**17 New York State Dental Establishments and Dentists: 2007-2012**  
Economic Survey  
H. Barry Waldman, D.D.S., M.P.H., Ph.D.; Steven P. Perlman, D.D.S., MScD, DHL (Hon)  
A comparison of dental economic data for the period that encompassed the “Great Recession” details the general economic difficulties faced by the dental profession during this period.

**21 Prevention of Alveolar Osteitis**  
Gabriela Jude Fernandes, B.D.S., M.S.; Michael N. Hatton, D.D.S., M.S.  
Alveolar osteitis, or dry socket, is a frustrating complication of exodontia, especially in the posterior mandible. A novel technique for its possible prevention is described.  
*Case report and review of literature.*

**26 A Multidisciplinary Approach for Managing Severely Malaligned Lower Molars**  
David Keinan, D.M.D., M.Sc., M.H.A., Ph.D.; Galit Birnboim-Blau, DMD MSc; Mariel Webber, D.D.S.  
In clinical cases of two impacted molars, it may be beneficial for the patient to save at least one molar. This can be achieved by orthodontic alignment of one of the molars, while extracting the other. The decision should be based upon prognosis and risks for each procedure and for both teeth.  
*Case report.*

**31 The Anterior Double-Tilt Precision Attachment Case for Cleft Palate Patients and Accident Victims**  
Edward Feinberg, D.M.D.  
Cleft palate patients and accident victims with poor or non-existent edentulous ridges have difficulty retaining a denture, so preservation of the existing dentition is essential for comfort and function. The anterior double-tilt precision attachment is a great option, as it does not apply destructive forces to abutment teeth and can last decades with minimal maintenance.  
*Case reports.*

**36 Diagnosing Juvenile Recurrent Parotitis**  
Diagnosis of juvenile recurrent parotitis is based upon clinical symptomatology, because no positive serologic signs have been identified. Objective confirmation is best obtained from sialographic or ultrasound studies.  
*Case reports.*

**40 Management of Traumatized Permanent Incisors**  
Revascularization and Delayed Replantation  
Maryam Gharechahi; Shiva Shojaeian  
Clinical description of successful revascularization treatment of right necrotic immature upper incisor and delayed replantation of left one. After 18 months, radiolucent lesions in periapical areas of both maxillary central incisors had healed, and root apex development was noted with thickening of walls in tooth #8.
Amateur Dentists

For all it has done to benefit society, the Internet has also complicated the practice of dentistry by turning patients into treatment "experts."

I saw a humorous meme on Facebook that I thought summed up very well how the Internet can make “experts” of us all in areas we know nothing about. It was a picture of a coffee cup. On the side was written the following message: “Please don’t confuse your Google search with my medical degree.” It’s funny, because it’s true.

How many times have you been confronted by a patient who knows everything about dentistry and doesn’t hesitate to tell you why your treatment is wrong for his or her problem? I have seen this many times in my practice. I present a treatment plan that I feel is best for the individual. The patient will argue with me because of something he or she read on a website. My treatment, it seems, doesn’t follow the patient’s preconceived notion of what must be done, a notion that came from something found on the Internet. And if it was on the Internet, it must be true!

The Internet is a wonderful tool. It opens many doors and provides us with information, right at our fingertips. How often do you need to know the answer to a question and someone says, “Google it?” When you do, you get so many answers, your mind wants to explode—talk about information overload; the Internet is information overload on steroids. If you can’t filter the true from the false, you can get into trouble quickly. This is what happens to our patients. They can’t differentiate what is true from what is false, because they don’t have the necessary knowledge.

That’s where our education takes over and our opinions should matter most. After all, we did pursue a career in health care and invested a great deal of time and money learning all we know. And most of us have done that without the Internet. Amazing!

Diagnosis and treatment planning, not to mention providing actual treatment, is something that should be left to those most qualified to provide it. When Internet-educated patients come in for treatment, armed with information about their problems gleaned from various websites, it can be very frustrating. We must educate our patients about dentistry. We must teach them about their particular problems and solutions. When they sit in our office, brimming with Internet data, we must not become confrontational, even though we may want to react that way.

You may remember “House,” the television show about a doctor with a terrible bedside manner. He spoke sarcastically to patients, particularly when patients questioned his knowledge and advice. When residents suggested a course of treatment that differed from his, he berated them for having the temerity to question him, the great doctor. There have been many times I have wished I could go “House” on people. But that doesn’t work. All it does is put a wall between you and your patient, creating a conflict that may never be resolved.

My advice is to approach the situation calmly. Explain in the most diplomatic way possible why
what the patient read on the Internet may not be good advice in this particular situation. Try to resolve the conflict without any animosity arising between the two of you. Swallow your sarcastic barbs, even if they will make you feel better. You have the education and training to do what is best for the patient. Convince the patient of this and you will have a patient for life and a good will ambassador for your practice.

In this day of increased competition and diminishing trips to the dentist by adults, we must do everything in our power to educate the public about dentistry. The only way we can do that is to counter the misinformation appearing on the web with information that is true and accurate. When a patient comes in to have all his or her old amalgam fillings removed because he or she read on the Internet that dental amalgams cause all sorts of diseases, it is our duty as health professionals to provide them with the truth about amalgam fillings and to disabuse them of the false knowledge they have gleaned from surfing the net.

The next time a patient confronts you with theories from the Internet about dentistry and “proper” treatment, listen. Once the patient has had his or her say, explain in a calm, professional manner why you don’t think the opinion expressed on the website is factual. Explain why the treatment you suggest is the correct approach and why the advice obtained online is fraught with danger. If you can be supportive in your explanations, I’m sure the patient will be convinced by your arguments. If nothing else, the patient will know you are a caring health professional with only his or her best interests at heart.

If you can’t convince the patient of your point of view, you really haven’t lost anything. If you did this in a calm, collegial manner, at least the patient won’t be mad or upset with you, and your reputation as a kind, caring dentist remains intact. And, at the end of the day, isn’t that what we all want? To be respected and acknowledged for our caring attitudes toward our patients and for watching out for their best interests?

LETTERS

Let’s Be Proactive
As a 1989 graduate of Buffalo, I know Dr. Hanley well. I’m responding to his editorial in the November Journal, “Roadblocks to Licensure.” Yes, debt is the new graduate’s biggest problem. It is also the dental profession’s biggest problem, as it leads to money-related treatment decisions instead of solid, evidence-based decisions. Our ethics take a hit; and our morals go down the tubes—not what the profession needs.

A wise man once said, “Anything worth having should not be easy.” I disagree that we should make it as easy as possible for students to get their credentials. Yes, graduation should be enough, but as we know, there have been some very shocking pass rates from certain schools within New York State. And those students should not receive a pass just because they graduated.

The curriculum integrated format, or CIF, is a great idea. It’s time to be proactive not reactive when it comes to these topics.

Thanks for your article, Kevin.

Peter T. Clement, D.D.S.
Rochester, NY
Every five years a series of studies is carried out by the Census Bureau which provides an opportunity to review the basic economic well-being of the many industries at the national, state and county levels. A comparison of dental economic data from the 2007 and 2012 studies for the period that encompassed the 2007-2009 “Great Recession” details the general economic difficulties faced by the dental profession during this period.

A study of the dramatic changes between 2006 and 2013 in New York State population and dental practitioner numbers were documented in an earlier review in The NYSDJ:¹

"Most of upstate New York continues to lose people... Although New York State grew by 87,093 people in the 15 months after the 2010 census, 37 upstate counties lost population, according to new U.S. Census Bureau population estimates."²

"Despite decreases in the population for 49 of the 62 counties in New York State between 2006 and 2013, the number of dentists increased in 52 counties... (this was) a change in landscape from 2000 to 2006, when the number of dentists decreased in 27 counties."¹

"During the period between 2006 and 2013, there was an overall increase of 1,216 licensed and registered dentists in the State; including 502 in New York City and 714 in the rest of the state."¹

However, during the years between 2006 and 2013 (the recent recession lasted from December 2007 to June 2009), there were dramatic changes in the finances of the country, which, in turn, had profound effects upon the economics of dental practices. In addition, there has been concern regarding the “graying” of communities as a result of the “flight of young adults” from so many upstate counties.¹

Based upon information available in 2013, the earlier evaluation was carried out and considered whether county population finances were a major factor affecting the numbers of dentists in New York State counties. The review indicated that, in 2012, there were small differences between many of the counties. For example, in 2012, the range of per capita median incomes of individuals 15 years of age and older in New York State counties was limited in many of the counties. Forty-eight counties (80% of the counties for which data were available) had a relatively similar per capita median income, between $21,000 and $28,000.

- Bronx County: $19,000.
- 48 counties between $21,000 and $28,000.
- 7 counties between $30,000 and $34,000 (Orange, Albany, Dutchess, Rensselaer, Rockland, Saratoga and Richmond).
- 4 counties between $36,000 and $39,000 (Suffolk, Westchester, Nassau and Putnam).
- New York County (Manhattan): $41,000.³

More recent information now available for business receipts for dental establishments at the state and county levels provides an opportunity to consider economic factors and dental practice...
from another perspective. However, the number of dentists per establishment is not reported.

**Method**

**Business receipt studies:** The Census Bureau carries out a business receipt survey of establishments every five years (in years ending in 7 and 2—e.g., 2007 and 2012—with reports published two and three years after the survey). These reports were used to consider the economic developments of dental practices in New York State and its counties.

The business receipt data are reported by the Census Bureau on a countywide basis for all dental establishments. The countywide data were divided by the number of dental establishments to develop the estimated average county dental establishment business receipt data. The countywide business data were divided by the number of dentists in the county to develop the average business receipt data per dentist by county. (3)

**Consumer Price Index (CPI):** A measure that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food and medical care. The CPI is calculated by taking price changes for each item in the predetermined basket of goods and averaging them; the goods are weighted according to their importance. Changes in CPI are used to assess price changes associated with the cost of living. The CPI for dental services is specific to the price changes for this service. For comparison basis, 1982-84 = 100 is used as the standard figure. The dental CPI for 2007 is 358.4; for 2012 it is 417.5. “Current dollars” represent actual costs at a particular period; “standard dollars” represent the comparative costs based upon the CPI for inflationary factors.

### Findings

**National:** In the United States, between 2007 and 2012, there was an increase of 6,137 dental establishments that were subject to federal taxes and had employees.

- Current dollar business receipts per establishment increased. However, standard dollar business receipts (removing the effects of inflation) decreased.
- Current dollar annual salary per employee (including dentists) increased. However, standard dollar annual salary per employee decreased (removing the effects of inflation) (Table 1).

**New York State:** Despite an increase in the number of dentists in 52 New York State counties (between 2006 and 2013), there was a decrease in 27 counties in the number of dental establishments (between 2005 and 2012). This “inconsistency” may reflect an increase in the number of establishments with more than one dentist. (This information is not provided by the Census Bureau.) Between 2007 and 2012, the number of dental establishments increased in 25 counties and remained unchanged in 10 counties (Table 2). In line with developments at the national level, between 2007 and 2012:

- Current dollar business receipts per establishment increased. However, standard dollar business receipts decreased (removing the effects of inflation), i.e., increases in business receipts did not keep pace with the rate of inflation.
- Current dollar annual salary per employee (including dentists) increased. However, standard dollar annual salary per employee decreased (removing the effects of inflation), i.e., increases in salary did not keep pace with the rate of inflation (Table 1).

**Findings**

### TABLE 1.


<table>
<thead>
<tr>
<th></th>
<th>United States</th>
<th>New York State</th>
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<tbody>
<tr>
<td></td>
<td>2007</td>
<td>2012</td>
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<tr>
<td>Total number of establishments</td>
<td>127,057</td>
<td>133,194</td>
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<td>Total business receipts</td>
<td>$93,930,384,000</td>
<td>$104,553,614,000</td>
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<td>Dental CPI</td>
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<td>$787,975</td>
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<td>Business receipts per establishment (standard dollars)</td>
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<td>417.5</td>
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<td>Business receipts per establishment (current dollars)</td>
<td>$206,271</td>
<td>$188,736</td>
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<td>Total number of establishments</td>
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<td>$5,540,449,000</td>
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<td>Business receipts per establishment (standard dollars)</td>
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<tr>
<td>Business receipts per establishment (current dollars)</td>
<td>$187,775</td>
<td>$169,103</td>
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</table>

### Table 1 Notes:

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

2. In order to protect the privacy of individuals, establishments and other reasons (not listed), the 2007 receipt data were not reported for four counties (Schuyler County—4 dental establishments; Warren County—37 dental establishments; Washington County—10 dental establishments; Yates County—2 dental establishments). Similarly, in 2012, receipt data were not reported for two counties (Orleans County—7 dental establishments and Yates County—2 dental establishments). The lack of information for these counties was recognized in the development of statewide estimated averages. In addition, in 2007 and 2012, Hamilton County did not have any dental establishments.

3. “County location reflects the licensee’s primary mailing address on record with the Office of the Professions; the address is not necessarily the licensee’s practice address. Although licensees must be registered to use the professional title or to practice within New York State, being registered does not mean the licensee is actively doing so.”

4. The number of registered dentists does not include the numbers of licensed individuals who are registered but are not located in New York State (2,908 dentists).

5. These reports were used to consider the economic developments of dental practices in New York State and its counties.

6. The number of registered but are not located in New York State (2,908 dentists).

7. “Current dollars” represent actual costs at a particular period; “standard dollars” represent the comparative costs based upon the CPI for inflationary factors.
Comparison between New York State and the United States:
- In 2007 and 2012, New York State average business receipts per dental establishment were lower than the national level.
- In 2007 and 2012, New York State average salary per employee was lower than the national level (Table 1).

New York State Counties: Between 2007 and 2012:
- There was an increase in the number of dental establishments in 29 counties, no change in the number in 7 counties and a decrease in 26 counties; all decreases were outside of New York City.
- In terms of current dollars, there was a decrease in the estimated average business receipts in 14 counties, including one (Richmond County) in New York City. The estimated average business receipts in 2012 ranged to more than one million dollars in Broome, Greene, Onondaga, Oswego, Schoharie, Warren and Wyoming counties.
- In terms of standard dollars (removing the effects of inflation), there was a decrease in the estimated average business receipts in 43 (including all counties in New York City) of the 61 counties with dental establishments, i.e., the increase in business receipts did not keep pace with the rate of inflation (Table 2).
- In 2012, the estimated average business receipt data per dentist ranged as high as $898,000 in Cortland County and $938,000 in Albany County. However, in 21 counties the estimated average business receipts per dentist were less than $400,000, including five counties where average business receipts per dentist were less than $300,000 (4) (Table 3).

Overview
The intervening period between the surveys for 2007 and 2012 were marked by the "Great Recession" (December 2007 and June 2009), with the peak of unemployment in October 2009, the passage of the Affordable Care Act and continuing gradual improvement in the rates of un-

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**TABLE 2.**
Number of Dental Establishments, Current and Standard Dollar Average Business Receipt Data (in 000s and rounded) per Establishment in 2012 and Changes Between 2007 and 2012 by New York State Counties.5-9,12-14

<table>
<thead>
<tr>
<th>County</th>
<th>2012 Number of Establishments</th>
<th>Change 2007-2012</th>
<th>Current Dollars (000s) 2012 Receipts per establishment</th>
<th>Change 2007-2012</th>
<th>Standard Dollars (000s) 2012 Receipts per establishment</th>
<th>Change 2007-2012</th>
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<td>139</td>
<td>2</td>
<td>$985</td>
<td>$111</td>
<td>$236</td>
<td>$-8</td>
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<td>95</td>
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<td>810</td>
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<td>577</td>
<td>-40</td>
<td>138</td>
<td>-34</td>
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<tr>
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<td>125</td>
<td>226</td>
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<tr>
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<td>4</td>
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<tr>
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<td>Ulster</td>
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<td>Warren</td>
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<td>660</td>
<td>-</td>
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<tr>
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<td>21</td>
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<td>169</td>
<td>158</td>
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<td>Westchester</td>
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</tbody>
</table>

New York City:
- **Bronx**: 268 establishment(s) with a $654,500 average receipt per establishment.
- **Kings**: 916 establishment(s) with a $522,10 average receipt per establishment.
- **New York**: 1,453 establishment(s) with a $834,38 average receipt per establishment.
- **Queens**: 1,023 establishment(s) with a $478,15 average receipt per establishment.
- **Richmond**: 206 establishment(s) with a $628,20 average receipt per establishment.

Totals:
- **NY City**: 3,866 establishment(s) with a $645,26 average receipt per establishment.
- **Rest of State**: 5,398 establishment(s) with a $731,42 average receipt per establishment.
- **NY State**: 9,264 establishment(s) with a $706,34 average receipt per establishment.

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(4) As noted previously, “County location reflects the dental licensee’s primary mailing address on record with the Office of the Professions; the address is not necessarily the licensee’s practice address.”6

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TABLE 3.

State Dentists and Average Business Receipt Data (in 000s and rounded) per Dentist by County:

<table>
<thead>
<tr>
<th>County</th>
<th>Number of Dentists</th>
<th>Receipts per Dentist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany</td>
<td>262</td>
<td>$938</td>
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<tr>
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<tr>
<td>Boonie</td>
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<tr>
<td>Chemung</td>
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<tr>
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<tr>
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<tr>
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<td>Jefferson</td>
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<td>Wyoming</td>
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<td>416</td>
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<tr>
<td>Yates</td>
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<td>–</td>
</tr>
</tbody>
</table>

New York City

<table>
<thead>
<tr>
<th>County</th>
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<th>Receipts per Dentist</th>
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</thead>
<tbody>
<tr>
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<td>$395</td>
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<td>Bronx</td>
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<tr>
<td>Kings</td>
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<td>294</td>
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<td>Richmond</td>
<td>398</td>
<td>325</td>
</tr>
</tbody>
</table>

Totals

<table>
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<td>Rest of State</td>
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<td>486</td>
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<tr>
<td>NY State</td>
<td>16,485</td>
<td>397</td>
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Note: Business receipt data are for 2012. Dentist data are for 2013.

As the general economy of the nation continues to improve, there undoubtedly will be increased use of oral health services. The need is to expand the delivery of care to underserved populations, including the poor, individuals with disabilities, minorities and new immigrant populations for whom oral health services may not be a priority commodity.

REFERENCES

The New York State Dental Journal

Prevention of Alveolar Osteitis
A Case Report and Review of Literature

Gabriela Jude Fernandes, B.D.S., M.S.; Michael N. Hatton, D.D.S., M.S.

ABSTRACT
Alveolar osteitis (aka, “dry socket”) is a frustrating complication of exodontia, especially in the posterior mandible. We describe a novel technique for its possible prevention. The method involves administration of doxycycline dispersed in a local anesthetic solution, along with the use of a Gelfoam carrier. The senior author has used this technique as a routine element of care for several decades without complication.

Alveolar osteitis, also known as “dry socket,” is a painful condition following the extraction of a tooth. The etiology of alveolar osteitis is attributed to loss of the post-procedure blood clot. Purported explanations involve bacterial breakdown of the clot and endogenous fibrinolysis. Oral contraceptive use, smoking, surgical extractions, female gender and pre-procedure infection involving the tooth being extracted may also be considered as causative.

Mandibular post-extraction sockets in the posterior regions have demonstrated a higher incidence of dry socket, as compared to their maxillary counterparts. Several studies have demonstrated a high incidence of this condition in cigarette smokers, which may be related to non-compliance of oral hygiene instructions (“do not smoke”), and an undesirable interaction of tobacco products with oral tissues, thus triggering a foreign body reaction. Negative pressure while smoking may lead to mechanical dislodgment of the clot from the socket. Several methods have been described for prevention of dry socket, but very few seem to have been widely accepted in dental practice.

The aim of this case report is to discuss a novel, cost-effective and successful technique in the prevention of alveolar osteitis. We will describe topical administration of doxycycline, dissolved in a local anesthetic vehicle and incorporated into an absorbable gelatin sponge as a scaffold. The carrier and medicament are then placed into fresh post-extraction sockets, compressed and sutured.

Preparation of the Material
A 7 mm x 7 mm absorbable gelatin sponge (Gelfoam) was used in all patients described in this report (Figure 1). A capsule of doxycycline hydrochloride (100 mg) was placed into a small sterile petri dish (Figure 2). Approximately 3 ml of 1:100,000 xylocaine with (2% epinephrine) was used to dissolve the doxycycline into the Gelfoam, thus forming a slurry (Figures 3,4).

Case History
A 44-year-old male patient presented to the periodontology clinic at the School of Dental Medicine at Buffalo, NY. It was determined that his diagnosis was “aggressive periodontitis.” The treatment plan involved extraction of several teeth. The patient had been a heavy smoker for the last 37 years and currently smokes two packs a day. After several counseling episodes of smoking cessation, the patient finally reduced the number of cigarettes smoked to six a day (self-reported by the patient). The remainder of his medical history was non-contributory.
Written and oral informed consent was obtained from the patient for extraction of tooth # 31. Vital signs were documented. A right inferior alveolar nerve block was administered using lidocaine 1:100,000 (2% epinephrine). The tooth was extracted using a forceps technique. A doxycycline/local anesthetic soaked Gelfoam sponge was placed into the apical portion of the socket. A 3-0 chromic gut suture was placed over the socket in a “figure of 8” pattern (Figure 7). Postoperative instructions were provided orally and in writing to the patient. Given the patient’s smoking history, we hypothesized that postoperative dry socket was a likely occurrence.

The patient was contacted on the evening of surgery and the day after surgery to determine his postoperative status. No pain or discomfort was reported. The patient mentioned that he was able to carry out his routine activities. The patient was also followed up, in person, a week after the procedure. He self-reported that during the time from extraction to the time of follow-up, he smoked approximately 10 cigarettes a day. The extraction site did not display any evidence of erythema or other inflammatory signs. There was almost a 70% approximation of the buccal and lingual flap over the socket (Figure 8).

**Procedure**

**Results**
**Discussion**

Alveolar osteitis has long been the nemesis of dentists who extract teeth. A dry socket involves severe pain, malodor and possible trismus. It is often treated by standard methods, like irrigation, placement of an anodine dressing and analgesics. However, oral analgesics alone may fail to alleviate the symptoms of dry socket, which can leave a patient in an agonizing state of pain and dysfunction.\(^{11,23,24}\) There is often frustration on the part of the patient, and dentist, during this difficult postoperative phase of healing.

Several studies have demonstrated the association between cigarette smoking and an increased incidence of dry socket. And smoking has been recognized as a dose-dependent risk factor.\(^ {25}\) This mechanism may be the result of foreign body reaction from tobacco products.\(^ {16}\) Post-extraction cigarette smoking may also mechanically dislodge a blood clot from the socket. In addition, cigarette smoking reduces neo-vascularization.\(^ {26}\) Smoking also interferes with the activity of the leukocytes, which are a key participant in wound healing.\(^ {16,25,30}\)

Tetracycline is a broad-spectrum polyketide antibiotic that possesses bacteriostatic activity against almost all aerobic and anaerobic bacterial genera, both Gram-positive and Gram-negative. Polyketides are complex organic products of living organisms that are often biologically active. *Pseudomonas aeruginosa* and *Proteus* species usually have intrinsic resistance to tetracyclines.\(^ {31-33}\) Tetracyclines are also administered in the treatment of inflammatory diseases, such as acne vulgaris, rosacea, bullous dermatoses, granulomatous diseases and livedo vasculitis.\(^ {34,35}\)

The anti-inflammatory effect of tetracyclines, at low antibiotic concentrations, can reduce production of neutrophil chemotactants, such as peptide chemotactic factor and lipase.\(^ {35,36}\) Tetracyclines also inhibit chemotactic activity of neutrophiles by chelating intracellular calcium and, thus, prevent the assembly of the microtubules. This action subsequently affects cell movement of leukocytes. Tetracyclines also inhibit matrix metalloproteins, protein kinase C (an enzyme related in signal transmission for inflammation) and granuloma formation.\(^ {38}\) This key attribute is likely the mechanism in prevention of dry socket occurrence. Doxycycline is a form of tetracycline that has been widely used in dentistry for co-management of periodontal conditions. Literature reports document use of tetracycline in the prevention of alveolar osteitis in 1948, when tetracycline was used as a bacteriostatic agent in postoperative extraction sites.\(^ {39}\)
Many studies have employed the intra-alveolar use of antibiotics, steroids and hemostatic agents in the prevention of dry socket. However, standard of care has been adopted by our profession for post-extraction prevention of dry socket. Tooth-related infections have been shown to predispose to the development of alveolar osteitis. Bacteria that are commonly involved are *Antinomies viscous*, *Streptococcus mutans* and *Treponema denticola*. These bacterial types are associated with delayed healing of extraction sites, high plasmin-like fibrinolytic activities and indirect activators of fibrinolysis. Doxycycline has a variable antimicrobial effect on the growth of these microorganisms.

Systemic use of doxycycline has risks for the dental patient. Sensitization to the drug can result from repeated administration. In addition, doxycycline has a product warning that it may cause esophageal ulceration. By contrast, topically administered doxycycline is not likely to cause sensitization compared to systemic delivery. The advantage of our procedure lies in the fact that the drug is being administered only once and not at repeated dosing intervals. The average cost of a single capsule of doxycycline is low and economical for single-dose administration.

As for the incorporation of the local anesthetic with the vasoconstrictor epinephrine, a question involving the use of the vasoconstrictor leading to the malformation of blood clot might arise. Studies have suggested a higher incidence of dry sockets with the administration of infiltration anesthesia, because the temporary ischemia leads to poor blood supply. However, the ischemia is relative, lasting only one to two hours. It is then followed by reactive hyperemia, which makes it irrelevant in the disintegration of the blood clot. It is currently accepted that local ischemia due to a vasoconstrictor in local anesthesia has no role in the development of alveolar osteitis. We use local anesthesia as a diluent, as it enables several hours of postoperative pain control. The epinephrine provides for local hemostasis. The gelatin sponge (Gelfoam), an effective and economical clot stabilization material, is purified porcine skin gelatin. It helps to accommodate the doxycycline, which, without the sponge, would simply slough from the socket. The major benefit of using this material is that it is completely absorbable and doesn’t need to be removed. It easily resorbs into the surrounding tissues. The material size is small enough for single patient use; and there is little waste of excess material. It is also easy to manipulate and conform to post-extraction sockets. Additionally, the Gelfoam sponge is relatively inexpensive, which makes the procedure economical for routine use.

Future Directions

The limitations of this study are that it involves the extraction of a single tooth and just one experimental site with no control site. The study can be improved by using a large number of patients, with control and experimental sites, to test the ultimate scientific success of this method. Standard dosing of the slurry, with a fixed concentration of doxycycline/sponge, can also be tested to better define universal dosing. Currently we use one capsule of doxycycline (100 mg) per two Gelfoam sponges. The senior author has employed this technique for more than 26 years in his oral and maxillofacial surgery practice, and with great success in the prevention of alveolar osteitis.

As an example, more than 2,000 mandibular posterior teeth were extracted under the guidance of the senior author in the past three years. Alveolar osteitis is more commonly observed in the mandibular posterior regions among smokers and in females. Not a single case of alveolar osteitis was observed in any patient. Many of these patients were indeed active smokers and female. While not a rigorous scientific observation, our simple finding of no dry socket cases lends weight to the successful use of our technique in a high-volume ambulatory dental setting.

Conclusion

Doxycycline/local anesthetic/Gelfoam sponge seems to be an effective technique in the prevention of dry sockets. However, more strategically designed studies are required to warrant widespread use of this technique before it can be regarded as a standard of care.

Queries about this article can be sent to Dr. Hatton at hatton@buffalo.edu.

REFERENCES

A Multidisciplinary Approach for Managing Severely Malaligned Lower Molars

David Keinan, D.M.D., M.Sc., M.H.A., Ph.D.; Galit Birnboim-Blau, DMD MSc; Mariel Webber, D.D.S.

ABSTRACT

An impacted mandibular molar is a common clinical situation that may damage adjacent teeth and impair periodontal health. Improper treatment brings the risk of damaging adjacent vital tissues. The risk can be reduced by early diagnosis and extraction of the impacted tooth by an experienced clinician. However, in clinical cases of two impacted molars, it may be beneficial for the patient to save at least one molar. This can be achieved by orthodontic alignment of one of the molars, while extracting the other. The decision should be based upon prognosis and risks for each procedure and for both teeth. The case presented here demonstrates a recommended clinical decision-making process before treatment, followed by monitored multidisciplinary treatment with adaptations made as the treatment progresses.

An impacted third molar is a common clinical finding, with maxillary and mandibular third molars the most commonly impacted teeth. This is not surprising since the development and eruption process of mandibular molars is prolonged and complex, a process that has been widely described. There is not enough room for vertical eruption of almost half of the third molars, which leads to a common mesially inclined position or even vertical rotation.

Impaction of the permanent lower second molar (LSM) is a less common clinical condition. Dental records of almost 3,000 Caucasian young orthodontic patients revealed prevalence of up to 1.36%. During LSM development, the tooth bud has a minor mesial inclination and some ability for position self-correction during eruption. LSM impaction is usually combined with a reduced distance between the first molar and the anterior margin of mandibular ramus, at the time of the second molar root development. However, even a wide space between the first molar and the ramus may cause orientation loss during eruption, which results in LSM impaction. Iatrogenic reasons, such as improper metal bands on first molars and orthodontically preventing mesial drift of the first molar were also offered. Ranta found that in cases where second maxillary molars were impacted, third molars were generally positioned occlusally and palatally to the second molar, thus preventing its eruption. Raghoebar et al. suggested that impaction of second molars is usually associated with a short dental arch.

A major complication of impacted teeth is root resorption of adjacent teeth. Aizenbud et al. recommended a multidisciplinary approach for successfully repositioning a horizontally impacted mandibular second premolar in order to reduce the damage to the surrounding hard and soft tissue. Uprighting lower molars was offered to provide occlusion with opposing teeth and proximal contacts with adjacent teeth, thereby minimizing the risk of caries and periodontal disease, and assisting in orthodon-
tic treatment.\textsuperscript{15,16} The aim of this article is to present a multidisciplinary approach for treatment of impacted lower second and third molars with continuous process monitoring.

**Materials and Methods**

A 20-year-old male was referred to our hospital by his local dentist, who could not complete initial preparation in the mandibular right first and second molars due to abnormal angulation of the mandibular right second molar. In addition, the patient had previous periodontal abscess in the mesial aspect of the mandibular right second molar. This abscess was the result of food impaction and an inability to maintain adequate oral hygiene in this region.

Upon examination, the molar relationships were Class I on the right and Class III on the left. Overbite and overjet were 1.0 mm and 1.5 mm, respectively. There was moderate crowding in the lower arch and mild crowding in the upper arch. The lower dental midline was shifted 2.0 mm to the right. The maxillary left second premolar had previously been extracted. The mandibular right third molar was also mesio angulated, partially erupted and did not have enough space to erupt normally. The mandibular right second molar was mesially angulated, so that only the distal part of the tooth crown was exposed to the oral cavity. As a result of that angulation, two different dental pathologies could not be treated. The first pathology was resorption of the distal cervical aspect of the mandibular right first molar by the mesial part of the second molar. The second pathology was occlusal caries of the second molar. Leaving the patient untreated would have led to progression of the two pathologies and possible loss of both teeth.

**Treatment Alternatives**

Several treatment options were considered, all segmental, since the patient was not interested in comprehensive orthodontic treatment. The first was to extract the mandibular right first molar and then upright and protract the second and third molars. This option had the advantage of extracting the most damaged tooth, but it would require prolonged treatment to close the extraction space and a questionable prognosis of new bone formation in the already existing bone defect.

The second option was to extract the third molar and then upright and protract the second molar. This option would result in minimal treatment time, but it would leave the two damaged teeth in the mouth and might result in a residual bone defect between the first and second molars. The third option was to extract the first and third molars and restore the area using a dental implant instead of the first molar.

In the consultation, the patient selected the second option.

**Treatment Progress**

Treatment progression was strictly monitored clinically and radiographically (Figures 1a-c, 2a-e). The mandibular right third molar was extracted. Three months later, fixed appliances (0.018-in slot Roth prescription) were bonded segmentally from the mandibular right second premolar and distally. A 0.014-in nickel-titanium wire was used, and a nickel-titanium open coil was placed between the first and the second molars to achieve distalization of the second molar. In order to obtain absolute anchorage and
to avoid involvement of the entire dental arch, an orthodontic mini-
screw was implanted between the second premolar and the first molar
(1x68 mm, MIS Corp.).

Considerable distalization of the second molar was achieved after
four months. The bracket on the second molar was replaced with a
molar tube, and a 0.016-in nickel titanium wire was placed to increase
the moment exerted on the tooth for the purpose of correct root an-
gulation. At this stage, the patient complained about sensitivity to cold
drinks in the area of the right lower molars. The first molar responded
with lingering pain for more than 10 seconds after a cold test with
Endo-Ice. The diagnosis was symptomatic, irreversible pulpitis, and a
root canal treatment was performed within two visits. The tooth was
restored with an amalgam core and then porcelain-fused-to-metal
crown was performed to achieve full coverage of the remaining tooth
structure. The second molar responded normally to the cold test and
was found vital and was, therefore, restored by amalgam restoration
after removal of caries.

A month later, the second molar angulation was improved. A
0.016 x 0.022-in stainless steel archwire was placed and protraction of
the second molar was initiated using an elastomeric chain. The chain
was replaced every month for reactivation. Rehabilitation of the first
molar was conducted during that period. After cementation of the per-
manent crown, the elastomeric chain was protracting the second mo-
lar directly against the second premolar while skipping the first molar
in order to avoid bracket cementation on the new crown. The mini-
implant enabled this phase by anchoring the second premolar.

The protraction phase lasted six more months, during which time,
bone formation was constantly occurring. Eventually, full contact was
conducted between the first and second molars. An Omnivac retainer
was provided to the patient to use at night to maintain the result.

Discussion
The recommended age to manage impacted LSM is between 11 years
and 14 years, since the roots are still developing.17 Impacted lower
molars present a clinical challenge, especially when more than one
molar is involved. The prudent clinician should take into consider-
ation the risks of surgical intervention or patient monitoring alone.
For many clinical cases, it may be recommended to offer the patient
orthodontic treatment with or without surgical intervention.8,18

A treatment option for mild cases with minor tilting of the crown
may be placing a brass wire separator between the molars.19 Monitor-
ing alone, while anticipating spontaneous eruption, should be per-
formed only in very mild cases with strict follow-up, since only 50%
of those cases can result in normal occlusion, according to a study
by Magnusson and Kjellberg. Magnusson & Kjellberg also found that
none of the impacted LSMs succeeded in spontaneously erupting into
normal occlusion without clinical intervention. According to their
findings, extraction of the second or third molar was the most com-
monly provided treatment, although end results were the least fa-
vorable. Recommended treatment for complicated cases should involve combined intervention by both surgical and orthodontic means. Selection of an orthodontic appliance for the treatment should be based upon several factors, such as level of impaction, third molar development and desired tooth movement.

One consequence achieved by our treatment was bone apposition between the first and second molars. In general, during tooth movement, we can expect bone resorption in the pressure side and bone apposition in the tension side. This positive effect of orthodontic movement on the periodontal supportive tissues has been suggested because of the pull of Sharpey fibers, leading to bone apposition. Studies found that after extraction of third molars, the bone level distal to the second molar was usually preserved. And in some cases, even increased. However, when bone level before extraction was decreased as a result of resorption by an impacted third molar, it usually did not improve. This might suggest early intervention at a young age, before root completion takes place. In this manner, there will be fewer complications and less risk of damaging adjacent teeth, thereby leading to a more successful treatment. In addition, advanced imaging techniques were recommended for complicated cases in order to gain additional data on the molars’ position and vital tissues.

**Conclusion**
A multidisciplinary approach enabled us to solve a very complicated case of malaligned lower second and third molars. An improper treatment plan may lead to losing important teeth while saving the compromised ones, as well as to compromised occlusion and damage to vital organs. The prudent dentist should tell the patient about the complexity of the expected treatment and about the need to monitor its progression over time.

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The Anterior Double-Tilt Precision Attachment Case for Cleft Palate Patients and Accident Victims
Case Reports
Edward Feinberg, D.M.D.

ABSTRACT
Passively retained precision attachment removable partial dentures have been used successfully since the 1920s. Adult cleft palate patients and accident victims often have endured a lifetime of wearing awkward appliances to replace the missing structures that never formed intraorally or were lost in a traumatic accident. These patients tend to be poor candidates for dental implants, even with repeated grafting surgeries.

The anterior double-tilt precision attachment case is a great treatment option for adults to restore the missing dental structures. Anterior precision partial dentures are stable appliances in the mouth that are worn 24 hours a day and only removed for hygiene. They can be custom designed for maximum esthetics. They do not require denture paste, and they extend minimally onto the palate. As a result, they do not interfere with musculature, tongue movements, speech and taste.

Cleft palate patients and accident victims with poor or non-existent edentulous ridges will have difficulty retaining a denture, so preservation of the existing dentition is essential for comfort and function. Because these prostheses do not apply destructive forces to the abutment teeth, they can last decades with minimal maintenance.

Patients generally do not like the thought of removable bridgework for several reasons. First, removable bridgework can dislodge, causing embarrassment and loss of confidence. Second, most removable bridgework is retained with hooks (clasps) or other gripping mechanisms that are unsightly or apply uncomfortable pressure on the remaining teeth. Anterior cleft palate patients often have the added discomfort of wearing a foreign object on the anterior palate that interferes with speech, taste and function. Sometimes the prosthesis is so bulky that it never leaves conscious awareness—just like a “horse’s bit.”

However, there is a removable bridge that has none of these drawbacks: the double-tilt precision attachment partial denture. This type of restoration has a long track record, but it is rarely offered as a treatment option by most dentists. The double-tilt precision attachment partial denture has been used successfully on natural tooth abutments for over 70 years and on implant abutments for over 20 years.
Discussion

Rationale for Precision Attachment Case

Practitioners have long been taught that fixed bridgework is always better for the patient. The prescription for fixed bridgework is often the rule—even for abutments with a questionable prognosis of longevity. When anterior periodontal structures are missing, along with the teeth, fixed bridgework cannot replace them without overloading the abutment teeth. According to Elliot Feinberg, precision attachment partial dentures should be the primary treatment plan rather than long spans of fixed restorations.¹

The precision attachment partial denture case has enjoyed a long track record of success on natural tooth abutments. Examination and follow-up of more than 1,500 cases during a 60-year period by Elliot Feinberg and Edward Feinberg overwhelmingly demonstrate that precision attachment cases offer one of the most successful approaches to removable partial denture therapy.² These cases were all created according to the same basic principles, even though the materials differed. The basic principles include full shoulder preparation of the abutment teeth, a three-dimensional approach relating the preparations to the gingiva and periodontal bone, and a step-by-step protocol for the passive design and fabrication of the full coverage restorations and precision attachment partial denture.³

The importance of accurate impressions and models cannot be over-emphasized. Precision attachments must be used with exactitude. Great care must be taken to ensure accuracy at every step, as the entire chain can only be as strong as the weakest link. Klein, in 1951,⁴ observed that no amount of skill in one step of the work will overcome an error in a previous step. To function effectively, double-tilt precision attachment cases must fit exactly; the abutments must be stable, and the frameworks must fit properly against the tissue without rock.

The double-tilt precision attachment case offers significant advantages. They are:
1. Superior esthetics.
3. Optimal support of the musculature through replacement of missing structures.
4. Superior comfort and confidence for the patient.
5. Superior longevity of the abutment teeth and preservation of the edentulous ridges.
6. The ability to retain questionable teeth so that they do not affect case longevity.
7. The ability to compensate for changes that occur in the mouth.
8. No necessity for frequent replacement of the precision attachment apparatus even after decades of continuous function.
9. No need for the use of denture powder or paste.
10. Natural tooth and/or implant abutments can be used.

Free Moving Attachment

There are numerous attachments available for partial denture therapy. These attachments are usually classified according to structural type (i.e., intracoronal, extracoronal, anchor, ball and socket, etc.). However, the Feinberg Classification for Precision Attachments⁵ categorizes attachments on the basis of function, rather than structure. According to this classification, attachments fall into two categories (Figure 1a). They are:
A. Rigid—mechanical locking action that includes clasps, lingual arms, springs and ball and socket, etc.
B. Passive—free moving, stress-breaking action

Despite tremendous variation in design and application, almost all of the precision attachments currently used in dentistry are of the rigid variety. They are designed to mechanically engage the abutment teeth to prevent muscular and gravitational forces from dislodging the denture during function. Unfortunately, rigid connectors apply lateral forces to the abutment teeth that are ultimately destructive through their torquing action. The deleterious effects of rigid connectors are not confined to the abutment teeth. According to Elliot Feinberg, the tissue may be subjected to constant pressure, resulting in ischemia, inflammation and resorption of the alveolar process.

FIGURE 1A

Functional Classification of Precision Attachments

1. Rigid: Mechanical locking action
   - clips, locks, snaps, clasps, ball & socket, etc.

   - Female is attached to crowns or bridgework. Male is attached to the partial denture.
In addition, wear of the components of the attachment or erosion and caries of the enamel on the abutment teeth is a common consequence of rigid partial denture connectors.6

By contrast, the passive, free-moving attachment dissipates destructive lateral forces on the abutment teeth. The forces are vertically directed, rather than horizontally directed, and easily tolerated by the abutment teeth. Forde, in “The Principles and Practice of Oral Dynamics,” theorizes that vertically directed forces drive the hydraulic system of dentitional blood supply to the periodontal structures, whereas rocking or rotational forces disrupt the dentitional blood supply, causing “force-induced mouth degeneration” and loss of teeth. The tissue under a passive, free-moving attachment case is generally pink and healthy as a result of the vertically directed physiologic stimulation during function. Passive, free-moving attachments also do not wear at a rapid rate. These attributes make it possible for free-moving precision attachment cases to succeed for decades—even on the weakest teeth.

The majority of free-moving, precision attachment cases fabricated during the last 64 years by Elliot and Edward Feinberg were made with the Sterngold #7 attachment that was patented in 1921 (no longer on the market). However, precision attachment partial denture cases have been just as successful with the Whaledent International P3.4 attachment and with the Sterngold Latch attachment. These attachments are similar in design to the Sterngold #7. They are all essentially “keys” (males) that fit with machined precision into receptacles (females). Any male out of the box will perfectly fit any given female, and the Latch attachment is fabricated to a tolerance of .0001 inches.8 The latch consists of a ball in the female that engages a depression in the male component. This latch actually does not function after a short time, so it does not lock the partial in place. Success with male-female precision attachments is not just a function of the attachment, but also how the attachment is used (Figure 1b).

Path of Insertion as Retentive Mechanism
The path of insertion can be used as a retentive mechanism—one that functions as a true stress-breaker, reduces wear of the attachment components, and eliminates the need for retention adjustments and eventual replacement of the attachment apparatus. The actual retention of the partial denture is a result of an unconventional path of insertion and withdrawal. This path is different from the pull of the muscles, the action of the tongue and gravity. In fact, Elliot Feinberg observed that the path of insertion is unlike virtually any oral movement, such as the patient’s tongue habits, so it is unlikely normal flexing of the musculature will dislodge the prosthesis.9

When a stress is applied to the partial denture during function, it can move slightly to release the stress, but it cannot be dislodged. The result is physiologic stimulation of the abutment teeth and the edentulous ridges and overall health. Because the path of insertion technique does not rely upon the flexing of metal components for retention, there is very little wear on the attachment components. Many patients wear these precision attachment partials for decades without replacing the male or female components of the attachment. When the partial loosens, a reline is all that is required to make it tight. Nothing is ever done to male or female components of the attachment to alter the fit.

The path of insertion technique was refined by Miller, but it has not achieved mainstream popularity. There is a perception that the prosthesis is too complex for patients with limited manual dexterity. Elliot Feinberg explained that original concern over the difficulty of insertion appears to be unsupported by clinical experience. In teaching patients how to insert more than 1,000 double-tilt cases, he reported, just one patient could not master the path of insertion with 15 minutes of practice.9 Precision attachment partial dentures have been successful on patients with arthritis, Parkinson’s and other diseases that affect manual dexterity.

Traditionally, intracoronal attachments are paralleled on the surveyor perpendicular to the occlusal plane—the same line of insertion as the vector of gravity and line of occlusion.9 Most technicians place the attachments with one tilt. Unfortunately, this method of surveying contributes to dislodging the partial denture, thereby necessitating the addition of locking mechanisms, such as lingual arms and clasps, to retain the partial denture. The double-tilt technique avoids this scenario and is simple to accomplish, employing the following steps:
1. The master model is secured to the surveyor table of the parallelogram. The model is placed with the occlusal plane approximately parallel to the table and the anterior teeth facing forward.
2. The heel of the model (posterior) is raised between 10 degrees and 15 degrees to provide an anterior-posterior tilt.
3. The left or right side of the model is subsequently raised approx-
Guidelines for Creating Anterior Precision Attachment Case

Anterior precision attachment cases are most successful when 10 guidelines are followed. They are:

1. Precision attachments must be used with exactitude. The male or female attachments must never be altered.
2. Use three to four precision attachments. Using four attachments vastly increases the technical difficulty, as all the components must be exactly parallel.
3. The double tilt path of insertion should be employed as the only retentive mechanism. Do not add lingual arms or clasps.
4. Center the attachments on the ridge on mesial or distal surfaces of the abutment teeth instead of the lingual surfaces.
5. Place the attachment as close as possible to the shoulder and axial wall of the abutment teeth.
6. Minimize the extension of the removable partial denture framework onto the anterior palate.
7. Eliminate the posterior palatal bar. Instead, extend supports alongside the lingual surfaces of the posterior teeth. Crowns and bridges should be made as thin as possible on their lingual surfaces to accommodate these supports.
8. Avoid unilateral design. Precision attachment cases must function bilaterally for optimal comfort and function.
9. Do not use metal anterior ridge saddles. The anterior saddle areas must be designed to retain acrylic or composite. Doing so will allow alteration to compensate for future changes.
10. Acrylic, composite or porcelain teeth may be used. The teeth can be customized to create ideal esthetics and compensate for asymmetrical anatomy. Often, the intracoronal attachment in the abutment tooth extends beyond the confines of a normal tooth. The pontic tooth on the partial can be custom made to overlay on the extended area so that all of the teeth appear normal in size.

Case Reports

Accident Victim

The patient was in an automobile accident that caused loss of the anterior teeth and associated periodontal bone. Fixed bridge-work could not replace the periodontal structures effectively and would overload the abutment teeth with excessive forces. Implant placement could only be effective with bone grafts, to re-create the missing periodontal structures. Many patients do not want to have these procedures or are not candidates for implant therapy. Implants were not available in the United States until the early 1980s. A precision attachment case was made for this patient in 1976, and the patient is still wearing this case. Full mouth X-rays, taken every two years, indicate that changes in the periodontal bone around the abutment teeth have been minimal and gradual over a 27-year period. The original attachments were not altered or replaced, and the only maintenance performed has been occasional relines on the tissue-bearing surfaces (Figures 3a, 3b).

Cleft Palate Patient

This patient has always worn a removable prosthesis to replace the missing anterior teeth and periodontal bone, which were never properly formed. During her lifetime she has endured appliances that were unstable and bulky constructions resting on her palate. Even though precision attachments were used on these appliances,
they were ground with a handpiece so that they did not fit with precision, and retention was actually achieved with several clasps.

A double-tilt anterior precision attachment case was made for this patient that eliminated the clasps and the extension onto the palate. The patient is extremely comfortable and remarked that this partial denture was the most stable prosthesis she has ever had in her mouth. The denture teeth were custom designed to wrap around the abutment attachments for maximum esthetics. No one can tell that she is wearing a removable appliance that replaces the missing anterior teeth (Figure 4).

Summary
The passive double-tilt precision attachment case has been used successfully on natural tooth abutments for over 70 years and on implant abutments for over 20 years. While the overwhelming majority of cases have been designed to replace missing posterior teeth, anterior precision attachment cases have had successful outcomes when employing the same basic principles. This treatment option is a great choice for adult accident victims and cleft palate patients when missing anterior teeth and periodontal bone contraindicate the use of fixed bridgework.  

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Diagnosing Juvenile Recurrent Parotitis

Case Reports


ABSTRACT

Diagnosis of juvenile recurrent parotitis is based upon clinical symptomatology, because no positive serologic signs have been identified. Objective confirmation is best obtained from sialographic or ultrasound studies.

Juvenile recurrent parotitis (JRP), the second most common pediatric salivary gland disorder after mumps, is best defined as a recurrent, non-obstructive, non-suppurative parotid gland (PG) inflammation. Usually, swellings of both PGs are seen with a tendency for one side to be dominant.1,2 These PG swellings develop in children, usually in the 3-year-to-7-year age range, and with a slight male predilection.1,3-10 Two or more episodes a year of unilateral PG swelling are considered diagnostic.11 Sporadic contralateral gland swellings are frequently encountered.5 The swellings are occasionally painful, with fever and malaise not always present.3-5,8,12-16

The PG swellings last from several days to several weeks. With subsidence of the swelling, the patient subjectively is symptom-free until development of the next exacerbation. Of great significance is the fact that JRP can heal itself. It is a self-limiting disease that regresses with the onset of puberty,1,3,5,7,11-13,15 although progression into adulthood occasionally occurs.2,14

During an acute episode, saliva exiting from the duct orifice of the involved PG is not suppurative.2,3,5,7,15,16 Rather, the saliva will contain plaque-like mucopus plugs in a background of clear saliva.1,6 Secondary infection may develop, at which time, cloudy saliva will become evident. Surprisingly, during periods of remission, the salivary return will be clear, and flocculations will be absent.

Diagnosis of JRP is based upon clinical symptomatology, because no positive diagnostic serologic signs have been found. However, objective confirmation can be obtained via sialographic and ultrasonographic studies. Sialography is a radiographic technique utilized for the visualization of a salivary gland’s duct system. It involves the injection of a small amount of contrast dye through the gland’s duct orifice. A radiograph is then taken to visualize the opaque dye within the duct system. A duct branching pattern, similar to a tree in wintertime, is considered normal. However, sialectasis, a stippled droplet pattern, will usually be seen in both PGs of a patient with JRP, even if only one gland has been objectively involved.1,3,4,12,15 The sialectic pattern represents the presence of dilated interlobular ducts.5

Ultrasound (US) studies also play a significant role in the objective diagnosis of JRP.1-5,13,17 The technique involves high-frequency sound waves that are transmitted from a transducer placed on the skin overlying the parotid gland. The transducer collects the sounds that bounce back from the underlying tissues, and a computer then creates an image. The normal parotid gland shows multiple medium-level echoes in a homogeneous pattern.
However, in JRP, hypoechoic areas, representing limited echo reflections from dilated ducts, are seen in a heterogeneous background. The hypoechoic areas correspond to the locations of the dilated ducts depicted in a sialographic study. At present, US is used more frequently than sialography, because US is a simple, non-invasive procedure that does not involve radiation or problems with child cooperation.

The authors report two cases of JRP that were accurately diagnosed only after one patient was confirmed objectively by sialography and the other by US.

Case Report One
A 5-year-old female was seen in the Salivary Gland Center (SGC) of the Columbia University College of Dental Medicine with a two-day presence of a left, moderately uncomfortable PG swelling (Figure 1). Her mother said the swelling was the sixth unilateral episode of gland swelling since the age of 4, with the right side being involved twice and the left side four times. Other than the PG swellings, the child has been in good health.

In the past, each swelling has spontaneously resolved in one to two days without treatment. The repetitive nature of the swellings has caused concern, and has served to initiate the decision to seek care.

The clinical examination revealed a somewhat diffuse left PG swelling. Palpation indicated that the left PG was tender and slightly indurated, while the right PG was painless and normal in tone. Intraorally, when the left PG was pressured extraorally, clear saliva with white flocculations was seen exiting from the left parotid duct orifice. The saliva exiting from the right parotid duct orifice was normal in appearance.

A tentative diagnosis of JRP was made. Because the patient was extremely cooperative, sialography was performed on the unaffected right PG. The characteristic sialographic pattern of sialectasis was clearly demonstrated and served to clinch the diagnosis of JRP (Figure 2).

Case Report Two
A 7-year-old female was seen in the SGC two days after the subsidence of a left PG swelling. Since the first episode of swelling at the age of 6, there have been two additional episodes of left PG swelling, each lasting two to three days. The most recent episode, the third, had been present for three days, but had subsided by the time of the visit to the SGC. Questioning indicated that the patient was in excellent health and has had no right PG problems.

At the time of examination, no salivary gland swellings were evident. Palpation indicated that both parotids were normal in tone and painless. Flocculations in a clear saliva were observed intraorally, exiting from both parotid duct orifices when the respective PGs were pressured extraorally. An US study was requested.

Figure 1. Case 1: Left parotid swelling.

Figure 2. Case 1: Right parotid sialogram shows sialectasis (circled droplet pattern).

Figure 3. Case 2: Sonogram left parotid gland. Note hypoechoic (sonolucent) areas scattered throughout heterogeneous gland background.
Both PGs revealed multiple hypoechoic areas in a heterogeneous background. These sonographic changes were most marked in the left PG (Figure 3). The US findings, combined with the clinical history, confirmed the diagnosis of JRP.

**Discussion**

The etiology of JRP has not been determined, but it may be related to factors such as congenital duct defects, local manifestations of autoimmune disease, allergy, infection or genetic conditions.1,2,18 The recent introduction of endoscopy has added relevant etiologic data concerning the PG’s duct system. Endoscopically, the duct walls are seen to have a whitish, rather than pink, appearance that reflects the duct’s avascularity.1,5,6,9,10,14,15,17 Some duct narrowing also has been observed.14,18 It is possible that the duct avascularity interferes with the PG’s sphincter system1,5,14 and causes salivary stagnation that results in an inadequate duct luminal lavage. In turn, the sluggish flow leads to precipitation of mucopus plugs that are visualized in the intraoral salivary return. Because the substandard salivary duct flushing favors an ascending infection from the oral cavity, a superimposed secondary infection with associated suppuration, fever and pain can be initiated.

The histologic examination of the PG in patients with JRP has revealed duct dilations surrounded by periductal lymphoproliferations.1-3,5,6 These findings provide the explanation for the sialographic and ultrasound observations. The stippled/droplet sialectic picture represents contrast dye in dilated ducts. The PG hypoechoic areas viewed with US represent the sonolucency of these dilated ducts. Additionally, aggregates of lymphocytes are sonolucent. Consequently, the periductal lymphoproliferations add to the size of the hypoechoic areas noted on the US study.

Differential diagnosis involves distinguishing JRP from mumps and Sjögren’s syndrome (SS). Mumps, whose etiologic cause is a paramyxovirus, can be seen in all age groups. Mumps is an infectious viral disease that confers immunity. Therefore, recurrences of PG swelling are not anticipated. The virus is highly contagious and is transmitted by salivary droplets. The parotid swellings are painful, and fever and malaise are to be expected. Associated systemic manifestations, such as orchitis and pancreatitis, can be present. Fortunately, the available mumps vaccine has significantly limited the incidence of mumps.

SS with PG swellings can occur in children, but it is a rare occurrence. Its differentiation from JRP rests in the presence of unique serum antibodies and the classic microscopic presence of lymphocytic foci in the parenchyma of the salivary gland. Positive ocular staining, reflecting decreased lacrimal lubrication, can be present. Dry mouth, frequently seen in adult SS patients, is not often seen in pediatric SS.

**Treatment**

Because JRP is essentially a self-limiting disease, with symptoms abating at puberty, supportive therapy has been advocated. This therapeutic approach includes sialogogic agents to increase salivary lavage, massage, warm compresses and duct probing. The use of antibiotics is questionable.5-7,14,19 It is only when secondary infection is superimposed on the JRP that antibiotics are indicated.

Sialography has not only proven to be a successful diagnostic approach, it also has demonstrated therapeutic value derived from its ability to lavage the ductal system.1,4,6,8,10,14,16,17 Similarly, the recently introduced endoscope has dual diagnostic and therapeutic capabilities. Narrowed duct luminal walls are not only visualized with endoscopy, the introduction of the instrument into the parotid duct through the orifice also results in duct dilation. Furthermore, the endoscope allows for pressurized irrigations of the ducts. The hydrostatic irrigations, along with the mechanical introduction of the endoscope, overcome blockages and act to dilate ducts.5,10,15,17 Adjunctive intraductal injections of steroids also have proven to be therapeutic.6,10,15,17

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Management of Traumatized Permanent Incisors
Revascularization and Delayed Replantation
Maryam Gharechahi; Shiva Shojaeian

A B S T R A C T
This article reports a clinical case of a 9-year-old boy with a traumatic injury to the maxillary central incisors 24 hours after a fall in his schoolyard. The upper left central incisor was avulsed and was kept in saliva for four hours from the moment of trauma until its replantation. The right one was necrotized after one month. We describe successful revascularization treatment of right necrotic immature upper incisor and delayed replantation of left one. After 18 months, radiolucent lesions in the periapical areas of both maxillary central incisors had healed, and root apex development was noted with thickening of the walls in tooth #8.

The traumatic injury of an immature permanent tooth can lead to loss of pulp vitality and arrested root development. The consequences of interrupted development include a poor crown-root ratio, a root with very thin walls, increased risk of fracture and an open apex. Disadvantages of traditional apexification are the necessity of multiple visits during a relatively long period of time (an average of 12 months) and the fact that there is no expectation that the root canal walls will be strengthened.

An alternative to traditional apexification is to place an artificial barrier at the apex to prevent the extrusion of filling materials during obturation. The material of choice is MTA, because of its sealing ability and biocompatibility. This latest technique is convenient because it is faster than the traditional apexification. The case can be finalized within two appointments, and a hard tissue barrier eventually forms against MTA. However, even this alternative approach has the same disadvantage as a tooth with thin dentinal walls and no further root development.

The ideal treatment to obtain further root development and thickening of dentinal walls in an immature tooth with apical periodontitis would be to stimulate the regeneration of a functional pulp-dentin complex. Performing the first clinical regenerative endodontic procedure by inducing bleeding from periapical tissue into root canal, Ostby, in 1961, observed histologically the formation of vascularized connective tissue and deposition of cementum on the root canal wall. However, the result in infected necrotic teeth was disappointing. Regarding studies that demonstrated the efficacy of triple antibiotics in disinfection of infected necrotic root canals,2 Iwaya et al.3 and Banchs and Trope4 reported successful revascularization treatment in immature teeth with apical periodontitis and sinus tract.

The typical revascularization protocol advocates that the immature tooth, diagnosed with apical periodontitis, should be anesthetized, isolated and accessed. Minimal instrumentation should be accomplished and the root canal irrigated with 5.25% NaOCl, followed by chlorhexidine. An antimicrobial medicament [either a triple antibiotic paste or Ca(OH)₂] should then be delivered into the root canal space, the access cavity sealed with a sterile sponge and temporary filling, and the patient discharged for three to four weeks.3 At the second appointment, in the absence of signs or symptoms, the tooth is re-entered and the tissue beyond the apical foramen irritated with a file until bleeding starts and a blood clot is
produced. Then, about 3 mm of MTA is placed over the blood clot, followed by a restoration. Within the next two years, a gradual radiographic improvement in root development can be observed.

In the case presented here, we describe use of this protocol to stimulate the continued root development in a case of trauma-induced necrosis of an immature permanent central incisor.

**Case Report**

A healthy 9-year-old boy was admitted to the Department of Endodontics, Mashhad Faculty of Dentistry, with a traumatic injury to the maxillary central incisors 24 hours after a fall in his schoolyard. Reportedly, an emergency examination had been carried out by a hospital pediatrician, who had found the patient free of neurologic and general physical symptoms and had referred him for management of dentoalveolar trauma. The left central incisor had avulsed in the accident and had been replanted and sutured at hospital four hours after the injury (Figures 1a, b).

During the first appointment, clinical examination revealed upper lip swelling and laceration, which had been sutured in hospital, but there were no other soft tissue injuries, crown fracture or abnormal dental relationship. Teeth #8 and #9 were sensitive to percussion and palpation, and the upper left central incisor was also slightly mobile. Cold testing with Endo-Ice spray and electric pulp test elicited a negative response from the upper left central incisor and a positive response from the right central incisor. Radiographic examination showed that only tooth #8 was immature with an open apex. Two radiographs with different angulations and one occlusal film were taken to evaluate any root or alveolar fracture.

The prognosis of the left central incisor appeared highly unfavorable because of the combination of the following problems:

1. The tooth had been replanted more than one hour after trauma.
2. The tooth had been stored in saliva before replantation.

The parents were informed that treatment of the left central incisor (#9) would be an attempt to extend the life of the root, and that this treatment might not be effective either in the short term or in the long term.

A treatment plan was formulated that included prolonged Ca(OH)\(_2\) therapy and RCT (root canal treatment) of the left central incisor. A special informed consent was signed. The sutures were removed from the teeth, a splint was made of acid-etched composite resin, and a wire was bonded to the lateral and central incisors (Figure 1c). The patient did not need an anti-tetanus booster after consultation with physician. Systemic amoxicillin and chlorhexidine (0.1%) mouthrinse were prescribed for a week. The patient was advised to eat a soft diet for two weeks and was scheduled for a follow-up visit.

A week later, the patient returned and after anesthesia, the pulp chamber of the left central incisor was accessed. Isolation was achieved using cotton rolls and gauze, as a rubber dam could not be placed in the presence of the trauma splint. The root canal was instrumented and irrigated gently with 10 mL of 5.25% sodium hypochlorite (NaOCl). Ca(OH)\(_2\) powder (Merck, Darmstadt, Germany) was mixed with sterile saline in a 3:1 ratio to produce a thick homogeneous paste. The mixture was placed in the pulp chamber using a plastic carrier and packed into the root canal with a file and paper points. Finally, the access cavity was sealed with Cavit (3M ESPE, Seefeld, Germany) (Figure 1d). The trauma splint was removed, and the patient was asked to return after one month for evaluation of the intracanal medication.

At the third appointment, Ca(OH)\(_2\) was present in the canal, but discoloration of the right central incisor was noted (Figure 2a). Results of an electric pulp test (EPT) and vitality test were negative. The tooth had immature roots on the radiograph, with a radiolucent periapical lesion adjacent to the root apex. Therefore, a diagnosis of pulp necrosis with apical periodontitis was made for the right central incisor after confirmation with cavity test. Considering the immaturity of the tooth, the treatment option was revascularization.

After thorough explanation of the treatment procedure, risks and benefits, an informed consent was obtained from the patient’s father. Rubber dam isolation was achieved without local anesthesia, and an access cavity was prepared using a diamond-coated fissure bur (Diatech, Heerbrugg, Switzerland) and high-speed handpiece with copious water spray. On entering the pulp chamber, pus and necrotic tissue were observed in the root canal. The canal was passively irrigated with copious amounts of 5.25% NaOCl without instrumentation. To prevent crown discoloration, the dentinal tubules of the chamber were sealed with a bonding...
resin-bonded composite

Then, the coronal access was refined, cleaned and restored with temporary restoration was removed and MTA setting was verified. was sealed with a moist cotton pellet and Cavit. One day later, the over the blood clot to a thickness of 4 mm (Figure 2c). The access produced 1 mm past the working length to stimulate fresh bleeding within the canal to the level of cement-enamel junction (Figure 2b); bleeding was left for 10 minutes to allow clotting. Mineral trioxide aggregate (MTA) was mixed with distilled water and filled within the canal. After root canal disinfection, under the presence of a large periapical lesion. In these cases, the stem cells from the apical papilla (SCAPs) might survive the infection. They are capable of forming odontoblast-like cells, producing dentin. Successful revascularization of the pulp canal has been demonstrated after appropriate root canal disinfection and the presence of a blood clot in the canal. After root canal disinfection, under the influence of the surviving epithelial cells of the HERS, SCAPs can differentiate into primary odontoblasts to continue root formation and increase the root length and thickness of the canal wall.

At the nine-month recall, tooth #9 was asymptomatic. A radiograph indicated complete disappearance of the radiolucency, and there was no sign of external resorption. Conventional endodontic treatment was performed using gutta-percha (Sure-Endo, Seoul, Korea) and AH26 sealer (Dentsply De Trey, Konstanz, Germany) by using the lateral condensation technique (Figure 2d).

During the 18-month follow-up period, the patient remained asymptomatic. The teeth were functional, without sensitivity to percussion and palpation or presence of swelling, with normal periodontal conditions. In radiographic examinations, radiolucent lesions in the periapical areas of both maxillary central incisors had healed; and the root apex development was noted with thickening of the walls in tooth #8 (Figure 2e).

Discussion

In the case presented here, the treatment plan for tooth #8 was regeneration; for the avulsed left central incisor (tooth #9), it was prolonged Ca(OH)₂ therapy.

Revascularization of a pulp-like tissue for dentin deposition will allow further development of the root and dentinal structure with a better long-term prognosis. Traditionally, calcium hydroxide has been used as the intracanal medication in apexification procedures. It creates an environment conducive to the formation of a hard tissue bridge at the apex. Direct contact between Ca(OH)₂ paste and any vital pulp tissue remaining in the canal can induce the formation of a layer of calcified tissue that will prevent the regeneration of pulp tissue into the occupied space within the canal. Another concern is that Ca(OH)₂, because of its high pH, may damage the Hertwig's root sheath (HERS) and thereby loss of its ability to induce the nearby undifferentiated cells to differentiate into odontoblasts. Therefore, with calcium hydroxide therapy, there is no expectation that the root canal walls will be thickened or strengthened.

In the case of an immature necrotic tooth with apical periodontitis, traces of pulpal tissue might survive apically, even in the presence of a large periapical lesion. In these cases, the stem cells from the apical papilla (SCAPs) might survive the infection. They are capable of forming odontoblast-like cells, producing dentin. Successful revascularization of the pulp canal has been demonstrated after appropriate root canal disinfection and the presence of a blood clot in the canal. After root canal disinfection, under the influence of the surviving epithelial cells of the HERS, SCAPs can differentiate into primary odontoblasts to continue root formation and increase the root length and thickness of the canal wall.

However, the source of stem cells responsible for regeneration is still unknown. Animal regenerative studies reported deposition of cementum-like tissue on dentin canal wall and bone-like and connective tissue in canal space, which explains stem cell in PDL, or the periapical area might be attributed to new tissue formation.

In the revascularization protocol, infected root canals should be treated as conservatively as possible. This is best achieved by copious irrigation with 2.5%–5.25% NaOCl and no instrumentation. Root dentinal walls are so thin that any instrumentation makes them weaker and more susceptible to

agent to avoid any contact between the tri-antibiotic paste and the dentinal walls. The inner surfaces of the coronal access were etched for 20 seconds with 35% phosphoric acid (Ultra-Etch; Ultra-dent, South Jordan, UT) and rinsed. The bonding agent was applied (Single Bond 3M, Minneapolis, MN) to the etched surfaces and cured for 20 seconds. The canal was gently dried with paper points (Ariadent, Tehran, Iran), and a creamy paste of equal proportions of metronidazole (Pars Daru, Tehran, Iran), ciprofloxacin (Amin Daru, Tehran, Iran) and minocycline (Razak, Tehran, Iran) were mixed with normal saline and placed inside the canal with a #70 K-file (Dentsply Maillefer). The tooth was restored temporarily with Cavit (Asia Chemi Teb Co, Tehran, Iran).

At the follow-up appointment three weeks later, the patient was asymptomatic, and the tooth was not sensitive to percussion and palpation. After anesthesia and rubber dam isolation, the temporary restoration was removed. The antibiotic mixture was removed, and the root canal was flushed with sterile saline and rinsed. The bonding agent was applied to the etched surfaces and cured to the etched surfaces and cured.

Figure 2a. Discoloration of right central incisor.
Figure 2b. File was introduced 1 mm past working length to stimulate fresh bleeding within canal.
Figure 2c. MTA was filled over blood clot to thickness of 4 mm.
Figure 2d. RCT was performed using gutta-percha and AH26 sealer for tooth #9.
Figure 2e. Radiograph at 18-month follow-up.
future fractures. And formation of a smear layer might occlude the dentinal walls and tubules.4

Studies have shown that different methods can be used for disinfecting the necrotic immature teeth in revascularization treatment, including use of triple antibiotic paste, calcium hydroxide in the coronal third of the root canals and formocresol. Previous reports have demonstrated the effectiveness of a triple antibiotic paste consisting of metronidazole, ciprofloxacin and minocycline in disinfection of infected root canals.5 In the present study, 5.25% NaOCl was used for irrigation of the canal, and the triple antibiotic dressing was placed for three weeks in tooth #8. The main disadvantage of this paste is minocycline-induced crown discoloration, which might be reduced by prior sealing of the coronal dentin with bonding agents.8 In the present study, this protocol was used and no unfavorable crown discoloration was seen.

Studies have shown that root canals with a blood clot formed inside them after disinfection have better radiographic treatment outcomes regarding the thickening of root canal walls and apical closure compared to those without a blood clot in the canal space. A clinical study revealed that failure to induce a blood clot after disinfection might be one reason for treatment failures in revascularization. A blood clot provides biodegradable scaffold for cell migration and also contains growth factors to trigger stem cell differentiation and proliferation. Studies of the effectiveness of collagen scaffold or platelet-rich plasma application in revascularization revealed controversial results.9

The importance of a bacteria-tight coronal seal for successful revascularization is well documented. The sealing ability and biocompatibility of MTA have been demonstrated in several studies. Therefore, in the case reported here, MTA was used for revascularization, but it was moved farther apically than desired. Therefore, collagen matrix on the blood clot should be used to control MTA placement.10

In the case presented here, after 18 months, the right central incisor was asymptomatic, and, continuing root development was observed, with no crown discoloration. The favorable results in this case of traumatized right central incisor show that regenerative endodontic treatment of pulpally involved traumatized immature teeth is a viable alternative to apexification or artificial apical barrier techniques. Although the nature of the regenerated tissue within the root canal is yet to be elucidated in humans, it is evident that this technique can allow for continued root develop-
ment and apical closure. However, histologic studies of human revascularized teeth and more clinical studies are recommended.

To date, only case reports and case series on endodontic revascularization treatment are available; no randomized controlled clinical trials have been published. Although case series do not provide definitive evidence to support a given treatment modality, they do have the advantage of being conducted in actual patients and, thus, provide a higher level of evidence than preclinical studies. Nearly all reported cases involve patients 8 to 18 years old and teeth with immature apices. Also, all of these reports noted continued thickening of root walls and subsequent apical closure. Bose et al., in a retrospective study, compared the radiographic changes in 48 revascularization cases to 40 control cases. They indicated that revascularization treatment with either the triple antibiotic paste or Ca(OH)\textsubscript{2} produced significantly greater increase in root length and dentin wall thickness compared with control groups. Also, they indicated that 12- to 18- month recall is probably the minimal time to judge radiographic evidence of root development.\textsuperscript{11}

As described earlier, prolonged Ca(OH)\textsubscript{2} therapy was carried out for the left avulsed central incisor. The ideal treatment option for an avulsed tooth is immediate replantation so that further injury to periodontal ligament (PDL) cells is prevented and optimum healing is achieved without resorption.\textsuperscript{1} However, rapid replantation rarely occurs because of the emotional stress of parents and lack of knowledge of appropriate first-aid measures to manage the problem at the location of the injury. In these conditions, the tooth should be maintained in a suitable media, such as HBSS, milk, saline, culture media or saliva, and not water until it is replanted. Yet, these storage media are not always available at the scene of injury except for saliva. Despite the fact that saliva has some disadvantages, such as low osmolarity and bacterial content, it minimizes the dry storage period and keeps the tooth hydrated.\textsuperscript{6}

In the present case, although tooth #9 was out of the alveolus, it remained in direct contact with saliva. The length of the time elapsed from the moment of trauma until replantation was four hours. Although this period is not ideal for the healing process of avulsion injuries, a delayed replantation was implemented considering that the avulsed tooth was preserved in saliva.

In the case presented, radiographic and clinical findings after 18 months revealed absence of root resorption, ankylosis or mobility of the replanted left central incisor. It is important to underline the fact that although root resorption and ankylosis were not observed after 18 months, these events might occur in the long term. Therefore, longer periods of clinical and radiographic follow-up are required.

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REFERENCES

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