

This article aims to quantify the impact of a novel partnership between a fee-for-service private practice and a teaching hospital dental service intended to provide oral care to an underserved population of pregnant women. Further, it seeks to ascertain the oral needs of this high-risk and diverse population. Data is presented that suggests the dire need for oral care among this pregnant population and the efficacy of treating these women in a private practice setting.


The DOH Guidelines state that improving oral health prevents the many complications of oral disease during pregnancy. It can decrease childhood caries by limiting the transference of bacteria that cause caries from mother to child. It may reduce adverse pregnancy outcomes. For many women, it may be the only time they have dental insurance and, thus, access to care. It is a teachable moment whereby significant lifestyle changes may be initiated. For these reasons, the DOH suggested that oral health should be an integral part of prenatal care. It further suggests that prenatal care providers encourage oral health exams for all pregnant women who have not had one in the last six months.

A novel program was developed in Nassau county, NY, to provide access to oral care to an underserved population of pregnant women. It combines the efforts of a private practice, fee-for-service periodontal practice and two teaching hospital dental services to deliver oral healthcare to pregnant women enrolled in a Prenatal Care Assistance Program (PCAP).

The target groups for this program are the Prenatal Care Assistance programs at the North Shore/Long Island Jewish Health System and South Nassau Communities Hospital. These programs are dedicated to decreasing the incidence of poor pregnancy outcomes in a high-risk population. The PCAP offers comprehensive obstetric care and provides prenatal care, employing obstetricians, nurses, social workers, nutritionist and a large constellation of supportive staff. The Long Island Jewish Hospital PCAP sees approximately 1,100 patients each year; the North Shore Hospital at Manhasset campus sees 350 patients; and South Nassau Communities Hospital PCAP sees 600 patients. The patients are a diverse, multicultural, at-risk, and often high-risk, group of women and families.

The aim of this study was:
1. To ascertain the oral needs of this PCAP population who were appointed for dental care.
2. To evaluate the efficacy of providing oral care to this population in a private practice setting.
Method

1. A Prenatal Care-Periodontal Risk Assessment Form was developed with the help of the DOH Dental Bureau.
2. Charts of 320 consecutive PCAP patients seen for oral care between April 1, 2008, and October 1, 2008, were reviewed and summarized using the Prenatal Care-Periodontal Risk Assessment Form.

Results

All women received a full-mouth periodontal examination. Probing depths were measured at six sites per tooth with a manual probe. Disease status was based on established criteria.2 Figure 1 shows the prevalence of periodontal disease at the initial examination. Only 12.5% presented with gingival health. 39.5% presented with gingivitis. Significantly, 48% of these women had a periodontal diagnosis of more advanced forms of periodontal disease.

Figure 2 reveals that only 7% of these patients have had an oral health visit within the last six months. 42% had not seen a dentist for over two years. And 26% have not had an oral care visit for five years or longer.

We evaluated the number of weeks pregnant at the first oral care appointment. While patients presented throughout their pregnancy as they were referred from the prenatal care providers, it is of note that 37% were referred for oral care examinations during the first trimester of their pregnancy. A significant majority (75%) of women returned for multiple visits for oral care as recommended by the oral care providers. Finally, 17.5% of these patients required emergency referral to a dental clinic for either pain or infection or both.

Discussion

The DOH has suggested that oral health be an integral component of prenatal care. A retrospective chart review was performed on 320 consecutive patients seen in a novel program in Nassau County dedicated to meeting the oral care needs of an at-risk population of underserved pregnant women. The goal of this study was to assess and treat the periodontal needs of this population. Further, it aimed to evaluate the potential of a hospital-based Prenatal Care Assistance Program to refer patients to a private practice and for that practice to treat these patients.

Gingivitis is a common finding among a population of pregnant women. Estimates range from 30% to 70%.3 The wide range of findings may be a result of disparate criteria for diagnosing the disease or because of different study populations. More advanced forms of periodontal disease can be detected in 37% to 46% of women of reproductive age and up to 30% of pregnant women.4 Our review shows that in this population of pregnant women, 87.5% had either gingivitis or more advanced forms of periodontal disease. Significantly, 48% had either mild, moderate or advanced forms of periodontal disease.4

It is estimated that 25% of pregnant women have tooth decay. While not specifically evaluated in this review, it is of note that 17.5% of these patients required referral for emergency den-
tal care for either pain or swelling or both. The combination of a high prevalence of periodontal disease, coupled with a significant number of women requiring emergency referral, clearly points to a dire need for oral care for this at-risk population.

It has been suggested that there is great difficulty overcoming urban myths regarding dentists providing, and patients seeking, oral care during pregnancy. Our data shows that 37% of patients were referred and appointed before 14 weeks gestation for oral examination and consultation. This data evidences that prenatal care providers can overcome misconceptions among this population and motivate them to seek oral care at a time in their pregnancy when they may receive the greatest benefit.

The DOH Guidelines suggest that prenatal care providers refer pregnant women for an oral examination if they had not seen a dentist in the last six months. Our data show that only 7% of this population had oral care within the last six months. Indeed, 25% had not seen a dentist for at least five years. Access to oral care in this population has been inadequate and, therefore, it seems appropriate for all women from PCAP programs in New York State to be referred for oral examinations. Screening for a disease that has a very high incidence and prevalence is not cost-effective. Scarce dollars should be spent on treatment.

Greater than 75% of these women returned for more then one treatment visit. Many who received only one visit did not require further treatment. We believe that this is evidence that this population can be motivated to receive oral care and that lifestyle changes can be brought about in a private practice setting.

Conclusion
This data shows that the need for oral care is great in this population of pregnant women and that access to oral care services has been historically inadequate. Data is presented from a novel program that combines the efforts of a private practice in periodontics, an Article 28 hospital-based dental program and three hospital-based PCAPs. This data suggests that underserved pregnant women can be successfully motivated by the joint efforts of prenatal and oral care providers to seek appropriate and timely treatment.

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Use of High-Magnification Loupes or Surgical Operating Microscope When Performing Prophylaxes, Scaling or Root Planing Procedures

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A B S T R A C T

The use of high-level magnification (6-8x loupes magnification, or higher degrees of magnification provided by the surgical operating microscope), combined with head-mounted, coaxial lighting, may improve the ability of a dentist or dental hygienist to perform prophylaxis or scaling and root planing procedures, compared to the performance of these tasks using unaided vision or entry-level (2.5x) magnification, combined with overhead operatory lighting. A magnified view of the supragingival contours of a tooth surface facilitates visualizing the dimensions and curvature of the unseen sub-gingival tooth surfaces, which facilitates detection and removal of calculus that is located on these subgingival surfaces. Improved calculus removal ability may lead to better periodontal disease treatment outcomes in dentistry.

The therapeutic value of a dental prophylaxis procedure consists mainly of the removal of hard calculus precipitates that form around teeth surfaces and the removal of soft, persistent biofilms located within periodontal pockets. This article argues that microscope-level magnification (6-8x or greater), combined with head-mounted illumination that is coaxial with the visual axis that the dentist uses to view intraoral surfaces, allows a dentist to more optimally perform dental prophylaxes procedures compared to using unaided vision and non-coaxial overhead operatory lighting.1-5

Detection of Hard Calculus Structures or Soft Inflammatory Subgingival Biofilms

Microscope-level magnification improves a dentist’s ability to detect the color contrasts between calculus and normal tooth structure, and to detect microscopic amounts of calculus that are located subgingivally near the opening of a periodontal pocket (Figure 1), or that are protruding like spicules from an aspect of a tooth surface that a dentist is viewing at an angle that is tangent to that surface aspect.1 A magnified view of the shape, morphology, and curvature of a tooth allows a dentist to better see how calculus that is layered over a tooth surface changes the normal contour of the tooth curvature.

A dentist can use microscopically precise tactile sensitivity to determine if there is calculus at any microscopically small point on a subgingival tooth surface. Using microscopes, a dentist can associate a tactile sensation of either “smooth” or “rough” with any microscopically small point on a tooth surface. A tactile feeling may be associated with a microscopically small point on a tooth surface that is directly visible, such as a point on suprag-
ingival tooth structure, or on a non-visible, subgingival surface point, the location of which is inferred based on a magnified view of tooth structure curvatures or on a magnified view of the angle and depth of penetration of a cavitron tip into a periodontal pocket.

A dentist using a microscope can detect tiny changes in the shape of the gingiva at different points along a tooth perimeter that are caused by gingival inflammation (Figure 2). The gingiva at various inflamed points along the perimeter of a tooth at the gingiva may be larger in volume, show different colors and show different magnitudes of curvatures, compared to points along the perimeter that are not inflamed. Associated with these inflamed points may be soft subgingival biofilms, microscopic overhangs of amalgam, subgingival crown cement or subgingival calculus.

Microscope-aided Observation of Tooth Surface Topography in Performing Prophylaxis

Microscope-level magnification provides a dentist with a magnified view of the supragingival tooth surface, the angle in three-dimensional space of the long axis of the tooth, the dimension of the perimeter of the tooth at the gingiva, and concavities on the supragingival clinical crown that indicate the furcations of roots or subgingival tooth surface concavities. Information about the dimensions of the shape and curvature of the visible supragingival tooth structure allows a dentist to make intelligent inferences about the dimensions of the shape and curvature of the non-visible subgingival tooth structure, and to infer where calculus is located on these subgingival surfaces (Figure 3).

Calculus that precipitates onto subgingival furcation surfaces can cause the normally concave morphology of the furcations seem smooth and contiguous with the rest of the subgingival root surface. However, with a microscope, the dentist may observe that touching a cavitron tip to this ostensible tooth “surface” results in microscopically small incremental increases in the depth of penetration of the cavitron tip towards the actual subgingival root surface. This increasing depth of penetration shows that this subgingival “tooth surface” is actually subgingival calculus. With a microscope, the dentist observes that as the calculus chips away in response to the cavitron tip force, the cavitron tip traces out, one point at a time, in three-dimensional space, the concave topology of the subgingival furcation surface.

A magnified view of the interproximal area between two teeth allows a dentist to better determine the location of the interfaces between tooth structure, gingiva and alveolar bone, and the locations of the contact areas. The dentist can better estimate the dimension of the contact area in three-dimensional space from the buccal to the lingual direction, and the dimensions of the empty embrasure space between the teeth. When the dentist places a cavitron tip interproximally and subgingivally and feels a hard structure, a magnified view of the interproximal allows a dentist to intelligently presume if this hard structure is calculus, tooth

Figure 1. Coaxially illuminated, magnified view of malposed maxillary incisors shows microscopic amounts of calculus at CEJ, periodontal pocket suppuration, and supragingival tooth surface curvature, which aids in making presumptions about subgingival tooth structure curvature.

Figure 2. Magnification makes it easier to read periodontal probing measurements and to associate measurement values with microscopically small points along tooth perimeter at CEJ. Increased gingival curvature due to inflammation is more obvious.

Figure 3. Magnified, coaxially illuminated view of maxillary canine shows calculus at distal furcation area and provides information about curvature of furcation surface on which calculus is precipitated.
structure or alveolar bone, or if the tip is lodged between two interproximal tooth surfaces that form the embrasure space.

**Improved Efficiency in Orienting Cavitron Tip While Removing Calculus**

Microscope-level magnification allows a dentist to more quickly and efficiently angle a cavitron tip in three-dimensional space so that the tip contacts calculus precisely. A cavitron tip may contact a tooth surface point such that the tip is tangential to the tooth surface, or multiple points on the tip may contact multiple points on the tooth surface simultaneously, or only the tip of the cavitron tip may touch a single point on the tooth surface. A magnified observation of how the tip contacts a tooth surface allows a dentist to evaluate if a particular tip contact results in efficient removal of calculus. Occasionally, a dentist may observe a microscopic gingival point along the tooth perimeter that is inaccessible to a cavitron tip, even after attempting to access this point by angling the tip in a variety of microscopically different ways; this indicates the need to switch to a different shaped tip or to use hand instruments to manually clean this point. A dentist can also observe if a tip of a certain length or width results in better penetration into the periodontal pocket at a specified point on a tooth perimeter compared to a tip of different dimensions.

Even if a cavitron tip that is placed into a periodontal pocket is oriented approximately parallel to the subgingival tooth surface, it may not be touching calculus; instead, it may only be touching the gingival tissue on the inner wall of the periodontal pocket that is facing the tooth surface. A dentist using a microscope can determine at what precise angle and depth of penetration the cavitron tip contacts the subgingival tooth surface at each point along a tooth perimeter. The dentist can then precisely reproduce this angle and depth of penetration of the tip and keep the tip concentrated on this point until he or she no longer detects microscopic chips of calculus being ejected from that point on the tooth surface as a result of the cavitron force.

A magnified view of the tip of an 11/12 explorer while it is contacting subgingival calculus allows a dentist to observe with microscopic precision the depth of penetration of the explorer tip into the periodontal pocket and the angle of contact of the tip with subgingival calculus. This magnified view allows a dentist to precisely match the angle and depth of penetration of a cavitron tip with that of the 11/12 explorer for precise targeting of the calculus spicule detected with the explorer. The dentist can also make microscopic changes to the rotation of the cavitron tip and move the tip superiorly or inferiorly in microscopic increments to clean calculus adjacent to the calculus at the initial point of tangential contact on the tooth surface.

A magnified view of a tooth allows a dentist to detect if the subgingival tooth structure is undercut relative to the supragingival tooth structure and to angle the cavitron tip accordingly to ensure that it contacts the undercut subgingival tooth surface. This enables a dentist to precisely clean, for example, the mesial subgingival surface of a mesially inclined mandibular molar or teeth that feature a deep lingual undercut due to the occlusal aspect of the lingual surface protruding lingually.

A magnified view of the three-dimensional structure of a block of calculus allows a dentist to visualize the directions of various imaginary axes that pass through the calculus block. The dentist can use this visual information to align the axis of the cavitron tip with the axes where the calculus is backed by air and not by tooth structure, or to touch the cavitron tip at the interface between the calculus and the tooth, which puts the calculus under maximum shear forces.

**Advantages of Head-mounted, Coaxial Illumination**

When performing a prophylaxis, a dentist must view teeth using multiple viewing angles. For each viewing angle, adequate lighting is required. It may be inefficient to use operatory lighting to illuminate teeth for all of these viewing angles, and some viewing angles cannot be illuminated using operatory lighting. Head-mounted lighting is coaxial with the axis of the dentist’s line of sight and allows illumination of the entire mouth during the prophylaxis procedure.

Unlike overhead lighting, coaxial illumination does not cast shadows on teeth. Shadows can obstruct visibility of specific points along a tooth perimeter at the cemento-enamel junction. A dentist may not be able to see the following at a shadowed, visually obstructed perimeter point: microscopic amounts of gingival inflammation; color contrasts between calculus and normal tooth structure; how calculus changes the morphology of an otherwise smooth tooth surface; the tooth surface contour at a specific point along a tooth perimeter; the angle in three-dimensional space of a scaling instrument; if a cavitron tip that is penetrating a periodontal pocket is actually contacting the subgingival tooth surface; if the cavitron tip is penetrating more deeply into subgingival tooth surface concavities or furcations as it chips away at calculus that is coating these concavities or furcations; whether or not chips of calculus are being ejected from that point in response to the cavitron tip; and the specific point on a tooth surface that is associated with a tactile feeling of roughness due to calculus still remaining at that point.

Coaxial lighting may be particularly useful for illuminating the buccal surfaces of maxillary posterior teeth; tooth surfaces that may be lingually inclined, such as the lingual surfaces of mandibular anterior teeth; and, in general, multiple malposed teeth of multiple emergence profile angles in a patient. Coaxial lighting improves illumination of a tooth that appears foreshortened in the perspective used to view it, improving a dentist’s ability to comprehend the dimensions of these teeth.

Also, if a patient is anxious or uncomfortable, the patient may curl his or her lips over the teeth to block the cavitron, creat-
ing a narrow crevice through which light must pass to illuminate the tooth surfaces. Coaxial lighting penetrates these crevices better than overhead lighting does and also illuminates the lingual surfaces of mandibular molars when the posterior aspect of the tongue blocks overhead light from reaching these surfaces.

Assessment of Origins of Tooth Stains and How Best to Remove Them

Using microscopes, a dentist can better analyze the types and possible causes of a patient’s tooth stains. Sometimes, stained calculus collects in microscopic pits, corrugations or depressions on a tooth surface. These pits may have to be cleaned tediously, one point at a time, using a cavitron tip. Microscopes facilitate detection of these pitted surfaces and aid in precise smoothing of the surfaces using an aluminum oxide composite polishing bur in a high-speed handpiece. The dentist then moves an explorer tip on the surface while viewing the surface with microscopes to verify that the surfaces are smooth and that all such pitting has been removed. At the next recall, the dentist will re-evaluate the tooth surface to see if the surface catches fewer stains overall and re-polish areas of the surface that still catch stain.

Stains can also be due to microscopic overhangs and ledges on composite restorations that catch and retain organic particles that eventually stain. A dentist can use microscopes to detect these ledges, often by directly seeing the ledge or other protrusions or sharp areas on the restorations, and to polish these ledges and remove the stains around the ledges using aluminum oxide composite polishing burs. If the stains still do not come off, which may occur if the composite features a pit or thin crevice, the composite may need to be replaced with another composite that has a less stain-catching surface topology. Stains that are associated with deep pits or soft areas can be caused by dental caries and would require direct restorations.

Microscope-level magnification allows a dentist to detect a thin, sometimes square-shaped film of yellow discoloration on the facial surfaces of incisors, which could be old orthodontic composite bonding material that was not removed when the orthodontic brackets were removed. A metal explorer tip may leave microscopic dark streaks when rubbed across this material. Here, the bonding material is abrading the metal and causing tiny metal streaks to form on the composite surface. Viewing the dark streaks with microscope-level magnification shows that the material is bonding material. The dentist polishes the bonding away with an aluminum oxide composite polishing bur and uses microscopes to verify that the bonding material has been removed and that the tooth surface is a homogeneous shade.
Detection and Polishing of Restoration
Overhangs and Associated Gingival Inflammation

Microscope-level magnification facilitates detection of microscopic ledges or spikes of restoration overhangs at the margins of crowns or buccal composites that facilitate gingival inflammation. The dentist uses microscopes to aid in precise angling of polishing burs to polish these overhangs, followed by an explorer and microscopically precise tactile sensitivity to verify removal of all overhangs.

Also, a dentist may detect an amalgam overhang by observing microscopic flakes of amalgam overhang being chipped away by the caviton tip while it is cleaning at the overhang areas.

Prophylaxis Procedures around Fixed Partial Dentures

Microscope-level magnification improves a dentist’s ability to detect the interface between the tooth root surface and subgingival crown margins that are hidden by gingiva, and to distinguish the hard sensations of crown margin overhangs from other hard sensations, such as subgingival calculus, subgingival tooth structure and excess subgingival crown cement. Coaxial lighting illuminates the junctions between the abutments and pontics underneath bridges and eliminates shadows that hinder the ability to distinguish between the metal collars of crowns and the gingiva and tooth structure inferior to these collars. The dentist can precisely angle a caviton tip underneath a bridge and into the mesial periodontal pocket of a mesially inclined molar bridge abutment.

Conclusion

Microscope-level magnification (6-8x or greater), combined with head-mounted, coaxial illumination aids, enhances a dentist’s ability to perform prophylaxis procedures by improving a dentist’s ability to detect hard calculus and soft biofilm structures to microscopic precision; sense the color contrasts between calculus and tooth structure; detect the morphological contours of both supragingival and (unseen) subgingival tooth surfaces; and to precisely reproduce working end angles that result in progressive and efficient cleaning of tooth surfaces.

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ABSTRACT

Tobacco is one of the most popular habits among the general population. Tobacco is also an important risk factor for oral cancer, oral mucosal lesions and periodontal diseases. There is substantial evidence suggesting that the risk of oral diseases increases with intensity and duration of tobacco smoking and that smoking cessation results in risk reduction. In this article, the influence of cigarette smoking on the periodontium as well as the alveolar bone will be discussed, highlighting the negative effects on dental implants and implant-related surgery.

There are an estimated 1.3 billion smokers worldwide, and 4.9 million people die from tobacco smoking-related diseases every year (WHO 2005).

Smoking was shown to be a primary risk factor for general health, responsible for many serious diseases: 90% of all lung cancers; 70% of chronic lung diseases; 80% of myocardial infarctions before the age of 50; and 39% of chronic ischemic heart diseases and strokes.1

In the dental and oral literature, smoking is reported to have compromised healing after mucogingival surgery2-4 and is associated with oral cancer, periodontal disease, leukoplakia, stomatitis nicotina and impaired gingival bleeding.5,7 Cigarette smoking accounts for half of all periodontal diseases,8 as demonstrated by an increased loss of attachment, development and progression of periodontal disease, and increased gingival recession. In addition, smoking is a potential risk factor for alveolar bone loss.9

The number of cigarettes smoked per day is a major risk factor for periodontal diseases, doubling the risk for those in the lowest consumption category and increasing it six-fold in the subgroup smoking more than 30 cigarettes per day.8

The use of osseointegrated implants as a foundation for the prosthetic replacement of missing teeth has become widespread in the last decade.10-12 Owing to the remarkable success of dental implants, there has been growing interest in identifying the factors associated with implant failure. Given the well-documented deleterious effect of smoking on wound healing after tooth extraction and its association with poor quality bone and periodontal disease, a negative effect of tobacco use on implant success is to be expected.13,14 Most of the studies report the failure rate of implants in smokers as being more than twice that in nonsmokers.15

Complications of implants influenced by smoking may cause a significantly more marginal bone loss after implant placement, increasing the incidence of peri-implantitis and affecting the success rates of bone grafts.13,14,16,17

In light of the facts presented, it becomes important to establish the effect of smoking on implant-related surgical procedures (that is, sinus lift procedures, bone grafts and dental implanta-
plakia is the most common pre-cancerous lesion associated with severe forms affect 20% to 30% of adults. Gingivitis, the mild-odontal disease affect 75% of adults in the United States; more

Two major oral diseases, dental caries and periodontal diseases, are both ancient and widespread.27

Periodontal disease is a chronic microbial infection that triggers inflammation-mediated loss of the periodontal ligament and alveolar bone that supports the teeth.30 An aggressive form of periodontitis is characterized by a rapid loss of clinical attachment and alveolar bone and normally affects young adults. As opposed to chronic periodontitis, the amount of biofilm and calculus accumulation in aggressive periodontitis subjects is inconsistent with the severity and progression of the periodontal destruction. These infections are subdivided into localized and generalized cases, according to the extent of the periodontal destruction.31

In addition to pathogenic microorganisms in the biofilm, genetic and environmental factors, especially tobacco use, contribute to the cause of periodontal disease. Genetic, dermatological, hematological, granulomatous, immunosuppressive and neoplastic disorders can also have periodontal manifestations.28 Therefore, the diagnosis of periodontitis requires exclusion of systemic disorders that may severely impair host defenses and lead to premature tooth loss.31

Common forms of periodontal disease have been associated with adverse pregnancy outcomes, cardiovascular disease, stroke, pulmonary disease and diabetes, but the causal relations have not been established. Prevention and treatment are aimed at controlling the bacterial biofilm and other risk factors, arresting progressive disease and restoring lost tooth support.28

Dental Implants
Dental implants are an option for tooth replacement following tooth loss due to caries, periodontal disease or injury. Dental implants are usually made of titanium screws that are inserted into the alveolar bone and function as artificial tooth roots. The success of dental implants is critically dependent upon the available bone at the implant site. The biocompatibility of the implant itself is determined by both the physical and chemical characteristics of the material and particular features of the implant surface, such as the thickness of the oxide layer, microstructure and porosity. The surface of the dental implant should enhance firm attachment of the implant to junctional epithelium, soft connective tissue and bone.

The most common dental implant material is titanium, which is resistant to corrosion and has an elasticity modulus similar to that of bone. Initially, implant surgery induces an acute inflammatory response. This is followed by repair processes, resulting in wound healing.32 While dental treatment offers a high success rate, it is not without complications. The complications associated with implant placement can be classified on a chronological basis. They are:

- Early complications—resulting from surgical trauma, inadequate bone volume, a lack of primary stability, intrabony

Smoking and the Oral Cavity
Following lung cancer, the highest relative risks for cancer are observed for the larynx and oral cavity. A recent meta-analysis reported on 12 studies that estimated oral cancer risk in the U.S., Uruguay, Italy, Sweden, India, China, Taiwan and Korea. The reported pooled cancer risk estimate was 3.43-times higher in smokers compared with nonsmokers.19 Several lines of evidence indicate that oral cancers arise as a result of mutagenic events causing multiple molecular genetic events in several chromosomes and genes. Two main carcinogens present in tobacco smoke are benzo-pyrine and tobacco smoke-derived nitrosamines.20 Several potentially malignant disorders, particularly oral leukoplakia and erythroplakia, are known to be more prevalent in smokers, and a proportion of these transforms to cancer over a period of time.

The presence of epithelial dysplasia in pre-cancerous lesions is a hallmark for cancer development, and several studies from the U.S. and the U.K. have demonstrated significant associations with smoking in relation to oral epithelial dysplasia.20 Oral leukoplakia is the most common pre-cancerous lesion associated with tobacco use.20

Among smokers, an increase in plaque accumulation, a higher incidence of gingivitis and periodontitis, a higher rate of tooth loss and an increased resorption of the alveolar ridge have been found in the oral cavity.13 In addition, smoking has been reported to cause brown/black discoloration of teeth,21 dental restorations and dentures;22 alteration in taste and smell;23 association with coated tongue (black hairy tongue);24 and impairment and delay of wound healing after dento-alveolar surgical procedures, such as extraction and implantation.25 Furthermore, smokers are more susceptible to oral candidosis.26

What is Periodontal Disease?
Oral health is an essential component of health throughout life. Two major oral diseases, dental caries and periodontal diseases, are both ancient and widespread.27

The periodontal diseases are highly prevalent and can affect up to 90% of the worldwide population.28 Mild forms of periodontal disease affect 75% of adults in the United States; more severe forms affect 20% to 30% of adults.29 Gingivitis, the mildest form of periodontal disease, is caused by the bacterial biofilm (plaque) that accumulates on teeth adjacent to the gingiva. However, gingivitis does not affect the underlying supporting bony structures of the teeth and is reversible.28
infection or bacterial contamination of the receptor zone.

- Late complications—related to microbiological (peri-implantitis) and biomechanical changes and implant fractures (occlusal overload).

Reported predictors for implant success and failure are generally divided into patient-related factors (for example, general patient health, smoking habits, quantity and quality of bone, and oral hygiene maintenance); implant characteristics (for example, dimensions, coating and loading); implant location; and clinician experience.

Smoking produces an adverse effect on clinical periodontal variables and alveolar bone height and density, acting as a potential risk factor for alveolar bone loss, even at an early age with low tobacco consumption. These factors ultimately may cause tooth loss. When the treatment of choice is implantation, bone volume and density at an implant site are critical factors with respect to surgical protocol and osseointegration.

Studies have shown that smokers present with greater bone loss, attachment loss and mean probing depth when compared with nonsmokers.

**Smoking and Periodontal Disease**

The periodontal tissues in smokers are continuously exposed to nicotine and its metabolites due to deposition of nicotine on the root surface. At the same time, cotinine levels (metabolite of nicotine) are elevated in saliva and gingival cervicular fluid.

Research conducted among young army recruits found a higher prevalence of aggressive periodontitis among smokers, particularly the generalized form of the disease, which agrees with previous reports that found a positive relation between cigarette smoking and aggressive periodontitis.

During cigarette smoking, nearly 4,000 different gases and chemicals are released, among them, nitrogen, carbon monoxide, carbon dioxide, ammonia, hydrogen cyanide, benzene, nicotine, nornicotine, anatabine and anabasine. Nicotine, considered the addictive component of cigarette smoke, has been implicated in the pathogenesis of numerous diseases. Carbon monoxide has a stronger affinity for hemoglobin than oxygen, resulting in displacement of oxygen from the hemoglobin and a lower oxygen tension in tissues.

Cigarette smoking is likely to affect the composition of the microflora due to a decrease in oxygen tension in the periodontal pockets and may lead to a selection of anaerobic bacteria. The composition of bacterial plaque is not altered by smoking, but it has been observed that the host’s response to bacterial plaque is disturbed.

Tobacco smoking affects the humoral-mediated and the cell-mediated immunity of the host and this may increase susceptibility to periodontal disease. Antibody production is altered by smoking as well. The proliferation response of T-cells to antigens is decreased by long-term exposure to cigarette smoking.

Periodontal disease is influenced by genetic factors. There is some evidence that tobacco smoking may affect the genetically determined susceptibility for periodontal diseases. Typical signs of an inflammation, such as changes in gingival color, swelling of the marginal and papillary gingiva, an increase in gingival cervical fluid flow, as well as bleeding on gentle periodontal probing, are caused by alterations of the vascular system. The periodontal tissues are very well vascularized. In smokers, the clinical signs of inflammation and bleeding on probing are not as prominent as in nonsmokers.

The findings of decreased inflammation and reduced gingival cervical fluid volumes in smokers compared to nonsmokers suggest that smoking impairs gingival blood flow. Although smokers have significantly higher numbers of neutrophils, they have shown decreased chemotaxis, phagocytosis and adherence.

The mechanisms by which smoking compromises wound healing are hypothesized as the direct cutaneous vasocostrictive action of nicotine, hemoglobin and blood viscosity, excessive levels of carboxyhemoglobin in blood, compromised polymorphonuclear neutrophil (PMN) leukocyte function and increased platelet adhesiveness.

In addition, nicotine may have an effect on cellular protein synthesis and impair gingival fibroblast ability to adhere, thus impairing wound healing and/or exacerbating periodontal disease.

Cigarette smoke could have a cytotoxic effect on human gingival fibroblasts, which results in capacity loss for adhesion and proliferation. The consequences of this could be impaired maintenance, integrity and remodeling of the oral connective tissue.

Studies have shown that smokers present with greater bone loss, attachment loss and mean probing depth when compared with nonsmokers. Even after treatment, smokers were found to have a lesser reduction in periodontal depth and lesser clinical attachment gain compared to ex-smokers or nonsmokers. In a six-year longitudinal study, nonsmokers had approximately a 50% higher rate of improvement in probing depth and clinical attachment levels after periodontal therapy than smokers.

Grossi et al. (1995) showed that smokers present a higher probability of periodontal bone loss when compared with nonsmokers, showing a ratio of 3.25- and 7.28-times higher for light smokers and heavy smokers, respectively.

Smoking might produce an adverse effect on alveolar bone height and density. In vitro studies have shown decreased proliferation and impaired collagen synthesis in osteoblast-like cells.
exposed to high concentrations of cigarette smoke. Bone loss and lower basic bone levels may be associated with smoking even in patients with good oral hygiene.

In a study by Levin and Levine, measurements were taken in order to investigate the relationship between smoking and alveolar bone loss among young healthy adults. The results showed that smokers exhibited significantly lower bone height and density values than nonsmokers. Alveolar bone loss was positively correlated to the reported number of cigarettes smoked per day and number of smoking years. The effect of calcium and vitamin D supplementation, as measured by increases in urinary calcium/creatinine excretion, was lower in smokers than in nonsmokers. This may be due to reduced enteric absorption from impaired mesenteric blood flow in smokers. Parathyroid hormone levels also correlate negatively with smoking. Moreover, smoking is associated with increased concentrations of free radicals, which may contribute to bone resorption. There is evidence of smoking’s impact on bone metabolism, such as an increased secretion of the bone-resorbing factors PGE2 and IL1B.

Smoking and Dental Implants

The use of endosseous implants has increased over the past decade in certain edentulous situations. Bone grafts and sinus lift operations are also common and well-documented procedures done prior to dental implant placement. Bain and Moy assessed the various factors that predispose implants to failure in a group of 540 patients who received 2,194 Bränemark implants. The most significant factor was smoking.

In a retrospective cohort study, the risk factors for implant failure were determined by evaluating a total of 4,680 implants placed in 1,140 patients over a 21-year period, from 1982 to 2003. Most of the subjects were followed up over 20 years. Smoking was found to be a significant predictor of implant failure, with a relative risk of 1. Most of the failures occurred within the first year, with very few failing at a later time. Patients who disclosed a history of smoking had a failure rate of 20%. These failure rates were higher than the previously reported rates of 6.50% and 11.28% in smokers.

Implant failure can be classified as either early or late. Early implant failures occur in the first months following implant placement, while late implant failures occur after loading the implant. Most implant failures are identified at or before loading or during the first two years of service. This suggests that interference with the wound healing process following implant placement may be an important reason for implant failure. Heat, as well as toxic byproducts of cigarette smoking, such as nicotine, carbon monoxide and hydrogen cyanide, have been implicated as risk factors for impaired healing and, therefore, may contribute to early implant loss. Furthermore, cigarette smoking has been implicated in the reduction of bone density and increased peri-implant bone loss, both of which have been associated with late implant failures. Consequently, smoking may lower implant survival outcomes even after successful osseointegration has occurred.

DeLuca et al. found that smokers had a 1.69-times higher incidence of early implant failures compared to patients who had never smoked or stopped smoking at least one week prior to implant surgery. Therefore, it can be deduced that smoking decreases the possibility of successful osseointegration, with the suboptimal healing response that occurs in smokers leading to a higher incidence of early implant failure. Heat, as well as toxic byproducts of cigarette smoking, such as nicotine, carbon monoxide and hydrogen cyanide, have been implicated as risk factors for impaired healing and, therefore, may contribute to early implant loss. Furthermore, cigarette smoking has been implicated in the reduction of bone density and increased peri-implant bone loss, both of which have been associated with late implant failures. Consequently, smoking may lower implant survival outcomes even after successful osseointegration has occurred.

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The location of the implant also has a significant effect on failure rate. Implants placed within the maxilla experienced almost twice the failure rate of those placed in the mandible. It has been shown that the maxilla is more prone to the deleterious effect of smoking. Implants placed in the anterior mandible had the lowest failure rate of any location. Lindquist et al. compared alveolar marginal bone loss (MBL) around osseointegrated dental implants among smokers and nonsmokers. Among smokers who also had poor oral hy-
Smoking and Implant-related Surgeries

The most common bone augmentation procedures for dental implants include guided bone regeneration (GBR), sinus lift operation (SLO) and bone grafting. GBR is a common and well-described procedure for augmentation, with considerable long-term results. SLO has a predictable outcome as well, with an implant survival rate of over 90% for three to five years. It is considered a safe treatment modality, with only minor complications.

The use of autologous bone grafts with dental implants was originally described by Bränenmark et al. in 1975 and is now a well-accepted procedure in oral and maxillofacial rehabilitation.

Smoking adversely affects treatment outcome, as measured by gains in clinical attachment levels of intra-bony defects treated by regenerative therapy. Smokers, after rehabilitation of severely resorbed maxillae with and without bone grafts, have a higher implant failure rate.

Cigarette smoking is detrimental to implant osseointegration in grafted maxillary sinuses regardless of the number of cigarettes consumed.

Levin et al. found 23.1% complications following onlay bone grafts (OGB) in nonsmokers compared to 50% complications in smokers. Major complications were found in one-third of the operations in smokers, compared to 7.7% in the nonsmokers.

There was also a trend of relation between complications and past smoking. There was no relation between SLO complications and smoking habits, including intra- and postoperative complications.

Hwang and Wang defined smoking as a relative contraindication for dental implant placement, together with adolescence, aging, osteoporosis, diabetes, etc.

Smoking Cessation

In a study investigating the rates of tooth loss by smoking status, it was found that current cigarette smokers of either sex had significantly more missing teeth than never-smokers or former smokers. Former smokers and pipe or cigar smokers tended to have an intermediate number of missing teeth. Current male smokers had more teeth with calculus, but the differences in plaque, tooth mobility, filled and decayed teeth, and bleeding on probing by smoking history were not significant. Prospective observations of 248 women (mean follow-up time = 6 ± 2 years) and 977 men (mean = 18 ± 7 years) indicated that individuals who continued to smoke cigarettes had 2.4-fold (men) to 3.5-fold risk (women) of tooth loss compared with nonsmokers. The rates of tooth loss in men were significantly reduced after they quit smoking cigarettes but remained higher than those in nonsmokers. Men who smoked cigarettes had a 4.5-fold increased risk of edentulism; this risk also decreased upon smoking cessation. These findings indicate that the risk of tooth loss is greater among cigarette smokers than among nonsmokers. Smoking cessation significantly benefits an individual's likelihood of tooth retention, but it may take decades for the individual to return to the rate of tooth loss observed in nonsmokers.

Patients who quit smoking tend to have a reduction in the adverse effects of smoking on implant survival, but the length of the time after cessation that is necessary for a significant improvement has not been sufficiently investigated. It was found that no statistically significant difference appeared between complications and past smoking, which indicates that the risk of complications can be reduced up to the normal nonsmoker complication rate when smoking ceases. Numerous smoking cessation protocols have been proposed to improve the surgical outcome in smokers. However, the effect of short-term smoking cessation upon the risk of complicating tissue and wound healing or other complications of general surgery is still controversial.

Following a protocol of complete cessation for one week before and eight weeks after initial implant placement surgery, Bain showed that implant failure was significantly lower in the group that stopped smoking than in those who continued. Furthermore, the failure rate was not significantly higher in the group that stopped smoking than in nonsmokers over the same period. At the very least, smokers should be advised to follow a smoking cessation protocol, which is a logical step if we accept the fact that smoking has a detrimental effect on implant prognosis.

The initial recommendations by Bain and Moy suggest that long periods of abstinence are required. They suggested that the patient cease smoking at least one week prior to surgery to allow reversal of the increased levels of platelet adhesion and blood viscosity, as well as the shorter-term effects associated with nicotine. The patient should continue to avoid tobacco for at least two months after implant placement, by which time bone healing would have progressed to the osteoblastic phase and early osseointegration would have been established.

Conclusion

It is important to improve periodontal monitoring of young smokers and to advise them to discontinue this habit as a preventive measure. Dental professionals should be especially prepared to urge their young patients to quit smoking. Additionally, specific
information regarding the adverse effects of smoking should be given to medical and dental students. Cigarette smoking is considered an important risk factor for periodontal disease occurrence and progression.

In relation to implant surgery, careful explanation of the harmful effects of smoking and of the patient’s responsibilities in the attempt to achieve the best prognosis would ensure the best obtainable level of compliance; this would also cover the clinician in the event of implant failure in a noncompliant patient. Unfortunately, while some patients complete the protocol successfully and stay off smoking for several months, the vast majority return to smoking. It is left to the discretion of the clinician whether to undertake implant treatment in high-risk situations. But should the surgeon decide to go ahead, the patient’s fully informed consent is essential before proceeding.

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REFERENCES


Gene Therapy in Dentistry
A Review

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ABSTRACT
Gene therapy is an emerging field of biomedicine that has commanded considerable scientific and popular attention. Genes are specific sequences of bases that encode instructions to make proteins. When genes are altered so that encoded proteins are unable to carry out their normal functions, genetic disorders can result. Gene therapy essentially consists of introducing specific genetic material into target cells to compensate for abnormal genes or to make a beneficial protein without producing toxic effects on surrounding tissue. Transferred genes can be used for either reparative or pharmacological purposes. Applications of gene therapy to dental and oral problems illustrate the potential impact of this technology on dentistry. This review provides an update on transfer techniques and clinical implications of gene therapy in dentistry.

Gene therapy typically involves insertion of a functioning gene into cells to correct a cellular dysfunction or to provide a new cellular function. In the mid-1980s, the focus of gene therapy was entirely on treating diseases caused by single-gene defects. However, in the late 1980s and early 1990s, the concept of gene therapy was being increasingly considered for treatment of a number of acquired diseases. In 1995, the first potential impact of gene therapy on dentistry was described. In 2000, the first report of a fully successful gene therapy treatment—a French study involving a severe combined immunodeficiency in young children—was published.

In the past six years, remarkable progress has been made in the field of gene therapy, including seven areas relevant to dental practice. They are: bone repair; salivary glands; autoimmune disease; pain; DNA vaccinations; keratinocytes; and cancer. While considerable problems remain, thus impeding the routine clinical use of gene transfer, gene therapy will have a pervasive and significant impact on areas of dental practice that are based in biological science.

There are two general ways to transfer genes. A gene that is inserted directly into a cell usually does not function. Instead, a carrier called a vector is used to introduce the therapeutic gene into the patient’s target cells. The most common vector is a virus that has been genetically altered to carry normal human DNA. Viral vectors typically are highly efficient for gene transfer in vivo, but they can pose a significant safety risk. Gene transfer mediated by viral vectors is referred to as transduction. Nonviral methods, while much safer for the host, at present are relatively inefficient for gene transfer in vivo. Gene transfer mediated by nonviral vectors is referred to as transfection.
The major problems hindering gene transfer applications are biological, resulting from limitations in our knowledge of the essential components involved in the process. These include inadequate understanding of virus biology, recombinant vector interactions with different cell types and the targeted diseases.5

Some of the different types of viruses used as vectors in gene therapy include:3

- Retroviruses (e.g., HIV)—A class of viruses that can create double-stranded DNA copies of their RNA genomes. These copies of the virus’s genome can be integrated into the chromosomes of host cells.
- Adenoviruses—A class of viruses with double-stranded DNA genomes; they cause respiratory, intestinal and eye infections in humans.
- Adeno-associated viruses—A class of small, single-stranded DNA viruses that can insert their genetic material at a specific site on chromosome 19.
- Herpes simplex viruses—A class of double-stranded viruses that can infect a particular cell type, i.e., neurons.

Besides viruses-mediated gene-delivery systems, there are several nonviral options for gene delivery. The simplest method is the direct introduction of therapeutic DNA into target cells. This technique has restricted use, as it requires large amounts of DNA to bring out the desired effect.

Another nonviral approach involves creation of an artificial lipid sphere (a liposome) with an aqueous core. This liposome, which carries the therapeutic DNA, is capable of transporting the DNA through the target cell’s membrane. Therapeutic DNA can also be introduced into target cells by chemically linking the DNA to a molecule that will bind to special cell receptors. Once bound to these receptors, the therapeutic DNA constructs are engulfed by the cell membrane and passed into the interior of the target cell. This delivery system, however, tends to be less effective than the other options.4

Experiments with the introduction of a 47th chromosome (an artificial, human techno-chromosome) into target cells are being carried out. This chromosome would exist autonomously alongside the standard 46 without affecting functions or causing mutations. It would be a large vector capable of carrying substantial amounts of genetic code and, because of its construction and autonomy, the body’s immune system would not attack it. A disadvantage with this potential method is the difficulty in delivering such a large molecule into the nucleus of a target cell.3

Implications of Gene Therapy in Dentistry

Salivary Glands
A gene therapy treatment for salivary glands (SG) involves transfer of a new gene via retroductal cannulation of the main excretory ducts of a major SG. This could lead to the production of a cellular therapeutic protein6,7 or to a secretion either in saliva or in the bloodstream.8,9 Cannulation of the main excretory ducts of major SGs is a fairly simple procedure that is used for contrast radiography (sialograms). This is a very effective delivery method, because virtually all the epithelial cells in SGs are continuous with the duct system. Since SGs in humans are encapsulated organs, vectors delivered through the ductal system are limited in reaching other organs or the bloodstream.1

A variety of genes used for salivary glands are genes-encoding hormones (growth hormone, insulin),10,11 an antimicrobial agent (histatin 3, or H3),12 membrane proteins (aquaporin-1 and aquaporin-5),13,14 a transcription factor (E2F-1),15 protease inhibitors (1-antitrypsin and kallikrein),16 a protein-affecting apoptosis (Fas ligand)17 and several nonmammalian “reporter proteins” (β-galactosidase, chloramphenicol transferase and luciferase).18,19,20

Transferring genes to salivary glands can correct systemic single-protein disorders. Since 1995, it was demonstrated in rats that transgene products could be secreted from salivary glands into the bloodstream—in other words, endocrine secretion.21 When an adenovirus-encoding human growth hormone, or hGH, was administered to adult rat salivary glands, serum hGH increased from background levels to ~16 nanograms per milliliter, well above the level considered therapeutic in humans: ~5 ng/mL.10 Importantly, these hGH levels induced serological responses indicative of systemic activity (increased insulin-like growth factor 1, triglycerides and blood urea nitrogen: creatinine ratio). Subsequently, this showed that it is efficient clinically that the direction (whether endocrine or exocrine) of transgene product secretion must be controllable.22 A research group at NIDCR23 reported that administration of the immunomodulatory drug hydroxychloroquine dramatically increases the efficiency of hGH endocrine secretion from rat submandibular glands.

Autoimmune Disorders
Sjögren’s syndrome (SS) is an autoimmune disease that leads to the destruction of salivary gland tissue and a marked reduction in salivary flow. SS is characterized by a focal mononuclear cell infiltrate in the salivary and lacrimal glands.24 This chronic inflammation and the consequent secretion of proinflammatory cytokines are associated with dry mouth (xerostomia—often with a marked increase in dental caries) and dry eyes (keratoconjunctivitis sicca). The gene transfer application of immune modulation appears to have potential for treatment of autoimmune diseases.

The cellular infiltrates in SS consist mainly of CD4+ cells, which show divergence into T helper 1 and T helper 2, or Th1 and Th2 subsets. Th1 cells are associated with cell-mediated immunity, producing cytokines, such as interleukin 2, or IL-2; interferon or INF-γ; and tumor necrosis factor, or TNF-α. Th2 cells produce IL-4, IL-6 and IL-10 and are associated with humoral immune responses. The Th1 cell subset induces inflammation; Th1-
related cytokines are likely to stimulate cytologic T cell processes within the gland. Th2-related cytokines tend to cause a decrease in inflammation.\textsuperscript{25} This situation gives rise to a general paradigm that has emerged for developing novel protein-based and, more recently, gene-based treatments for several autoimmune diseases, including SS. This strategy, which we use, is that biological factors that enhance Th2 functions and suppress Th1 cells likely will be efficacious for therapy.\textsuperscript{26} The transfer of genes-encoding anti-inflammatory cytokines, such as Interleukin -10 (IL10) or Vasoactive intestinal peptide (VIP), could lead to a decrease in the expression of proinflammatory cytokines and, thus, protect SGs and preserve their secretory function.\textsuperscript{27}

**Bone Repair**

Studies by researchers at the University of Michigan School of Dentistry have used ex vivo methods to transfer genes-encoding bone morphogenetic proteins, or BMPs.\textsuperscript{28,29} BMPs are well-established agents in the induction of both orthotopic and ectopic bone formation. In ex vivo studies, researchers accomplish the actual gene transfer in a tissue culture environment and then place the transduced cells, carrying the foreign genes, back into the host. Other recent studies conducted by researchers have used mesenchymal stem cell–mediated gene therapy for bone regeneration. Genetically engineered mesenchymal stem cells expressing BMP-2 induced increased formation of new blood vessels, as well as new bone.\textsuperscript{30,31}

A recent investigation by Alden and colleagues\textsuperscript{32} demonstrated that it is possible to directly deliver the BMP-2 gene in vivo to tissue via an adenoviral vector (vs. using ex vivo cellular re-engineering) and thus achieve healing of mandibular osseous defects. Another group at the University of Michigan reported transfer of the platelet-derived growth factor gene to periodontal cells, which resulted in DNA synthesis and cellular proliferation.\textsuperscript{33}

**Pain**

Gene transfer may be particularly useful for managing chronic and intractable pain.\textsuperscript{34} Several studies in animal models have shown that viral-mediated transfer of genes-encoding opiate peptides to peripheral and central neurons can lead to antinociceptive effects. There is a report also from the University of Rochester in New York showing the feasibility of direct gene delivery to the articular surface of the temporomandibular joint by using feline immunodeficiency viral vectors, FIV (lacZ). Considerably more research is needed before gene transfer can be tested clinically as a strategy for chronic pain management.

**DNA Vaccinations**

DNA vaccination can be done by directly delivering DNA in a plasmid vs. the traditional administration of a purified protein or an attenuated microbe.\textsuperscript{4} Kawabata and colleagues in 1999 used plasmid DNA encoding the *Porphyromonas gingivalis* fimbrial gene in animals. This gene led to the production of fimbrial protein locally in the salivary gland tissue of mice, with the consequent production of specific salivary immunoglobulin A and immunoglobulin G antibodies and serum IgG antibodies. Although it was not shown in their report, one might expect that the secretory IgA secreted in saliva could neutralize *P. gingivalis* and limit its ability to participate in plaque formation. Furthermore, any secreted fimbrial protein in saliva could bind to pellicle components and also inhibit the attachment of *P. gingivalis* to the developing plaque. Although applications of DNA vaccination are in the earliest stages of use with oropharyngeal tissues, it seems reasonable to suggest that these approaches will play a role in future strategies for preventing periodontal diseases and dental caries.\textsuperscript{35}

**Gene Therapy for Oral Cancer**

**Gene Addition Therapy**

Cancer cells generally demonstrate impaired cell-cycle progression, largely due to mutations and the overexpression of cell-cycle regulators. Several genetic alterations have been described in oral cancer, including mutations of p53, the retinoblastoma gene (RB1), p16 and p21.\textsuperscript{26} The most extensively studied mutations in oral cancer are those of p53. Since the protein p53 plays a role in cell-cycle regulation and in apoptosis, p53 gene transfer was initially tested in squamous cell carcinoma patients by injecting the primary or regional tumor with an adenoviral vector-expressing wild-type p53. Adenoviral p53 (Ad-p53) was demonstrated to be safe and well tolerated. Several randomized studies of adenoviral p53 are underway in patients with squamous cell carcinoma to determine its role as a surgical adjuvant and in combination with DNA-damaging agents.\textsuperscript{37}

**Antisense RNA and Ribozymes**

Gene expression can usually be inhibited by RNA that is complementary to the strand of DNA expressing the gene. This “antisense” RNA can prevent the activity of several known oncopgenes, including myc, fos and ras, and can inhibit viruses such as HSV-1, HPV and HTLV-1.\textsuperscript{38}

Bertrand et al. observed inhibition of tumor growth in xenograft models of oral cancer with systemic administration of EGFR antisense DNA. The ability of gene-specific, double-stranded RNA to trigger the degradation of homologous cellular RNAs is known as RNA interference (RNAi). Small, interfering RNAs (siRNAs) mediate mRNA degradation in the process of RNAi and have been shown to be potentially more effective than antisense RNA, likely due to enhanced resistance of siRNAs to nuclease degradation.\textsuperscript{59}

**Immunotherapy**

The immunologic gene therapy approach to oral cancer involves either increasing the immunogenic potential of tumor cells or augmenting the patient’s immune response to a tumor. Patients with squamous cell carcinoma of the head and neck demonstrate
deficient function of several categories of immune cells, including natural killer cells, T-lymphocytes and several cytokines. Studies in pre-clinical animal models have included administration of interleukin-2 (IL-2)-activated lymphokine-activated killer (LAK) cells, tumor necrosis factor-alpha (TNF-) and immunomodulatory gene therapy with IL-2, IL-4, interferon-gamma (IFN-), IFN- and granulocyte-macrophage colony-stimulating factor (GM-CSF); IL-6 had enhanced killer cell-mediated cytotoxic effects. The feasibility and efficacy of combination non-viral lipid-formulated murine interleukin 2 (mIL-2) and polymer-formulated murine interleukin 12 (mIL-12) gene therapy for squamous cell carcinoma have been investigated in pre-clinical models. The use of combined mIL-2 and mIL-12 gene therapy resulted in significant anti-tumor effects, most likely due to increased activation of cytolytic T-lymphocyte and natural killer cells.

**Suicide Gene Therapy**

“Suicide” gene therapy involves introduction of a gene into a cell that enables a prodrug to be activated into an active cytotoxic drug. The most extensively studied approach utilizes herpes simplex virus-thymidine kinase (HSV-TK). This gene encodes a viral enzyme that phosphorylates ganciclovir into a monophosphate form, which is then further phosphorylated by intracellular enzymes into an active triphosphate compound that terminates DNA synthesis. Thus, this system selectively targets actively dividing cancer cells.

**Replicating Viruses That Destroy Tumor Cells**

A novel approach to gene therapy that has been evaluated extensively in pre-clinical and clinical studies for squamous cell carcinoma involves a vector that selectively replicates within and lyses tumor cells. An E1B 55kD gene-deleted adenovirus, ONYX-015 (d11520), has been developed for the treatment of tumors lacking p53 function. Since the E1B 55kD gene product is responsible for p53 binding and inactivation, it has been hypothesized that an E1B 55kD deletion mutant would be unable to inactivate p53 in normal cells and would, thus, be unable to replicate efficiently. In contrast, cancer cells lacking functional p53 (e.g., due to gene mutation) would hypothetically be sensitive to viral replication and subsequent cytopathic effects. Animal studies with ONYX-015 have also suggested that the efficacy of the virus is significantly augmented with the administration of standard chemotherapeutic agents. ONYX-015 can be administered safely via intra-tumoral injection to patients with recurrent/refractory squamous cell carcinoma. However, evidence of only modest anti-tumoral activity has been detected when this approach to gene therapy was used alone. In a Phase II trial of a combination of intra-tumoral ONYX-015 injection with cisplatin and 5-fluorouracil in patients with recurrent squamous cell cancer of the head and neck, there were substantial objective responses, including a high proportion of complete responses. By six months, none of
the responding tumors had progressed, whereas all non-injected tumors treated with chemotherapy alone had progressed. Tumor biopsies obtained after treatment showed tumor-selective viral replication and necrosis induction, although there was no apparent correlation between p53 mutational status in the tumor and clinical response. These results suggest the lack of a bystander effect and underscore the importance of developing agents for systemic administration. 42

Conclusion
Gene therapy is having a pervasive and significant impact on areas related to science-based dental practice. Gene therapy represents a new and innovative approach to the treatment of many oral diseases. Further investigation is warranted to establish safe and effective approaches that utilize gene therapy for the prevention and treatment of oral diseases. 43

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Aloe Vera as Cure for Lichen Planus


ABSTRACT

Oral lichen planus is a difficult condition to treat because of its chronic nature. Various treatment modalities have resulted in partial regression of symptoms but not a complete cure. Aloe vera, a product with minimal adverse effects, can be tried to treat this disorder. A 38-year-old male patient diagnosed with lichen planus of the skin and the oral mucosa was suffering from severe pain and a burning sensation intraorally and pruritus of the skin lesions. Considering the extensive involvement, an herbal alternative was considered. The patient was prescribed aloe vera juice and gel application for two months. At the nine-month follow-up, the patient was symptom-free and totally cured of the intraoral and skin lesions.

Oral lichen planus (OLP) is a common disease affecting approximately 1% to 2% of the population. Cutaneous lesions develop in approximately 15% of patients with OLP. The usual presentation is either in the reticular or erosive forms; the papular form is rarely seen. This form presents as multiple, small white pinpoint papules of the oral mucosa approximately 0.5 mm in size. The treatment of lichen planus can be prolonged due to the nature of the lesion, with periods of waxing and waning of symptoms. The various treatment modalities used so far in ameliorating the symptoms of OLP include corticosteroid topical and systemic therapy, retinoids, calcineurin inhibitors and ultraviolet phototherapy. In contrast to the above-mentioned therapies, aloe vera is an entity with minimum documented side effects, most notably, burning sensation, eczema in a few hypersensitive individuals and allergic dermatitis. Patients with extensive oral and skin involvement can be good candidates for the use of aloe vera juice and gel, considering the low toxicity profile and varied beneficial effects.

Herein we report a case of papular and reticular OLP with cutaneous involvement treated with aloe vera juice and gel application.

Case Report

A 38-year-old male patient visited the department of Oral Medicine and Radiology with a chief complaint of a burning sensation and pain in the mouth for 15 to 20 days. The patient gave a history of sudden onset of symptoms and difficulty opening his mouth. This was preceded by the occurrence of multiple small white boils on the inner side of the cheeks and tongue, which gradually turned into flat white patches. The patient had a habit of smoking three to four cigarettes a day and consuming alcohol once a week for 20 years.

On general physical examination, two irregularly shaped purplish macules were seen on the left and right clavicular region, the
skin behind the left ear (Figure 1), and on the extensor surfaces of the hands and feet. The patient reported these lesions to be extremely pruritic. Intraoral examination revealed multiple, small pinpoint white papules scattered all over the left and right buccal mucosa and sparsely over the tongue (Figures 2, 3, 4) and hard palate. The ventral surface of the tongue presented with reticular, lace-like white striae, also involving the floor of the mouth. The lesions were smooth and tender on palpation.

A provisional diagnosis of lichen planus was given, considering the clinical features exhibited by the patient. An incisional biopsy was performed from the left buccal mucosa that confirmed the diagnosis. As there was significant, widespread distribution of oral and skin lesions, an herbal option of treatment was explored. The patient was advised to take 30 ml of aloe vera juice in the morning on an empty stomach and at night before bedtime. He was asked to swish the juice for about one minute in the mouth, then swallow, and to apply the aloe vera gel intraorally to the left and right buccal mucosa and ventral surface of the tongue twice daily for two months.

For the initial two weeks, the patient reported no improvement in the burning sensation and pain. After this, the patient reported a slight reduction in the burning sensation. At the end of one month, there was complete cessation of the burning sensation and pain, and the lesion showed partial regression. After obtaining symptomatic relief, the patient discontinued the aloe vera treatment and did not return for follow-up at two months. The patient was reviewed after nine months and showed complete healing of the skin and oral lesions and has remained symptom-free for the subsequent nine months (Figures 5, 6, 7, 8).

Discussion
Lichen planus is a chronic inflammatory disorder involving the skin and the oral mucosa. Despite advances in science that have helped to elaborate the etiopathogenesis of this disorder, no definite cure has been discovered. Considering the chronic nature of the disease, any treatment used should aim at having minimal side effects.

Of the conventional treatment modalities used for OLP, topical steroids are considered to be the first choice. The treatment success with midpotency corticosteroids and fluorinated corticosteroids has been in the range of 30% to 100%. The various side effects of short-term systemic steroid therapy include insomnia, diarrhea, psychotic episodes, sodium and water retention, muscular weakness, increased susceptibility to infection, hypertension, hyperglycemia and adrenal suppression. Topical retinoids are an effective alternative treatment modality for OLP, especially when lichen planus is associated with mild dysplasia. The use of systemic retinoids is associated with severe side effects and, hence, their routine use in the management of OLP is avoided.

Cyclosporine is an immunosuppressant drug and inhibits the proliferation and function of T lymphocytes and the release of interleukin 1 and 2. The primary side effect of use is a transient burning sensation; the main adverse reaction is renal dys-
function. The main limiting factor for use of cyclosporine is its high cost.2,6

Tacrolimus is another potent immunosuppressive agent that can be used in the management of recalcitrant OLP. However, there is a black box warning by the FDA stating that the use of this agent can cause an increased risk for the development of malignancy in psoriasis. Hence, caution should be exercised in its use.3 PUVA therapy includes administration of 8-methoxypsoralen and exposure to long wave ultraviolet A light.7 Some of the side effects include nausea, dizziness, headache and paresthesia.8 A serious drawback is the potential for development of squamous cell carcinoma.6

Aloe vera has been in use for the past 2,000 years, with no major adverse events documented.9 It is a plant belonging to the Liliaceae family.10,11 Among the approximately 400 species only two, namely A. barbadensis and A. aborescens, are used commercially.10 The aloe barbadensis comprises two parts: the inner portion of the leaves parenchymal tissue; and specialized cells known as pericyclic tubules. Aloe vera has been found to contain 75 active constituents, such as vitamins, minerals, enzymes, sugars, amino acids, etc.12 The proposed actions of aloe vera include moisturizing properties, anti-inflammatory, antibacterial, antiviral, antifungal, wound healing and pain relief.11 The various conditions in which aloe vera have been tried and claimed to be effective include asthma, arthritis, candidiasis, digestive and bowel disorders, skin disorders,12 ulcer-like recurrent aphthae, extraction sites to prevent alveolar osteitis, lichen planus,11 etc.

A randomized controlled trial reported in 1996 on the efficacy of aloe vera extract in a hydrophilic cream in psoriasis vulgaris states that aloe vera was found to be significantly more effective than a placebo in reducing the psoriatic plaques, with no toxic effects.13 A 1999 systematic review included 10 well-documented clinical trials using aloe vera mono preparations. In summary, it states that aloe vera was effective in reducing blood glucose levels in diabetic patients and in lowering lipid levels in hyperlipidemic patients. Topical use was also effective in genital herpes and psoriasis but not in radiation-induced skin damage or wound healing.12 A 2005 review of aloe vera suggests its uses in dentistry in treating aphthous ulcers, alveolar osteitis, lichen planus and as a denture adhesive.11

A randomized controlled trial reported in 2008, conducted to determine the efficacy of aloe vera gel in the treatment of OLP, suggests that aloe vera gel was significantly more effective than a placebo in inducing clinical and symptomatic improvement in OLP patients.14 The safety of aloe vera has been unquestioned due to the lack of substantial documentation of any major adverse reaction. As these products are natural, they are perceived to be harmless. But as shown by a case series in 2010, three female patients, aged 55, 62 and 57, were reported to suffer from aloe-induced acute hepatitis.15 The literature on adverse effects has been sparse and anecdotal; hence, the safety of aloe vera needs to be tested stringently considering the upsurge in herbal supplements. A trial recently reported in 2011 comparing the efficacy of aloe vera mouthwash with 0.1% triamcinolone acetonide in
OLP showed healing in 74% of the aloe group patients and 78% among the triamcinolone acetonide patients. This study suggests aloe vera is an effective substitute in the management of OLP.16

Conclusion
To the best of our knowledge, only one case report so far has documented the efficacy of aloe vera in the treatment of lichen planus.9 In conclusion, the authors wish to state that alternative therapies with evidence of effectiveness in oral lesions should be tried and their effects described, as every new case reported provides valuable information to the existing literature. 

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REFERENCES