Clearing up the Confusion about Medicare and Dentistry
Judith L. Shub, Ph.D.; Lance Plunkett, J.D., LL.M.

Dentists have until December to properly enroll in Medicare to satisfy regulatory changes to the system. What they need to know.

Barotrauma: Tooth under Pressure
Satheesh Kumar, B.D.S., M.D.S.; Preeti Satheesh Kumar, B.D.S., M.D.S.; Jins John, B.D.S., M.D.S.; Ruchi Patel, M.D.S.

Modern dental encounters include patients whose pain symptoms coincide with air travel or underwater exploration. A review of literature on classification, etiology and manifestations of barodontalgia, along with clinical considerations for its management.

TMJ Changes in Adolescent TMD Patients Seen on MRI in Clinical Setting
Nan Su, B.Sc.; Renee Poon, B.Sc.; Lawrence Friedman, M.B., B.Ch., FRCP(C), FACP; Mark Darling, B.Ch.D., M.Sc. (Med), M.Ch.D.; Miriam Grushka, M.Sc., D.D.S., D.D.S., Ph.D.

Retrospective chart review was undertaken to determine if temporomandibular joint changes are similar between adolescent and older TMJ disorder patients. It was determined that both displayed comparable disc/bone changes in their TMJ.

Evolution of Orthodontic and Triple-headed Toothbrushes When Used Alone or in Conjunction with Single-tufted Toothbrush in Patients with Fixed Lingual Orthodontic Appliances
Malka Ashkenazi, D.M. D.; Nurit Flasher Salem, D.M.D.; Silvia Garon, D.M.D., Liran Levin, D.M.D.

Randomized clinical trial is undertaken to determine effectiveness of brushing with single-tufted toothbrush in conjunction with manual toothbrush, as widely recommended. While triple-headed toothbrush appeared to remove plaque more effectively than orthodontic toothbrush, adding single-tufted toothbrush eliminated differences between them.

Management of a Dental Implant with Internal Thread Damage

Patient treatment report illustrates clinical intervention needed to prevent possible misalignment and damage to internal aspect of implant body when confronted with implant in which internal threads are damaged.

Lack of Correlation between Benign Brain Tumors and Markers of Oral Health
Steven Lehrer, M.D.; Sheryl Green, M.B.BCh.; Kenneth E. Rosenzweig, M.D.

Examination of association of benign brain tumor incidence with number of dentists and other correlates of oral health was undertaken to determine what risk, if any, dental X-rays posed to development of intracranial meningioma.

Oral Cavity Lymphoid Neoplasms: A Fifteen-year Single Institution Review
Elizabeth Phillipone, D.M.D.; Govind Bhagat, M.B.B.S.; Bachir Allohead, M.D.

Retrospective search of surgical pathology database at New York City teaching hospital reviewed all oral biopsy specimens diagnosed as either lymphoma or plasma cell neoplasm over past 15 years. Forty-seven cases of oral cavity lymphoid neoplasms were identified. A report of those cases is presented.

Diagnosing the Parotid Lipoma
Ashley Houle, B.S.; Louis Mandel, D.D.S.

Clinical features of rarely reported and diagnostically challenging parotid gland lipoma are described. Case report.
As an orthodontist, I have treated many special needs patients. They all present with situations you don’t see ordinarily in the day-to-day practice of dentistry. Their malocclusions, for example, seem to be much worse than what I see in my other patients. However, I have always found treating these special needs patients to be very rewarding. They are challenging to be sure, but they appreciate all that I do for them. And they make you think about treatment beyond the typical plan.

Because of their disabilities, it takes longer than usual to treat special needs patients. Some treatments, for example, can involve a more difficult orthodontic-surgical approach. Nevertheless, I never regretted having them as patients. Their successful treatment gives me a sense of fulfillment that is greater than what I experience when treating someone without a disability.

Special needs patients need dental treatment, just like all other patients. However, during a typical dental education, students aren’t exposed much to special needs patients—which may be one reason these patients find it hard to find a dentist who will care for them. It might be also that dentists feel uncomfortable providing treatment, because of their limited knowledge and experience, so they avoid taking special needs patients into their practices—to the detriment of both the patient and the dentist.

As I said, I have found treating special needs patients to be very rewarding. The Down syndrome patients I have treated are the friendliest and most caring people you could ever encounter. One of my Down syndrome patients was an amateur comedian; he had us laughing at every appointment, telling us new jokes whenever he came in. Another was a sweet little girl, who just wanted to have straight teeth. When her braces came off, her smile melted my heart.

You may not feel comfortable treating patients with special needs. You may think you don’t have the proper education to undertake such a task. In that case, I have a suggestion to make. NYSDA and the New York State Dental Foundation are sponsoring a summit to address the future of special needs dentistry, hospital dentistry and dental education on May 14 and 15 in Albany. The event is titled “The Impending Oral Health Crisis: Ensuring Quality Dental Care and Access for New York’s Most Vulnerable Patients,” and it’s taking place in the Legislative Office Building on the Empire State Plaza.

The summit is the brainchild of NYSDA President Elect David Miller and Carl Tegtmeier, chair of NYSDA’s Council on Dental Health Planning and Hospital Dentistry. It is expected to
bring together a broad spectrum of knowledgeable presenters who will discuss varied topics concerning the treatment of special needs patients. The keynote address will be given by Robert Lewando, executive dental director of Blue Cross/Blue Shield of Massachusetts. The title of his presentation is “Linking Oral Health and General Health: How Oral Health Care Can Help Medical Costs.”

Richard Speisman, chair of the Department of Dentistry, Rochester Regional Health System, Rochester General Hospital, will discuss “Dental Care for Patients with Complex Treatment Needs.” John Morgan, associate professor at Tufts University School of Dental Medicine, will detail the “Challenges in Providing Preventive Care to Residents in Long-Term Care.” And Elizabeth Smith-Boivin, University School of Dental Medicine, will detail the “Challenges in Providing Oral Health Care in the Home Setting.” John Morgan, associate professor at Tufts University School of Dental Medicine, will detail the “Challenges in Providing Preventive Care to Residents in Long-Term Care.” And Elizabeth Smith-Boivin, University School of Dental Medicine, will detail the “Challenges in Providing Oral Health Care in the Home Setting.”

“A Collaborative Model to Reduce Health Costs” will be offered by Fred Ferguson, director of pediatric dentistry at Stony Brook University School of Dental Medicine. Gary Goldstein, director of the dental program for Emblem Health Family Dental Practice, and Carl Tegtmeier finish the first day with a report on the New York State Office of Persons with Developmental Disabilities Task Force on Special Needs Dentistry in “Transitioning Patients with Developmental Disabilities into Managed Care.” The second day of the symposium has equally relevant topics and speakers.

This promises to be an excellent, fact-filled, educational two days about a topic with which not many of us are familiar. Special needs patients deserve the best treatment we can give. This symposium will give us the knowledge and background we need to accomplish just that. I will be attending. I suggest if special needs patients are part of your practice, you do the same.

E-prescribing Delayed One Year
On another topic, NYSDA achieved legislative success in March when, working with the Medical Society of the State of New York, it persuaded the State Legislature and Gov. Cuomo to delay implementation of e-prescribing regulations for one year to ease what has been a difficult implementation. Scheduled to go into effect on March 27 of this year, the requirement that every dentist, physician and other health care personnel who write prescriptions, transmit those prescriptions electronically, will now take effect on March 27, 2016.

Even though NYSDA was ahead of the curve on implementation, recommending that its members subscribe to an e-prescribing service and securing such a service at a reduced rate, members were encountering technical glitches that made it difficult to sign up. Now we have another year to complete the process. My advice is not to wait until next year, but to complete the process as soon as you can. March 27, 2016, will be here before you know it, and there won’t be another extension.

Please, don’t be like my son, who waits until April 14 to fill out and file his tax forms. Every year I admonish him to get his taxes filed early, but that never seems to happen. Sign up now, so that your transition to e-prescribing will be a smooth one.

E. J. Hanley, D.D.S.
Clearing Up the Confusion about Medicare and Dentistry

Dentists have until December to properly enroll in Medicare to satisfy regulatory changes to the system.

Judith L. Shub, Ph.D.; Lance Plunkett, J.D., LL.M.

Most dental practices that treat patients over 65 years of age will be affected by a significant change to the Medicare regulations. Medicare recipients who purchase supplemental Medicare insurance policies (that is, Part D drug plans) will be eligible for benefits from those plans only when the ordering doctor has enrolled in Medicare by opting in, opting out or enrolled using the 8550. The Centers for Medicare and Medicaid Services (CMS) has delayed enforcement of this regulation until Dec. 1.

It is advisable for dentists to enroll now as Medicare providers or to submit affidavits indicating that they wish to opt out of the program. Because enrollment is not immediate, dentists should file the necessary documentation—or register online—to opt in, opt out or submit an 8550 form with Medicare as soon as possible. If a dentist takes no action, patients with Part D coverage will not receive benefits when their dentist writes a prescription for them. The important things to note are:

1. Regardless of your decision (to opt in, opt out or submit an 8550), your patients with Medicare Part D plans will have coverage for any prescriptions covered by their Part D plans.
2. Dentists who elect to opt out are not required to provide individual notification to patients in their practices, as dentistry is not included in the Medicare program. However, dentists who have opted out of Medicare are required to enter into a written agreement with a patient advising the patient that they are not Medicare providers only when and if they are performing a procedure covered by Medicare Part B.

Dentistry is excluded from the Medicare benefit package with limited exceptions. Opting out of Medicare has no real impact for most dentists because they do not perform medical treatment services covered by Medicare Part B. The only drawback to opting out is that it is in force for only two years.

Recently, in addition to opting in or out, CMS has established a third option that would enable patients with Medicare Part D Supplemental Drug Plans to receive coverage for their dentists’ prescriptions. Dentists now may choose to submit the Form 8550 to be placed on the Medicare Ordering and Referring Registry, which will deem them eligible to order and refer patients to Medicare enrolled providers and suppliers for prescribing. The ability to utilize the 8550 is a desirable alternative for most dentists, given that Medicare does not cover dental treatment and resubmitting opt out affidavits biannually is inconvenient. Submitting the 8550 is not a form of opting in, because it does not allow the practitioner to bill Medicare. But it is also not opting out, because it does not trigger any other obligations in that regard.

The new regulations do not change anything with respect to the relationship between dental specialists who do perform medical services covered by Medicare Part B and Medicare. Dentists who bill Medicare can simply continue to do what they have always done with respect to enrolling. That is, if they opt in, they are compelled to accept Medicare reimbursement when they perform a medical service covered by Medicare Part B. If they opt out, they can bill their patients and collect their usual fees.

1. It is advisable that dentists inform their patients that Medicare does not cover dental treatment. They may wish to include this information with instructions given to patients about the practice and its billing policies. Example: “Medicare does not cover dentistry. Our practice does not participate in Medicare. Nonetheless, if you have a Part D supplemental drug plan, your plan will cover your prescriptions because we have registered with the Medicare program.”
Medicare and Dentistry
Again, Medicare does not include coverage for routine dental treatment. Nonetheless, to refer or order services for a Medicare patient (where the service provider expects to be paid by Medicare), practitioners must be on record as known to the Medicare program. Medicare will not pay a second provider if the referring provider is not enrolled as a Medicare provider or has opted out. Do not be confused by the terminology. Opting out is different from completely ignoring Medicare by doing nothing. Opting out is a status that Medicare recognizes even though it means a doctor will not be billing and will not be reimbursed by Medicare.

Dentists are not required to provide written notification to their patients that they do not participate as Medicare providers unless they are providing services that are covered by Medicare Part A or B. Because dental care is excluded from Medicare generally, it is exempt from the advance beneficiary notice of non-coverage requirements.

Section 1862 (a)(12) of the Social Security Act states:
“where such expenses are for services in connection with the care, treatment, filling, removal, or replacement of teeth or structures directly supporting teeth, except that payment may be made under part A in the case of inpatient hospital services in connection with the provision of such dental services if the individual, because of his underlying medical condition and clinical status or because of the severity of the dental procedure, requires hospitalization in connection with the provision of such services.”

Most of the procedures performed by dentists who do qualify for Medicare reimbursement typically are performed by specialists—biopsies, including brush biopsies, for example. Medicare Part B excludes the following two categories of services from coverage:

1. A primary service (regardless of cause or complexity) provided for the care, treatment, removal or replacement of teeth or structures directly supporting teeth—for example, preparation of the mouth for dentures or removal of diseased teeth in an infected jaw.
2. A secondary service that is related to the teeth or structures directly supporting the teeth unless it is incidental to and an integral part of a covered primary service that is necessary to treat a non-dental condition (for example, tumor removal)

and it is performed at the same time as the covered primary service and by the same physician/dentist.

In cases where these requirements are met and the secondary services are covered, Medicare does not make payment for the cost of dental appliances, such as dentures, even though the covered service resulted in the need for the teeth to be replaced; the cost of preparing the mouth for dentures; or the cost of directly repairing teeth or structures directly supporting teeth (for example, alveolar process).

Certain dental services are always covered, including the extraction of teeth to prepare the jaw for radiation treatment of neoplastic disease, and an oral or dental examination performed on an inpatient basis as part of a comprehensive workup prior to renal transplant surgery or performed in a rural health center/federally qualified health center prior to a heart valve replacement. Dentists should contact Medicare directly with questions about whether a service will or will not be covered. A key thing to remember is that Medicare is not really paying for a dental service but, rather, is either paying for a covered medical service that a dentist can perform or is paying for a dental service that is a necessary adjunct to a covered medical service.

Understanding Medicare Part B and Supplemental Plan Coverage
There are two key issues to understand with respect to Medicare in deciding which enrollment option is best for an individual dentist. The first issue pertains to the scope of coverage of Medicare Part B. The second is the impact of the regulatory changes to the Part D supplemental plans taking effect this year.

Billing for Medicare Part B Covered Services
If a dentist has not opted out of the Medicare program and that dentist performs Medicare-covered services for patients eligible for Medicare, the dentist has only three options:

1. Enroll as a Medicare provider and submit a claim for the treatment in accordance with the Medicare fee schedule.
2. Refer the patient for services covered by Medicare to a dentist who is a Medicare provider.
3. Not charge the patient for the treatment provided.

Unless the dentist has opted out, the dentist legally cannot
charge a Medicare recipient for a treatment service covered under the Medicare Part B schedule.

Coverage for Prescription Drugs under Medicare Part D
Supplemental Coverage
As a result of new CMS regulations, in December, patients who purchase Medicare Part D prescription drug coverage will only receive benefits for prescriptions issued by prescribers who have enrolled with Medicare by opting in, opting out or submitting an 8550 enrollment application. Thus, it is beneficial for dentists to enroll with CMS to assure that their patients will be eligible for benefits when the dentist prescribes a covered drug.

Medicare Dental Advantage Plans
Medicare Advantage plans are part of Medicare. They are issued by private insurers contracted to administer Medicare benefits. A provider who opts out cannot be paid any Medicare dollars for Part B Medicare services. This does not affect dentists who contract with Medicare supplemental dental plans because Medicare Part B does not pay for dental services.

As with Part B, Medicare Advantage plans are prohibited from paying anyone who is opted out of Medicare for services that Medicare Part B otherwise pays for. Since Medicare Part B basically does not pay for dental services, these dentists are not affected directly by this. However, it is important for anyone contracted as a Medicare Advantage provider to review whether he or she is contracted to provide medical services and consider this in making any enrollment decision. Nonetheless, it would be virtually anomalous for this to make any difference with a supplemental dental plan under Medicare Advantage.

Sleep Apnea Devices
There is one other type of service for which dentists are eligible for Medicare reimbursement. Dentists who fabricate sleep apnea/snoring devices for patients over 65 years of age must enroll with CMS as providers of durable medical equipment (CMS form 855S). This is unrelated to the dentist’s status as a Medicare provider for the purpose of billing for medical/dental treatment. It is completely unrelated to the doctor’s status as a practitioner. A dentist who enrolls using form 855S would still need to opt in or opt out as a dentist provider.

Treatment for sleep apnea is outside of the scope of practice for dentistry in New York State. Because dentists do not treat sleep apnea, they cannot submit claims to Medicare for such treatment. Nevertheless, dentists can fabricate sleep apnea appliances on the order of a physician. Dentists who fabricate such appliances must be registered with Medicare as a DME (durable medical equipment) provider to bill Medicare or Medicare Advantage for any sleep apnea device. Medicare is billed for the DME service, not for the dental/medical service by the DME provider—in this instance, the DME provider just coincidentally happens to also be a dentist. Dentists who fabricate sleep apnea appliances can enroll as DME providers on the CMS website.

A dentist may enroll as a Medicare DME provider and opt out of Medicare Part B. DME suppliers cannot opt out of Medicare with respect to payment for durable medical equipment, that is, sleep apnea devices. No Medicare dollars can be paid by anyone to a DME supplier who is not registered with Medicare. A dentist who makes sleep apnea devices cannot be paid with Medicare monies if the person is not registered as a DME provider.

How to Enroll or Opt Out
Patients’ ability to obtain benefits from the program and supplemental insurers is not affected—as long as the dentist opts in or out (or completes the 8550). In order to opt out, the dentist must notify the contractor handling Medicare claims for New York State that he or she intends to contract privately with Medicare patients. This is done by filing an affidavit in which the dentist attests to certain specific terms. Affidavits must be filed within 10 days of entering the first private contract and are valid for two years. Non-Medicare enrolled dentists wanting to opt out must obtain and use a Unique Physician Identifier Number (UPIN) provided by the Medicare carrier.

Information and forms to enroll are available at:
http://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/MedicareProviderSupEnroll/EnrollmentApplications.html.

Alternately, practitioners can file an opt out affidavit with the contractor for New York State, National Government Services, Inc. To opt out of Medicare, you must file a Medicare Opt Out Affidavit. The required form is available on the NYSDA website, www.nysdental.org, in the “members only” section.

Contact information for National Government Services, Inc., is as follows:

For additional information regarding opting out, log onto:

For general information, call the Medicare provider customer service number, 1 (866) 837-0241.

Dr. Shub is NYSDA Assistant Executive Director for Health Affairs. Mr. Plunkett is NYSDA General Counsel.
Barotrauma
Tooth under Pressure

Satheesh Kumar, B.D.S., M.D.S.; Preeti Satheesh Kumar, B.D.S., M.D.S.; Jins John, B.D.S., M.D.S.; Ruchi Patel, M.D.S.

ABSTRACT

With the growing number of air passengers, flight attendants, leisure pilots, as well as military and airline pilots, dentists may encounter physiological and pathological phenomena precipitated by high altitude. With the introduction of the self-contained breathing apparatus (SCUBA), many of these manifestations caused by changes in atmospheric pressure were reported in association with diving as well. Limited literature exists on this subject. Hence, this article aims to review literature concerning the classification, etiology and manifestations of barodontalgia, as well as important clinical considerations for its management.

Barodontalgia, which affects air crew and aircraft passengers, as well as underwater divers, is pain or injury affecting teeth due to changes in pressure gradients.1 It has been reported also as a consequence of air bag rupture and the high pressure air inhaled by the car driver during an accident.2 It is sustained from the failure to equalize the pressure of an air-containing cavity to that of the surrounding environment.

In general, barotrauma is defined as pressure-induced damage that can occur at both high and low pressures. Changes in ambient pressure, for example, during flying, diving or hyperbaric oxygen therapy, can lead to barotrauma. Flying and diving are usually associated with different types of pressure changes. During commercial flights, for example, aircraft personnel are exposed to only minor pressure differences, but this exposure lasts for a relatively long period of time.

By contrast, military and aerobatic pilots are subjected to rapid pressure changes and strong acceleration forces. As a result of the higher density of the surrounding medium, divers are exposed to very high ambient pressures. Compared with aircraft personnel, however, the duration of exposure is usually short. Depending upon diving depth and technique, there are considerable differences in the breathing gases used. This causes further physiological and metabolic changes in the human body, in addition to changes in ambient pressure.3

Etiology

Barodontalgia is a symptom rather than a pathological condition and in most cases reflects a flare-up of pre-existing oral disease; hence, most common oral pathologies have been reported as possible sources of barodontalgia.4,5,6

The chief prerequisite for toothache at high altitude is the presence of some pre-existing pathological disturbance of the pulp. The environmental changes associated with high altitudes may cause an exacerbation of symptoms. High altitude environment does not affect a normal pulp.

From an analysis of more than 1,000 case histories by the army/air force dental research group,6 toothaches at altitude were grouped into the following three categories on the basis of clinical findings:

Group I: Pain in teeth with irreparable damage to the pulp. Clinical findings included pulp destruction and periapical lesions. Treatment includes root canal therapy or extraction.
Barodontalgia affects 11.9% of divers and 11.0% of military air crews, with a rate of 5 episodes/1,000 flight-years. Upper and lower dentitions were affected equally in flight, but more upper than lower dentitions were affected in diving. The most prevalent etiologic pathologies for in-flight dental pain were faulty dental restorations (including dental barotrauma) and dental caries without pulp involvement (29.2%), necrotic pulp/periapical inflammation (27.8%), vital pulp pathology (13.9%), recent dental treatment or “postoperative barodontalgia” (11.1%). Barosinusitis was the main cause of pain in 9.7% of the cases. 1,4,7

Barodontalgia was most prevalent in the third decade of life and showed no gender preference.

**Classification**

Barodontalgia is subgrouped into direct (dental-induced) and indirect (nondental-induced) pain. The currently accepted classification of direct barodontalgia consists of four classes according to pulpal/periapical conditions and symptoms. 4,8,9

Strohaver 10 has advocated the differentiation of barodontalgia into direct and indirect types. In the direct type, reduced atmospheric pressure contributes to a direct effect on a given tooth. In the indirect type, dental pain is secondary to stimulation of the superior alveolar nerves by a maxillary barosinusitis.

Direct barodontalgia is generally manifested by moderate-to-severe pain, which usually develops during ascent, is well localized, and the patient can frequently identify the involved tooth. Indirect barodontalgia is a dull, poorly defined pain that generally involves the posterior maxillary teeth and develops during descent. If pain occurs during descent, indirect barodontalgia attributable to barosinusitis should be suspected. If indirect barodontalgia is diagnosed, the patient should be referred to a medical practitioner or an ear, nose and throat specialist for treatment. 11,12

**Pathology**

The pathology of barotrauma is directly related to Boyle’s law, which states, if temperature remains constant, the volume of a fixed mass of an ideal gas is inversely proportional to the pressure of the gas. As pressure increases, the volume of a confined gas decreases. Specifically, as a person descends deeper and deeper below the water surface, pressure exerted on the diver by the water increases and reduces the volume of gases in enclosed spaces such as teeth and sinuses.

The same law applies if a person climbs to high altitudes (in flight); in this case, outside pressure decreases, permitting the volume of gases to increase. 1,14,15 Pain during ascent can indicate the presence of a disease of vital pulp tissue (pulpitis). Pain during descent can be indicative of pulp necrosis or facial barotraumas. 3,15

**Pathogenesis**

There was no published research regarding the pathogenesis of barodontalgia in the past decade. Some theories exist, but most were offered in the first half of the 20th century. Kollmann 5 refers to three important hypotheses to explain this phenomenon: expansion of trapped air bubbles under a root filling or against dentin that activates nociceptors; stimulation of nociceptors in the maxillary sinuses, with pain referred to the teeth; and stimulation of nerve endings in a chronically inflamed pulp. 1 He strongly supports the last two hypotheses and states, for the latter, that histologic evidence shows that chronic pulpal inflammation can still be present even when a thin dentin layer covers the pulp—for example, as in a deep cavity preparation. 1 Yet the pathogenesis of this unique dental pain remains occult.

**Diagnosis**

Certain generalities have been established to help with the diagnosis of direct barodontalgia. Posterior teeth are more frequently involved than anterior teeth, while maxillary teeth are affected more often than mandibular teeth. Teeth with amalgam restorations are more likely to be involved than unrestored teeth; and recently restored teeth are particularly susceptible. Examination of a patient complaining of barodontalgia should include an estimation of the age of restorations in the suspected area, exploration for caries or defective restorations, percussion of any suspected tooth, the patient’s response to the application of electrical stimulation and/or cold and heat, and radiographic examination. 11,16,17 Appropriate radiographs of the suspected teeth should be obtained, with the understanding that a negative radiograph does not rule out pulpitis. 16

Barodontalgia has been found to occur during diving in teeth with carious lesions, or where there are periapical lesions, periodontal abscesses, maxillary sinus congestion and recently crowned teeth.

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**TABLE 1**

**Classification of Direct (dental-induced) Barodontalgia**

<table>
<thead>
<tr>
<th>Class Pathology Features</th>
<th>Features</th>
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<tbody>
<tr>
<td>1. Irreversible pulpitis: Sharp transient (momentary) pain on ascent.</td>
<td></td>
</tr>
<tr>
<td>2. Reversible pulpitis: Dull throbbing pain on ascent.</td>
<td></td>
</tr>
<tr>
<td>4. Periapical pathology: Severe persistent pain (on ascent/descent).</td>
<td></td>
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</tbody>
</table>
Strohaver has recommended that diving drills be restricted for 48 to 72 hours to allow time for the dental pulp to “quiet down” or stabilize. Overall, regular dental examinations are essential for divers. And any dental problem that might predispose to barodontalgia should be corrected to prevent the development of symptoms.11

Exposure to reduced barometric pressure is evidently a precipitating factor, with disease of the pulp a probable cause. Ferjentsik et al.8 stated that normal pulp tissue would not produce pressure-associated pain, regardless of whether restorations or caries were present. However, Hodges19 has reported that dental pain could be produced in apparently healthy teeth when the atmospheric pressure was increased to a level corresponding to a depth of three atmospheres.

The clinician has to discover the offending tooth, which could be any tooth with an existing restoration or with endodontic treatment (often clinically acceptable) and/or adjacent anatomical structures (e.g., maxillary sinus). The clinician usually cannot reproduce the pain trigger (i.e., barometric pressure change) in ordinary dental facilities and, even in a diagnostic altitude chamber simulation, sometimes it is impossible to reproduce the pain.

**Discussion**

The first description of pressure-related disease was written by Paul Bert in 1978, when he noted symptoms of Caisson disease in bridge workers who, after finishing their shifts and returning to the surface, presented with dizzy spells, difficulty in breathing and pain of the abdomen and joints.2

During World War II, as aircraft began to fly at altitudes greater than 25,000 feet, the number of dental emergency visits by flight crewmen increased.20 The name of this dental pain was given the prefix “aero” (i.e., aerodontalgia) and was reported for the first time as an in-flight physiologic and pathologic phenomenon at the beginning of the 20th century. In the 1940s, with the appearance of SCUBA, many in-flight manifestations caused by barometric changes were found to be associated with diving as well. Consequently, the prefix was changed to “baro,” a broader, more appropriate term, barodontalgia. In the diving environment, this pain is commonly called “tooth squeeze.”

Barodontalgia, which affects air crews and aircraft passengers, as well as underwater divers, is pain or injury affecting teeth due to changes in pressure gradients.1,14,22 The prevalence of barodontalgia was 1% to 3% of all military flights and was ranked fifth for in-flight physiological complaints of U.S. pilots and third as a causative factor of premature landing.6,20,23 Barodontalgia was reported to occur during flying at altitudes of 600m to 1500m and during diving at depths of 10m to 25m.3,15 It is well known that as one rises in the atmosphere, air density and pressure fall. The drop in pressure is such that at 6,000 meters, the air pressure is around half that at sea level. At about 10,000 meters, it is a quarter of its sea level value.2

**TABLE 2**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pulp disease-induced (direct) barodontalgia</th>
<th>Periapical disease-induced (direct) barodontalgia</th>
<th>Barosinusitis, barotitis media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause</td>
<td>Pulp disease</td>
<td>Periapical disease</td>
<td>Barosinusitis, barotitis media</td>
</tr>
<tr>
<td>Appearance</td>
<td>During ascent</td>
<td>Periapical periodontitis: usually at high altitude [38,000 ft] during ascent or descent</td>
<td>During descent Pain usually continues on ground</td>
</tr>
<tr>
<td>Symptoms</td>
<td>Nonreversible pulpitis: sudden sharp penetrating pain, reversible pulpitis or necrotic pulp: dull beating pain</td>
<td>Continuous intense or dull beating pain, swelling</td>
<td>Dental pain in maxillary molar or premolar region</td>
</tr>
<tr>
<td>Dental History</td>
<td>Recent dental work, Recent dental thermal sensitivity (e.g., during hot or cold drinking)</td>
<td>Recent dental percussion sensitivity (e.g., during eating)</td>
<td>Present upper respiratory infection Past sinusitis illness</td>
</tr>
<tr>
<td>Clinical Findings</td>
<td>Extensive dental caries lesion or (defective) restoration, Acute pain upon cold (40°C) test</td>
<td>Extensive caries lesions or (defective) restoration, Acute pain upon percussion test</td>
<td>Pain on sinus palpation Pain upon acute change in head position</td>
</tr>
<tr>
<td>Radiological Findings</td>
<td>Pulpal caries lesions Restoration close to pulp chamber</td>
<td>Pulpal caries lesions Restoration close to pulp chamber Periapical radiolucency</td>
<td>Opacity (fluid) on maxillary sinus image</td>
</tr>
</tbody>
</table>
The physical properties of the gas mixture used during deep sea diving may also contribute to barodontalgia. In scuba tanks, oxygen’s natural diluent gas, nitrogen, is replaced by helium, resulting in a gas of lower viscosity. This gas can enter tissues, including teeth, and can sometimes become trapped in closed spaces, such as the pulp chamber and root canal. There are two mechanisms by which gases can be trapped in spaces: if there is a space between a tooth and its restoration, gas may be forced into it during an increase in pressure; and dissolved gas may diffuse from tissues into spaces as pressure decreases. Consistent with Boyle’s Law, trapped gas will expand and the resulting stress may cause tooth fracture.1

Calder and Ramsey studied tooth fracture at high altitude and have coined the term “odontecrexis” (Greek for tooth explosion) to describe this physical disruption of teeth with leaking restorations due to barometric pressure change.24

Clinically, people affected by barodontalgia were found to have one or more of the following: acute or chronic periapical infection; caries; deep restorations; residual dental cysts; sinusitis; and a history of recent surgery.1,12 The latter is of particular concern for people wearing oxygen regulators when diving, using self-contained underwater breathing apparatus (scuba) or when wearing oxygen masks during high performance aircraft flights, due to the risk of air being pushed into the tissues. Sinusitis may also contribute to barodontalgia, although it may not be related to any tooth pathology.1

Kennebeck et al.6 have suggested that decreased atmospheric pressure plays a role in the development of apical lesions and in the dissemination of focal infection. Hence, apical periodontitis due to necrosis of the dental pulp tissue can also be considered a causative pathology of the pain.21 In the literature,15 pulpitis with periapical inflammation or after dental restoration is reported to be the most common cause of barodontalgia.

Ear-nose-throat disorders account for more than 50% of cases of flying-associated diseases. The middle ear is the most common structure to be subjected to barotrauma, whenever the Eustachian tube is functionally impaired because of mucosal congestion or edema. Symptoms may include clogging of the ear, ear pain, dizziness, tinnitus and hemorrhage. The paranasal sinuses may also be affected if the sinus orifices are occluded.

The Fédération Dentaire Internationale (FDI) has classified barodontalgia into four groups according to its signs and symptoms. From moderate to severe, they are: acute pulpitis; chronic pulpitis; necrosis of the pulp; and periapical abscess or a cyst. The FDI also recommends an annual checkup for divers, submariners and pilots, with oral hygiene instructions from dentists.1,7

Prevention

Periodic oral and dental examinations, including periapical radiographs and vitality tests, are recommended for the prevention of barodontalgia in high-risk populations (e.g., aircrews, divers). In addition, screening panoramic radiographs are recommended for these populations at three- to five-year intervals.1,17 When dealing with patients involved in diving or aviation, clinicians should pay close attention to areas of dentin exposure, caries, fractured cusps, periapical pathology, defective (fractured or cracked) restorations, restorations with poor retention, secondary carious lesions and signs of attrition.1,13,14,15,18

Retrospective studies showed that most patients with clinical manifestations of barodontalgia had carious lesions or defective restorations extending into the dentin.6 The clinical implication of this finding is that patients who have carious lesions or who have undergone dental treatment, including the exposure of dentin, for example, during prosthetic tooth preparation, should avoid exposure to pressure changes until definitive treatment is completed.15

As a rule, individuals should undergo a thorough dental examination before being exposed to pressure changes. Treatment must include the restoration of all carious lesions, the removal of all defective restorations and the management of inflammation. Vitality testing of all teeth is required for the detection and treatment of asymptomatic pulp necrosis.3 Dentists should advise patients to avoid exposure to pressure changes until all necessary surgical, conservative and prosthetic procedures have been completed.15
Based on the results of the study conducted by Khanna,11 dental surgeons should consider cementing fixed prosthetics with resin cements for patients who are exposed to marked variations in environmental pressure, such as divers and submariners during escape drills. The placement of a zinc oxide eugenol (ZOE) base was found to prevent barodontalgia when reversible pulpitis was the underlying cause. This is attributed to the well-known sedative effects of zinc oxide eugenol.1,7,22

Rossi dictates the grounding of military aircrews from the time of diagnosing the need for endodontic treatment until completion of treatment. He recommends against direct pulp capping in the military aircrew patient and for pulpectomy and endodontic treatment in all caries management in which exposure of the pulp chamber is evident or suspected.1,4,7,13

Stoetter et al. suggest that warm gutta-percha obturation techniques are preferred to cold lateral condensation or warm carrier-based Resilon obturation techniques in the endodontic treatment of patients such as professional divers or parachutists, who are often exposed to changes in atmospheric pressure.25

Temporary flight restriction (grounding) after dental and surgical procedures is still a powerful tool for prevention of post-operative barodontalgia.13

Recommendations

Although barodontalgia is not common, it should not be dismissed as unimportant, as it can pose a serious safety risk to divers, submariners, pilots and airline passengers. It may be prevented by regular dental examinations, with adequate attention paid to existing dental restorations. The flight population would be better served by a more comprehensive understanding of the issues and awareness of the limitations of our current knowledge base.

Patients should not dive or fly in non-pressurized cabins within 24 hours of dental treatment requiring aesthetic or seven days following surgical treatment.1 A subject of aviation dentistry needs to be incorporated into the dental curriculum. Continuing dental education programs should be conducted to educate dental and healthcare professionals about the prevalence, diagnosis and treatment of barodontalgia.

Summary

The article presented here reviews available literature regarding barodontalgia. Although it may seem that barodontalgia was almost neglected in dental education and research in the second half of the 20th century, reports appearing during the past decade were gathered to draw an updated image of this pain entity. The efforts of more researchers, educators and clinicians are needed for further enhancement of theoretical, as well as practical, knowledge of barodontalgia.  

Queries about this article can be sent to Dr. Satheesh Kumar at drkskk@gmail.com.

REFERENCES

TMJ Changes in Adolescent TMD Patients Seen on MRI in Clinical Setting

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ABSTRACT
To determine whether temporomandibular joint (TMJ) changes are similar between adolescent and older TMJ disorder (TMD) patients, a retrospective chart review for TMJ MRIs was done for disc and bone changes. Patients were divided into adolescent, adult and elderly groups. Results: The groups had similar prevalence of joint changes and number of joints involved. Disc changes were more prevalent in adolescents (p=0.008), while bone changes were more prevalent in the elderly group (p=0.10). Anterior disc displacement was the most common finding and was most prevalent in adolescents (p<0.001). Conclusion: Adolescents display similar disc/bone changes in their TMJ as older TMD patients.

The temporomandibular joint (TMJ) is a synovial joint composed of the mandibular condyle, articular disc, the glenoid fossa and articular eminence of the temporal bone. The articular disc is a biconcave disc consisting of three zones: an anterior band, intermediate zone and posterior band. The thinnest is the intermediate zone, which sits between the mandibular condyle and mandibular fossa and eminence. On normal opening, the condyle and disc both translate forward to the articular eminence, with the intermediate zone of the articular disc remaining between the condyle and eminence. Anatomical disorders of the TMJ can occur when disc and/or condyle fails to translate properly.

Clinically, signs and symptoms of temporomandibular joint disorder (TMD) include joint noises, locking, pain, muscle tightness/tenderness, tinnitus and psychosocial effects. The pain and discomfort resulting from TMD may restrict the daily activities of children and adolescents, including talking, eating and sleeping, with these restrictions increasing with age in the adolescent population. Pain caused by TMD has been found to have an impact on behavioral and psychosocial factors. It is more prevalent in girls than boys. This increased likelihood of females having TMD signs and symptoms compared to males has been found to be similar to the higher prevalence in females compared to males of having TMD in later stages of life.

Disc displacement, osteoarthritis and myofascial syndromes are the major classes of TMD, the first two of which can be seen on MRI. MRI is the current gold standard in diagnosis of TMD, although diagnosis of disc displacement can be up to 83% accurate based only on clinical signs and symptoms.

Many MRI studies have been performed to determine the prevalence of changes occurring in TMD patients, but these studies tend to look at all patients as a single population. MRI studies have also been performed to determine the type of specific changes that can be seen in children and adolescents, but these often lack comparison to the adult TMD.
population, which has been well studied. Therefore, this study aims to compare the pattern of changes found on MRIs of children and adolescent TMD patients compared to those of TMD patients in the later stages of life to determine whether there are similarities.

### Material and Method

Medical charts were reviewed for patients who were seen between July 2009 and July 2012 at a private oral medicine clinic. Patients were included in the study if they complained of TMD symptoms, including popping/clicking, pain and locking at the initial assessment, and had an MRI done subsequently. A total of 159 MRI reports from various hospitals in Ontario, Canada, were reviewed and grouped by patient age into adolescent group (8-18 years old), adult group (30-39 years) and elderly group (>50 years old).

MRIs were reviewed for disc changes, including displacement, tear, morphological changes and degenerative and morphological bone changes, for each group.

The Mantel-Haenszel test was performed to look for a linear trend across categories. The Chi-square test was performed to look for any differences between the study groups. Pairwise comparisons were performed if the overall test was statistically significant. Bonferroni correction was performed, and comparisons were considered statistically significant at 0.05/3=0.0167. Fisher’s Exact test was performed for bone changes due to the low number of subjects.

### Results

There were no differences among the three groups in terms of gender distribution (p=0.456) (Table 1). The prevalence of changes found on MRI were not significantly different (p=0.268) among the three groups, nor were the number of joints affected (p=0.757) (Table 2). The Chi-square test was significant for disc changes (p=0.025), and disc and bone changes (p=0.023); however, pairwise comparison with Bonferroni correction at a significance of p<0.0137 did not demonstrate significant differences in prevalence of disc and bone changes among the different groups except for anterior displacement of the disc without reduction, which was significantly higher in the adolescent group compared to the adult group (p <0.001), and disc changes, which were significantly higher in the adolescent compared to the elderly group (p=0.007) (Table 3).

Anterior displacement of the disc was the most prevalent change noted on MRI in all three groups, with 75.0% in the adolescent group, 62.5% in the adult group and 43.6% in the elderly group. Anterior displacement without reduction was significantly higher in the adolescent group compared to the adult group (p<0.001) (Table 4).

The Mantel-Haenszel test demonstrated a linear correlation between age and the prevalence of disc changes (p=0.008) and bone changes (p=0.10). This trend can also be seen in Graph 1.
Discussion

Three study groups were formed based on the process of maturation of the mandibular condyle. The adolescent group included children from 8 years up to 18 years, since subchondral cortical bone formation begins at the age of 13 to 14 in boys and 12 to 13 in girls and is usually completed by the early 20s. The adult groups consisted of patients between the ages of 30 and 39, as their cortical bone has completed formation and has not been affected by the onset of osteoporosis. Patients ages 50 and over were grouped into one group, since by the age of 50, more than 55% of the population will have osteoporotic changes.

MRI studies of the TM joints were prescribed because of the MRI’s sensitivity compared to clinical diagnosis based on signs and symptoms in identifying soft tissue changes, as well as its ability to demonstrate bone changes. Although CT scans are better at identifying bone changes, MRI has an advantage in that it is a relatively safe imaging study that does not expose patients to radiation and is, therefore, an appropriate screening device in children and adolescents.

All three groups showed a female predominance of TMD, which is consistent with current literature. All three groups show similar proportions of the number of patients with changes found on MRI, indicating that disc and joint change occurrence is not related to age but may be due to other factors, such as gender, anterior crossbite, condylar displacement, sleep bruxism, etc.

However, the type of changes seems to be affected by the age of patients. The Mantel-Haenszel test showed a linear trend between age and disc changes, as well as age and bone changes. As the patient population increased in age, the prevalence of disc changes decreased, while the prevalence of bone changes increased, which was consistent with the finding of Guarda-Nardini et al. (2012) of a decrease in internal derangement with increased age and increased inflammatory-degenerative changes with increase in age. Disc changes were significantly more prevalent in the adolescent group than in the elderly group suggesting that disc changes may be inducing bone remodeling of the TM joints. The elderly group displayed more bone changes consistent with the onset of osteoarthritis.

The prevalence of having both joints showing changes was more predominant in all groups, with anterior disc displacement the most commonly found change noted on MRIs in all three groups: 75.0% (30/40) in adolescents; 62.5% (40/64) in adults; and 61.8% (32/55) in the elderly group. Lateral, medial and posterior disc displacement was not examined due to lack of details on the majority of the MRI reports. In all groups, the prevalence of having a disc that reduces is the highest, with the adolescent group
having a significantly higher prevalence of fixed discs than the adult population, consistent with the Guarda-Nardini et al. (2012) finding of a decrease in internal derangement with increased age.17

The results of the study suggest that children and adolescent TMD patients show similar patterns in terms of changes found on MRI. However, the study is limited in its retrospective design with the lack of strict control in location and reading of the MRI. The design of the study also did not take into account the experiences of radiologists in terms of reading a TMJ MRI. In addition, MRI is limited when it comes to visualizing bone changes, with CT scan a better choice; therefore, many bone changes may have been missed.

Although there are several limitations in the designs of this study, the results describe what may be presented on TMJ MRIs in a clinical setting, as not all TMD patients can attend the same hospital for MRIs and have the same radiologist read the MRI. A future study with a well-controlled, prospective design will help in better understanding the changes in TMJ in adolescent TMD patients.

Conclusions
Based on the results of this study, young TMD patients would benefit from both clinical examination and imaging study before treatment planning to allow for the best possible outcome. Further, prior to orthodontic or other dental treatment, including extraction of wisdom teeth, pre-screening with MRI in young TMD patients may be helpful in factoring in the presence of jaw changes while undergoing these treatments, thereby preventing aggravation of the joint that may eventually lead to TMJ surgery.

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REFERENCES
Evaluation of Orthodontic and Triple-headed Toothbrushes When Used Alone or in Conjunction with Single-tufted Toothbrush in Patients with Fixed Lingual Orthodontic Appliances

A Randomized Clinical Trial

Malka Ashkenazi, D.M.D.; Nurit Flaisher Salem, D.M.D.; Silvia Garon, D.M.D.; Liran Levin, D.M.D.

ABSTRACT

Brushing with a single-tufted toothbrush in conjunction with a manual toothbrush has been widely recommended, although its effectiveness has not been proven. This study investigated the effectiveness of orthodontic and triple-headed toothbrushes when used alone or in conjunction with the single-tufted toothbrush in patients with fixed lingual orthodontic appliances.

Methods: In this randomized, single-blinded, controlled clinical trial, orthodontic patients (N=26, mean age 27.3 years) with lingual fixed appliances were asked to brush with a triple-headed or an orthodontic toothbrush alone for one month, followed by brushing in conjunction with the single-tufted toothbrush for an additional month. Teeth were professionally cleaned at baseline and one month later. A clinician blinded to group assignments examined the patients and evaluated tooth plaque index, bracket plaque index, modified gingival index and bleeding on probing at baseline at one month and two months.

Results: After one month of brushing with the orthodontic toothbrush, the mean plaque index for tooth and bracket, bleeding index and gingival index were higher by 74.4% (0.68 vs. 0.39, p=0.026), 54.2% (0.37 vs. 0.24), 15.4% (0.15 vs. 0.13) and 30% (0.26 vs. 0.20), respectively, than after brushing with the triple-headed toothbrush. After combined brushing with the single-tufted toothbrush, no additional statistical differences were found between groups.

Conclusion: When used alone, the triple-headed toothbrush seems to remove plaque more effectively than the orthodontic toothbrush. The addition of the single-tufted toothbrush eliminates differences between groups.

Orthodontic brackets and wires tend to trap food and debris and increase plaque retention, hampering toothbrushing and increasing enamel decalcification and gingivitis. Regular toothbrushing reduces caries and gingivitis by reducing dental plaque and is of utmost importance during orthodontic treatment.
In patients undergoing treatment with lingual fixed orthodontic appliances, the proximity of the brackets, ligatures and wires to the gingival margin, and the small inter-bracket distance, might also promote accumulation of plaque and calculus on the teeth, further impeding access of the toothbrush and obscuring the detection of plaque. These individuals suffer frequently from gingival inflammation and, therefore, are required to increase their toothbrushing skill and effort to maintain an adequate level of oral hygiene.

Several toothbrushes have been designed to assist toothbrushing performance in individuals with labial fixed appliances, including a manual orthodontic brush, manual triple-headed toothbrush, electric brushes and interproximal brushes. A recently published systematic review concluded that the evidence supporting the use of powered toothbrushes for orthodontic patients is insufficient. Further, studies measuring the effectiveness of orthodontic compared to conventional toothbrushes in reducing plaque and gingivitis in teeth with labial fixed appliances have produced conflicting results. The triple-headed toothbrush was shown to be more effective than the conventional or orthodontic toothbrush in reducing plaque and improving gingival health in patients with lingual fixed orthodontic appliances, and in removing plaque from the lingual aspect of teeth in children and adults.

Some practitioners advocate the use of inter-dental brushes for improving plaque removal in patients undergoing orthodontic treatment with fixed appliances. In 2008, a systematic review evaluated the evidence-based benefit of using inter-dental brushes in addition to standard toothbrushes in increasing plaque removal and improving dental health of patients undergoing fixed orthodontic appliance therapy. The authors did not identify any studies that met their search criteria.

Despite the fact that effective toothbrushing of teeth with lingual fixed orthodontic appliances requires higher skill and effort, we could not find in an English language literature search any studies that evaluated the effectiveness of different toothbrushes in patients with lingual appliances.

The aims of the present study were to evaluate orthodontic and triple-headed toothbrushes when used alone or in conjunction with the single-tufted toothbrush in patients with fixed lingual orthodontic appliances.
Material and Methods

Ethics
The Ethics Committee of Tel Aviv University approved the study, participation was voluntary and written consent was obtained from the participants.

Study Population
Participants in this randomized, single-blinded, controlled clinical trial were healthy patients without periodontal disease who received orthodontic treatment at the Department of Orthodontics, School of Dental Medicine, Tel Aviv University, or at the private practice of one of the authors (SG), and who were treated by lingual fixed appliances. The subjects were asked personally to participate in the study. They were told that participation would require toothbrush prophylaxis and scaling every month for a two-month period, free of charge, and that the examination would be performed during their regular appointments.

Inclusion criteria were patients who received orthodontic treatment using lingual fixed appliances and agreed to participate in the study. Exclusion criteria were non-lingual orthodontic treatment and an unwillingness to participate.

Study Design
At baseline, before assignment to the groups, the lingual aspects of teeth with brackets were evaluated for:

- Tooth plaque index (0-no plaque; 1-islands of plaque; 2-continuous line of plaque < 1 mm; 3-continuous line of plaque ≥ 1 mm).18
- Bracket plaque index (indexed between 0 and 3).19
- Modified gingival index (0-absence of inflammation; 1-mild inflammation, slight change in color, little change in texture of any portion of marginal or papillary gingival unit; 2-mild inflammation as above but involving the entire marginal or papillary gingival unit; 3-moderate inflammation, glazing, redness, edema and/or hypertrophy of marginal or papillary gingival unit; 4-severe inflammation, marked redness, edema and/or hypertrophy of marginal or papillary gingival unit, spontaneous bleeding, congestion or ulceration).20-21
- Bleeding on probing index (0-no bleeding within 15 seconds; 1-point bleeding within 15 seconds; 2-abundant bleeding within 15 seconds),21-22 as described previously.5

All evaluations were performed and recorded by one calibrated dentist (NFS).

Table 1

<table>
<thead>
<tr>
<th>Plaque Index Tooth at Baseline and at One- and Two-month Follow-up</th>
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<tbody>
<tr>
<td>Tooth</td>
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<tr>
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</tr>
<tr>
<td>THTB maxilla</td>
</tr>
<tr>
<td>OTB maxilla</td>
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<tr>
<td>Between groups p-value</td>
</tr>
<tr>
<td>THTB mandible</td>
</tr>
<tr>
<td>OTB mandible</td>
</tr>
<tr>
<td>Between groups p-value</td>
</tr>
<tr>
<td>THTB total</td>
</tr>
<tr>
<td>OTB total</td>
</tr>
<tr>
<td>Between groups p-value</td>
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</tbody>
</table>

*Two patients dropped from study

Table 2

<table>
<thead>
<tr>
<th>Plaque Index Bracket at Baseline and at One- and Two-month Follow-up</th>
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<tr>
<td>Bracket</td>
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<tr>
<td>---------</td>
</tr>
<tr>
<td>THTB maxilla</td>
</tr>
<tr>
<td>OTB maxilla</td>
</tr>
<tr>
<td>Between groups p-value</td>
</tr>
<tr>
<td>THTB mandible</td>
</tr>
<tr>
<td>OTB mandible</td>
</tr>
<tr>
<td>Between groups p-value</td>
</tr>
<tr>
<td>THTB total</td>
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<tr>
<td>OTB total</td>
</tr>
<tr>
<td>Between groups p-value</td>
</tr>
</tbody>
</table>

*Two patients dropped from study

THTB- Triple-headed toothbrush OTB- Orthodontic toothbrush
lars were excluded from the study. Immediately after examination, teeth were professionally cleaned to obtain a plaque-free condition at baseline. The patients were then randomly assigned to use one of two toothbrushes. Thirteen (nine females and four males) were assigned to use a triple-headed toothbrush (regular size, Dr. Barman Superbrush, Dentaco AS, Norway) and 13 (nine females and four males), an orthodontic toothbrush (Ortho Brush, Paro, Switzerland).

Each participant was personally instructed by the same dentist (NFS) regarding toothbrushing using the toothbrush he/she was assigned. Instruction for toothbrushing included an explanation of the purpose of brushing and a demonstration of the technique on a plastic model and on their own teeth. To improve plaque removal around the orthodontic brackets, the patients were instructed to brush 15 strokes for each group of tooth surfaces. They were further instructed to brush their teeth twice daily—in the morning and in the evening, immediately after meals—and to use the same toothpaste (Elmex, Teva 1400ppm F-, Gaba International, Switzerland), which they received free of charge. To avoid bias, patients were asked to abstain from using oral rinses and gels during the study.

For the follow-up visits, patients were asked to brush their teeth immediately before arriving to the dental appointment; and they were screened immediately at their arrival.

After one month, plaque, gingival and bleeding indices were re-evaluated by the same dentist, who was blinded at that time to the information in the patient’s file regarding the type of toothbrush group. The patient was identified during the follow-up assessment only by a serial number that was given at the first appointment. Participants were then asked to add a single-tufted toothbrush (Paro interdental cleaning toothbrush, Switzerland) in conjunction with the toothbrush they used during the previous month. Each participant received instruction on how to use the single-tufted toothbrush, including rotator movements around and between the brackets. Immediately after instruction, their teeth were professionally cleaned. Toothpaste was provided again.

At the two-month assessment, all indices (plaque tooth and bracket, gingival and bleeding) were re-evaluated.

At the one- and two-month assessments, participants were asked to rate, on a five-point scale, their satisfaction with the toothbrush(es) used during the previous month regarding three aspects of brushing: the time required; convenience; and the subsequent feeling of freshness.

### Statistical Analysis

Statistical analysis was performed using SPSS. Fisher’s exact test was calculated for descriptive statistics; the paired T-test (2-tailed) was used to compare indices at different points in the study (baseline to one-month evaluation and one- to two-month evaluation). ANOVA with repeated measures was used to compare the improvement of indices with time (at baseline and at one- and two-month evaluations) between groups. Statistical significance was set at 5%. Due to the limited number of patients in this cohort, it might be considered as underpowered. Subjects were served as the unit of analysis. Descriptive statistics were used for the questionnaire analysis.

### Results

Overall, 29 patients were approached to participate in the present study. Of these, two refused to participate and were not examined at all. Another one refused to participate in the study immediately after completion of the baseline examination. These three patients were not included in the present report. Two patients declined to participate in the study immediately before the second-month assessment when they realized that they would have to spend additional time at the dental office for the study. One was in the triple-headed toothbrush group and one in the orthodontic toothbrush group. Thus, a total of 26 patients completed the study.

The mean patient age was 27.3 years; 18 were female (69.2%) and 8 male (30.8%), with no difference between groups (25.99± 4.26 and 28.6± 6.47 years). Twenty-five patients were treated in both their maxillary and mandibular arches, and one patient was

<table>
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<tr>
<th>TABLE 3</th>
<th>Blood on Probing Index at Baseline and at One- and Two-month Follow-up</th>
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</thead>
<tbody>
<tr>
<td>Blood on Probing Index</td>
<td>Baseline (n=26, 13 in each group)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>THBT maxilla</td>
<td>0.09±0.72</td>
</tr>
<tr>
<td>OTB maxilla</td>
<td>0.12±0.23</td>
</tr>
<tr>
<td>Between groups p value</td>
<td>P=NS</td>
</tr>
<tr>
<td>THBT mandibule</td>
<td>0.27±0.29</td>
</tr>
<tr>
<td>OTB mandibule</td>
<td>0.24±0.52</td>
</tr>
<tr>
<td>Between groups p value</td>
<td>P=NS</td>
</tr>
<tr>
<td>THBT total</td>
<td>0.17±0.16</td>
</tr>
<tr>
<td>OTB total</td>
<td>0.17±0.16</td>
</tr>
<tr>
<td>Between groups p value</td>
<td>P=NS</td>
</tr>
</tbody>
</table>

*Two patients dropped from study; THBT: Triple-headed toothbrush; OTB: Orthodontic toothbrush
treated only in his maxillary arch. All patients had at least 10 treated teeth. The total number of evaluated teeth was 584.

First Month (Triple-headed and Orthodontic Toothbrush)
At the one-month assessment, the average reduction in plaque index tooth for the triple-headed toothbrush and orthodontic groups was 57.14% and 40.87%, respectively, and 53.90% and 57.96% in plaque index brackets, respectively; in bleeding on probing index 57.58% and 11.77%, respectively; and in gingival index 45.94% and 55.17%, respectively, compared to baseline (Tables 1-4).

Second Month (Additional Use of Single-tufted Toothbrush)
One month after brushing with the single-tufted toothbrush, the mean plaque index tooth, plaque index brackets, gingival index and bleeding on probing index were decreased by an additional 34.29% and 45.00%, 86.36% and 25.00%, respectively, in the triple-headed toothbrush, and by 56.92%, 44.83%, 44.44% and 37.50%, respectively, in the orthodontic toothbrush group.

Triple-headed vs. Orthodontic Toothbrush
At one month, the total plaque index tooth, plaque index brackets, bleeding on probing index and gingival index were higher by 85.71%, 45.00%, 33.33% and 22.73%, respectively, among patients in the orthodontic toothbrush group compared with those in the triple-headed toothbrush group. After using the single-tufted toothbrush, the differences between groups were 21.74%, 45.45%, 11.11% and 400%, respectively.

To investigate if the improvements in all indices during the second study period were related more to the duration of the study or to the type of toothbrush used, ANOVA with repeated measures (general linear model) was run. It was found that the improvement in both groups was related mainly to the duration of the study (for bleeding in probing $p=0.021$, plaque index brackets $p=0.0001$, plaque index tooth $p=0.0001$, gingival index $p=0.0001$).

Patient Satisfaction
One and two months after study initiation, differences in mean satisfaction scores reported by the participants in the triple-headed and orthodontic toothbrush groups did not differ significantly (Table 5).

Table 1-4
Gingival Index at Baseline and at One- and Two-month Follow-up
(Number of evaluated patients in parenthesis)

<table>
<thead>
<tr>
<th>Gingival Index</th>
<th>Baseline (n=26, 13 in each group)</th>
<th>1 Month (n=24, 12 in each group)</th>
<th>2 Month* (n=24)</th>
<th>Base-1M Paired T-test pvalue (n=24)</th>
<th>1M-2M Paired T-test pvalue (n=24)</th>
<th>Base-2M Paired T-test pvalue (n=24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTB maxilla</td>
<td>0.10±0.17</td>
<td>0.09±0.07</td>
<td>0.03±0.11</td>
<td>0.880</td>
<td>0.086</td>
<td>0.192</td>
</tr>
<tr>
<td>OTB maxilla</td>
<td>0.25±0.34</td>
<td>0.08±0.12</td>
<td>0.08±0.19</td>
<td>0.032</td>
<td>0.910</td>
<td>0.077</td>
</tr>
<tr>
<td>Between groups</td>
<td>P=NS</td>
<td>P=NS</td>
<td>P=NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THTB mandible</td>
<td>0.64±0.72</td>
<td>0.30±0.38</td>
<td>0.03±0.08</td>
<td>0.155</td>
<td>0.037</td>
<td>0.012</td>
</tr>
<tr>
<td>OTB mandible</td>
<td>0.95±0.59</td>
<td>0.45±0.36</td>
<td>0.21±0.29</td>
<td>0.004</td>
<td>0.108</td>
<td>0.004</td>
</tr>
<tr>
<td>Between groups</td>
<td>P=NS</td>
<td>P=NS</td>
<td>P=NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THTB total</td>
<td>0.37±0.41</td>
<td>0.20±0.27</td>
<td>0.03±0.07</td>
<td>0.232</td>
<td>0.063</td>
<td>0.009</td>
</tr>
<tr>
<td>OTB total</td>
<td>0.58±0.31</td>
<td>0.26±0.17</td>
<td>0.15±0.19</td>
<td>0.002</td>
<td>0.082</td>
<td>0.001</td>
</tr>
<tr>
<td>Between groups</td>
<td>P=NS</td>
<td>P=NS</td>
<td>P=NS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Two patients dropped from study

Table 5
Patient Satisfaction after Using Triple-headed and Orthodontic Toothbrushes With or Without Additional Use of Single-tufted Toothbrush

<table>
<thead>
<tr>
<th>Type of variable</th>
<th>Months after study initiation</th>
<th>Triple-headed Mean± SD</th>
<th>P T-test 2-tailed</th>
<th>Orthodontic Mean± SD</th>
<th>P T-test 2-tailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of toothbrushing</td>
<td>One month</td>
<td>3.27±0.90</td>
<td>0.341</td>
<td>3.18±0.87</td>
<td>0.176</td>
</tr>
<tr>
<td></td>
<td>Two months</td>
<td>3.46±1.04</td>
<td></td>
<td>2.73±0.79</td>
<td></td>
</tr>
<tr>
<td>Toothbrushing convenience</td>
<td>One month</td>
<td>3.27±1.01</td>
<td>0.167</td>
<td>3.27±0.64</td>
<td>0.553</td>
</tr>
<tr>
<td></td>
<td>Two months</td>
<td>3.46±1.04</td>
<td></td>
<td>3.09±0.83</td>
<td></td>
</tr>
<tr>
<td>Feeling of freshness following toothbrushing</td>
<td>One month</td>
<td>3.18±0.98</td>
<td>0.025</td>
<td>3.27±0.65</td>
<td>0.104</td>
</tr>
<tr>
<td></td>
<td>Two months</td>
<td>3.73±0.65</td>
<td></td>
<td>3.64±0.51</td>
<td></td>
</tr>
</tbody>
</table>

Discussion
In this study, the mean plaque index tooth decreased more after one month of brushing with the triple-headed toothbrush than with the orthodontic toothbrush. The mean plaque index bracket, bleeding on probing index and gingival index reductions did not differ significantly after one month brushing with the two types of toothbrushes. Enhanced effectiveness of the triple-headed toothbrush may be due to its unique inclination of bristles, enabling access to the gingival margins of
the brackets around which the plaque is trapped without requiring special manual skills. This is important, especially in patients with lingual fixed appliances.

Interestingly, at the one-month assessment, significant improvement in plaque index was observed also in patients using the orthodontic toothbrush, though its design is similar to that of a conventional toothbrush. It can be assumed that the improvement in this group resulted from increasing awareness and guidance for correct toothbrushing. Another possible contributor to the improved gingival health in this cohort is the professional prophylaxis that was performed as part of the study.

The lesser improvement in the plaque index of the maxilla in the orthodontic group may reflect difficulty accessing the palatal aspect with the orthodontic toothbrush. These results concur with those of Rafe et al.,11 which showed that the triple-headed toothbrush was more effective than a conventional toothbrush in removing plaque in patients with buccal fixed appliances by 48.8% for plaque index total and by 38.2% for plaque index brackets. The study conducted by Rafe et al.11 has shown no statistical differences in the PIT, PIB, GI or BOP indices scores before and after instruction between the orthodontic toothbrush and the regular toothbrush.

In the current study, the statistical similarity in other indices at the one-month assessment, regardless of toothbrush, may be due to the fact that only patients with high motivation who had good oral hygiene and high esthetic awareness were candidates for lingual fixed orthodontic appliances. This is further reinforced by the relatively lower basic scores (by 30%-86%) of PIT, PIB, BI and GI of the patients in the present study as compared with previously published data about children (mean aged 15.6) undergoing orthodontic treatment.11 Moreover, in the present study most participants were females (18 vs. 7). Zadik et al. have shown that females reported significantly higher frequencies of toothbrushing and flossing than males did.24

The major limitation of the present study is the small cohort of participants; thus, further larger-scale studies are warranted.

The duration of each phase of the present study was one month. According to Trimpeneers et al., it is sufficient to assess the effect of toothbrushing on plaque and gingival indices.8 Even one week has been considered sufficient for estimating the effectiveness of toothbrushing on plaque removal, since after meticulous plaque removal, it takes only a few hours for new visible plaque to develop.25

The addition of the single-tufted toothbrush to the triple-headed or orthodontic toothbrush was found to further improve the plaque, gingival and bleeding indices. One month after using the triple-headed or the orthodontic toothbrush, and immediately before adding the single-tufted toothbrush, the mean bleeding on probing and gingival indices in the orthodontic toothbrush group were 28.7% and 23.6% higher, respectively, than those in the triple-headed toothbrush group. After using the single-tufted toothbrush for one month, the differences in bleeding on probing decreased, though without statistical significance. However, the difference in gingival index between groups increased, and was five-times higher in the orthodontic group.

The differences between groups in gingival index at the second-month assessment, as well as the significant improvement in bleeding on probing in both groups, may be due not only to the effectiveness of the single-tufted toothbrush, but also to the fact that improvement in gingival health requires a longer time for clinical presentation.

The similarity in assessed indices between those using triple-headed and orthodontic toothbrushes in conjunction with the single-tufted toothbrush suggests that the high effectiveness of the single-tufted toothbrush may, at least partially, obscure differences between toothbrush types. Therefore, the main advantage of using the triple-headed toothbrush in conjunction with the single-tufted toothbrush in highly motivated patients is the shorter time required for toothbrushing. The main advantage of the triple-headed toothbrush is the need to perform fewer strokes per quadrant of teeth (one instead of three for buccal, occlusal and lingual) as compared to a conventional toothbrush; thus, it takes a shorter period to perform fewer strokes.

These findings concur with those of others who reported that for individuals with high oral hygiene motivation who receive oral hygiene instruction, the type of toothbrush is less significant.5 Nevertheless, the improvement in most indices’ scores following two months justifies recommending using the single-tufted toothbrush in addition to OTB or THTB. Generally, it can be stated that the better the oral hygiene, the better the oral health. It is difficult to draw a line when the magnitude of improvement is relevant from a clinical point of view. However, since the orthodontic treatment is prolonged, and good oral hygiene is challenging, it can be assumed that all effort should be put to improve oral hygiene.

It should be noted in this context that early diagnosis and treatment are essential for successful long-term prognosis in patients with caries and periodontal diseases. The role of the orthodontist in diagnosis and referral for adequate treatment is crucial, since most orthodontic patients are adolescents and caries and aggressive periodontitis may affect them greatly.26 Many patients undergoing orthodontic treatment believe that their regular and frequent visits to the orthodontic office are sufficient to monitor their dental and periodontal needs. Orthodontists should be aware of this notion.26

Conclusion
At the one-month assessment, the triple-headed toothbrush was more effective than the orthodontic toothbrush in plaque removal among patients undergoing orthodontic treatment with lingual fixed appliances. Overall improvements were observed and the differences dependent upon toothbrush type decreased following the second month of additional brushing with a single-tufted toothbrush. The improvement may be due, at least in part, to the increased duration of the follow-up period. Further large scale study is warranted to confirm those results.4
REFERENCES


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Management of a Dental Implant with Internal Thread Damage

A Patient Treatment Report


ABSTRACT

When a patient presents with an implant with the internal threads damaged (or cross-threaded), a definitive restorative challenge may be faced. By having a difference in hardness between an abutment screw and the implant to which it is to be attached, there is potential for internal thread damage to the implant if the opposing threads do not interface properly. As such, the operator must use care when positioning the abutment and engaging the threads to prevent possible misalignment and damage to the internal aspect of the implant body. This article describes such a situation and the action taken to overcome the problem.

Case Description

An 84-year-old male patient presented for evaluation to have new maxillary complete and mandibular partial removable dental prostheses made. Because of tooth loss, he required a Kennedy Class II mod 2 classification mandibular prosthesis. Also, several teeth needed crowns to provide rest seats and adequate retentive clasp undercuts and to improve the occlusal alignment (Figure 1). Significant bilateral mandibular tori were present, which posed a potential problem for the planned prosthesis. After considering the patient’s age, his desire to avoid excessive oral surgery and the size of the bilateral tori, it was decided not to pursue their removal. Instead, the plan was to place two Zimmer Dental Tapered Screw-Vent implants (Zimmer Dental, Warsaw, IN), one on each side of the mandibular arch, to improve the retention and support for the planned prosthesis. The implants were placed by a periodontist. Four to six months healing time was allowed. After four months, the root-form implants appeared to have bone approximating each fixture...
in radiographs and so they were uncovered by the same periodontist and healing abutments placed.

Upon attempting removal of the healing abutments by the restorative dentist to measure for Locator (Zimmer Dental) attachment abutments, it was noticed that the healing abutment on the left side “caught” at a certain point during unscrewing. It was theorized that the abutment was either not seated correctly or was somehow forced into the implant body at the time of placement, resulting in cross-threading or damage to the internal threads of the implant body and/or abutment screw (Figure 2). Eventually, after repeated attempts, the healing abutment was removed. Examination with 3X magnification showed an area near the apex where the thread was nicked and blunted (Figures 3, 3a). After selecting the appropriate size Locator abutments, the right attachment abutment was screwed to place passively; the left one would not seat after an initial twist. A radiograph demonstrated that the abutment was not fully seating into the implant body (Figure 4).

A Zimmer 3.25 OMNI/SPL TAP (Zimmer Dental) specific for re-threading the Tapered Screw-Vent implant placed in this patient (Figures 5, 5a) was used to correct the internal thread damage in the implant. Following Zimmer’s directions, the tap was inserted into the implant and turned slightly, a quarter turn, clockwise. It was then turned counter-clockwise and removed. Copious irrigation with water and with high vacuum suction was accomplished to remove any filings and clean out the internal implant chamber.

The tap was inserted again and turned another quarter turn past the previous point. This was followed by irrigation and evacuation. The process was continued until the tap was fully seated into the implant. Finally, the Locator attachment abutment was able to be screwed into the implant body without any evidence of resistance. A radiograph was made to verify that the abutment was fully seated. After verification, the abutment screw was torqued to the recommended preload (Figure 6). Re-tapping of the internal threads of the implant facilitated fabrication of the definitive partial removable dental prosthesis as designed, producing a highly acceptable functional and esthetic result (Figures 7, 7a).

Discussion
When a patient presents with damage to the internal threads of a dental implant, a restorative problem oc-
curs that can complicate or even negate planned treatment. Re-
regeneration of the internal threads in the implant body may be
necessary by re-tapping. If the internal threads cannot be correct-
ed, there are few options except to bury or replace the implant.

Although the authors could not find a report or discussion in
the literature regarding this unique dental implant complication,
the maker of this particular implant system (Zimmer Dental) must
have anticipated a need since a tool for re-tapping was available.
(A tapping tool is used to initially generate the internal threads
on most titanium dental implants after they are milled during
fabrication.) Platform reshaping followed by internal re-tapping
was used by Mendonca in 2009 to salvage a horizontally fractured
dental implant.5

It is hoped that this report will make others aware of this
corrective option and avoid the possible need for implant removal
and replacement.

Queries about this article can be sent to Dr. Rubel at brubel@umc.edu.

REFERENCES
2. Pjetursson B, Bragger U, Lang N, Zwahlen M. Comparison of survival and complication
rates of tooth-supported fixed dental prostheses (FPDs) and implant-supported FPDs and
3. Theoharidou A, Petridis H, Tsannas K, Garefi P. Abutment screw loosening in single im-
milling forces in titanium alloy. International Journal of Machine Tools and Manufacture
2013;67:28-34.
5. Mendonca G, Mendonca DB, Fernandes-Neto AJ, Neves FD. Management of fractured den-

Dr. Rubel Dr. Hill

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Lack of Correlation between Benign Brain Tumors and Markers of Oral Health

Steven Lehrer, M.D.; Sheryl Green, M.B.BCh.; Kenneth E. Rosenzweig, M.D.

ABSTRACT
Case control studies implicating dental X-rays in the genesis of intracranial meningiomas have yielded conflicting results. To further evaluate what risk, if any, that intracranial meningioma might be associated with dental X-rays, we examined the association of benign brain tumor incidence with the number of dentists and other correlates of oral health in U.S. states and the District of Columbia. We compared these correlations to the association of the same markers of oral health with Alzheimer’s death rates. Poor oral health, especially periodontal disease, is a well-established risk factor for dementia.

Results: Pearson correlations, number of cases (49, no data from Kansas or Maryland) and significance (2 tailed p values) of benign brain tumor incidence and parameters of oral health are presented. None of the correlations approached statistical significance. In contrast, Alzheimer’s deaths by state were negatively correlated with number of dentists and other markers of oral health.

Conclusion: Our finding of a total lack of correlation between benign brain tumors and markers of oral health and, by implication, dental X-rays, suggests there may be no relationship between dental X-rays and meningioma or other benign brain tumors. This conclusion is strengthened by our demonstration of the known negative correlation between Alzheimer’s and dental care.

Meningioma is the most frequently occurring brain tumor, comprising more than a third of all benign and malignant brain neoplasms. But case control studies implicating dental X-rays in the genesis of intracranial meningiomas have yielded conflicting results. Longstreth et al. found that dental X-rays involving full-mouth series performed 15 to 40 years before their 2005 study, when radiation exposure from a full-mouth series was much greater than in 2005, were associated with an increased risk of meningioma. They did not observe an increased risk with bitewings, lateral cephalometric or panoramic radiographs. Claus et al. also reported that exposure to dental X-rays performed in the past, especially bitewings, increased the risk of intracranial meningioma.
TABLE 1
Pearson Correlations, Number of Cases (49, no data from Kansas or Maryland) and Significance (2 tailed p values) of Benign Brain Tumor Incidence and Parameters of Oral Health. (None of the correlations approached significance.)

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEANED TEETH YES</td>
<td>0.058</td>
<td>0.691</td>
<td>49</td>
</tr>
<tr>
<td>CLEANED TEETH NO</td>
<td>-0.128</td>
<td>0.382</td>
<td>49</td>
</tr>
<tr>
<td>LOST ALL TEETH YES</td>
<td>0.134</td>
<td>0.359</td>
<td>49</td>
</tr>
<tr>
<td>LOST ALL TEETH NO</td>
<td>-0.056</td>
<td>0.7</td>
<td>49</td>
</tr>
<tr>
<td>DENTAL VISITS YES</td>
<td>0.056</td>
<td>0.7</td>
<td>49</td>
</tr>
<tr>
<td>DENTAL VISITS NO</td>
<td>-0.089</td>
<td>0.545</td>
<td>49</td>
</tr>
<tr>
<td>DENTISTS PER POPULATION</td>
<td>0.089</td>
<td></td>
<td>49</td>
</tr>
</tbody>
</table>

To further evaluate what risk, if any, that intracranial meningioma might be associated with dental X-rays, we examined the association of benign brain tumor incidence with the number of dentists and other correlates of oral health in U.S. states and the District of Columbia. People who have the least access to preventive services and dental treatment have greater rates of oral diseases.10,11

We compared these correlations to the association of the same markers of oral health with Alzheimer’s death rates. Poor oral health, especially periodontal disease, is a well-established risk factor for dementia.12-15

Methods
Age-adjusted data on benign brain tumor incidence by state are from CBTRUS Statistical Report: Primary Brain and Central Nervous System Tumors Diagnosed in the United States in 2005–2009.1 Data on number of dentists per 10,000 population in 50 U.S. states and the District of Columbia are from Table 1.12 (Active dentists, by state, 1993–2008, US Centers for Disease Control and Prevention, National Center for Health Statistics, http://www.cdc.gov/nchs.)

Data on Dental Visits: Percent adults aged 18+ who have visited a dentist or dental clinic in the past year (yes and no).

Teeth Cleaning: Percent adults aged 18+ who have had their teeth cleaned in the past year (among adults with natural teeth who have ever visited a dentist or dental clinic, yes and no).

Complete Tooth Loss: Percent adults aged 65+ who have lost all of their natural teeth due to tooth decay or periodontal disease (yes and no).

Lost Six or More Teeth: Percent adults aged 65+ who have lost six or more teeth due to tooth decay or periodontal disease (yes and no) are from BRFSS (Behavioral Risk Factor Surveillance System 2008), the US Centers for Disease Control and Prevention survey, which tracks health risks in the United States (www.cdc.gov/brfss). Survey methods have been described in detail elsewhere.16

Age-adjusted Alzheimer’s death rates by state are from the Alzheimer’s Association.17

Results
Pearson correlations, number of cases (49, no data from Kansas or Maryland) and significance (2 tailed p values) of benign brain tumor incidence and parameters of oral health are listed in Table 1. None of the correlations approached statistical significance.

In contrast, Alzheimer’s deaths by state were negatively correlated with number of dentists (Figure 1). Pearson correlations, number of cases and significance (2 tailed p values) of age-adjusted Alzheimer’s death rates and parameters of oral health are listed in Table 2. All of the correlations were significant.

TABLE 2
Pearson Correlations, Number of Cases and Significance (2 tailed p values) of Age-adjusted Alzheimer’s Death Rate and Parameters of Oral Health in 50 U.S. States and District of Columbia. (All of the correlations were significant.)

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEANED TEETH YES</td>
<td>-0.311(*)</td>
<td>0.027</td>
<td>51</td>
</tr>
<tr>
<td>CLEANED TEETH NO</td>
<td>-0.311(*)</td>
<td>0.027</td>
<td>51</td>
</tr>
<tr>
<td>LOST ALL TEETH YES</td>
<td>-0.408(**)</td>
<td>0.003</td>
<td>51</td>
</tr>
<tr>
<td>LOST ALL TEETH NO</td>
<td>-0.408(**)</td>
<td>0.003</td>
<td>51</td>
</tr>
<tr>
<td>DENTAL VISITS YES</td>
<td>-0.313(*)</td>
<td>0.025</td>
<td>51</td>
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<tr>
<td>DENTAL VISITS NO</td>
<td>-0.313(*)</td>
<td>0.025</td>
<td>51</td>
</tr>
<tr>
<td>DENTISTS PER POPULATION</td>
<td>-0.483(**)</td>
<td>&lt;0.001</td>
<td>51</td>
</tr>
</tbody>
</table>

*Correlation is significant at 0.05 level, 2-tailed. **Correlation is significant at 0.01 level, 2-tailed.
Discussion

White et al. noted that radiation exposure from dental X-rays is too low to cause tumors. Calnon found multiple inconsistencies in the Claus et al. study and that the odds ratios Claus et al. calculated were small and of borderline statistical significance. Jorgensen concluded that radiation-induced meningioma risks cannot possibly be as high as Claus et al. suggested. 20 Our finding of lack of correlation between benign brain tumor and markers of oral health is in agreement with White et al., Jorgensen and Calnon.

A weakness in our analysis is possible confounding by the ecological fallacy (or ecological inference fallacy), a logical fallacy in the interpretation of statistical data where inferences about the nature of individuals are derived from inference for the group to which those individuals belong. In this case, inferences about individuals are being drawn from the characteristics of the U.S. states where they reside, rather than from the individuals themselves.

Nevertheless, our finding of a total lack of correlation between benign brain tumors and markers of oral health and, by implication, dental X-rays, suggests that there may be no relationship between dental X-rays and meningioma or other benign brain tumors. This conclusion is strengthened by our demonstration of the known negative correlation between Alzheimer’s and dental care.

Queries about this article can be sent to Dr. Lehrer at stevenlehrer@hotmail.com.

REFERENCES

Oral Cavity Lymphoid Neoplasms
A Fifteen-Year Single Institution Review

Elizabeth Philipone, D.M.D.; Govind Bhagat, M.B.B.S.; Bachir Alobeid, M.D.

A B S T R A C T

Although relatively rare, lymphomas can and do present within the oral cavity and can represent either the initial presentation or secondary involvement in the setting of systemic disease. Our objective was to conduct a retrospective search of the surgical pathology database at our institution to review all oral biopsy specimens diagnosed as either a lymphoma or plasma cell neoplasm over the past 15 years. Based on our search, we identified 47 cases. We report here the type of neoplasm, location, patient age and gender, and available pertinent clinical information.

Despite being the second most common malignancy of the head and neck, lymphoid neoplasms of the oral cavity are relatively infrequent, as the vast majority of oral malignancies are squamous cell carcinomas.1 Whereas lymphoma is a neoplastic proliferation of mature lymphocytes, often initially involving the lymph nodes, plasma cell neoplasms are clonal expansions of terminally differentiated B-cells (plasma cells). Both lymphomas and plasma cell neoplasms can involve either the soft tissues of the mouth or bone and be either a primary occurrence or manifestation of disseminated disease.

In this study we reviewed all biopsies from the oral soft tissues or jaw bones diagnosed as a lymphoma or plasma cell neoplasm. Our goal is to provide practitioners with a summary of the prevalence, types and relevant clinicopathologic findings for cases seen at our institution.

Materials and Methods
Following institutional review board approval, a 15-year (1/1/1997-6/1/2012) retrospective search of the surgical pathology database at our institution was performed to identify all intra-oral biopsies diagnosed as lymphoma or plasma cell neoplasm. Myeloid neoplasms were excluded for this study.

H&E sections prepared from formalin-fixed and paraffin-embedded tissue were used for morphologic analysis. A comprehensive panel of immunohistochemical (IHC) stains and in situ hybridization (ISH) was performed on all cases for confirmation of diagnosis and proper classification of the neoplasm. In addition, results of cytogenetic and polymerase chain reaction (PCR) analyses were reviewed when available.

We provide a descriptive analysis. All cases were diagnosed and classified according to the current WHO 2008 classification of hematopoietic neoplasms. We restricted our review to biopsies submitted by dentists and/or oral surgeons and did not include cases occurring in the palatine tonsils or nasopharynx.

Results
A total of 47 patients—22 males and 25 females—had intraoral biopsies in which a diagnosis of either lymphoma or plasma cell neoplasm was rendered. No cases of oral Hodgkin lymphoma
were found. The most to least frequently rendered diagnoses are listed in Table 1, with diffuse large B-cell lymphoma (n=13) being the most frequent. Forty-six patients were adults ranging in age from 23 to 94 years (median – 66 years); one patient was a 7-year-old child.

**Location**
Thirty-five of the lesions presented in soft tissue, most frequently involving the buccal mucosa. Twelve patients presented with intraosseous lesions, seven cases occurring in the maxilla and five in the mandible. Nine of the intraosseous cases were diagnosed as lymphoma and three as plasma cell neoplasm. The sites of involvement are summarized in Table 2.

**Clinical Impression**
A clinical differential diagnosis and/or adequate clinical history were provided for 35 of the 47 patients. Lymphoma was the rendered clinical diagnosis in nine cases. In eight of these cases, the submitting clinician was aware of a prior history of lymphoma elsewhere (implying the patient had systemic lymphoma with secondary involvement of the oral cavity or, as in one of the cases, the lymphoma was a recurrence at the same site). Plasma cell neoplasm was the suspected clinical diagnosis in one case in which the clinician was aware of a history of such.

The next most common clinical diagnosis was squamous cell carcinoma (n=4), followed by salivary gland tumor (n=3) and mucocele (n=2). A simple statement of “rule out neoplasm” was the clinical diagnosis for three of the cases. Peripheral odontogenic tumor, radicular cyst, sarcoma, granulomatous inflammation, granulation tissue, peria temporal lesion, lymph node osteonecrosis and ameloblastoma comprised the clinical diagnoses for the remaining cases.

**Clinical Presentation**
A description of the clinical presentation was provided for only 14 of the cases. The most commonly reported presentation was of an enlarging soft tissue mass (n=7). This was followed by a painless nodule (n=4). Gingival overgrowth, persistent swelling and ulceration were reported for one case each.

**Past Medical Histories**
We were aware of a prior history of lymphoma for 16 of the lymphoma cases. A history of HIV was provided in two of the three cases of plasmablastic lymphoma. A history of metastatic papillary thyroid carcinoma was provided in one case of diffuse large B-cell lymphoma clinically described as a mass at the base of the tongue. A history of metastatic breast cancer was provided in a case of diffuse large B-cell lymphoma that presented intraosseously within the mandible. Both of the patients diagnosed with

---

**TABLE 1**
Subtype, Number of Cases, Age and Gender

<table>
<thead>
<tr>
<th>Subtype</th>
<th>No. of cases</th>
<th>Age range (years) [Mean(years)]</th>
<th>M:F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffuse large B-cell lymphoma</td>
<td>13</td>
<td>36-94 [70.8]</td>
<td>2:3</td>
</tr>
<tr>
<td>Chronic lymphocytic leukemia/small lymphocytic lymphoma</td>
<td>8</td>
<td>71-86 [77.3]</td>
<td>1:1</td>
</tr>
<tr>
<td>Follicular lymphoma</td>
<td>6</td>
<td>59-79 [66.6]</td>
<td>3:2</td>
</tr>
<tr>
<td>Extranodal marginal zone lymphoma of mucosa-associated lymphoid tissue</td>
<td>5</td>
<td>23-85 [60]</td>
<td>1:1</td>
</tr>
<tr>
<td>Plasma cell neoplasms</td>
<td>5</td>
<td>42-71 [61.4]</td>
<td>1:3</td>
</tr>
<tr>
<td>Plasmablastic lymphoma</td>
<td>3</td>
<td>29-49 [37.7]</td>
<td>2:1</td>
</tr>
<tr>
<td>Mantle cell lymphoma</td>
<td>2</td>
<td>88,84</td>
<td>1:1</td>
</tr>
<tr>
<td>CD30+ T-cell lymphoproliferative disorder</td>
<td>2</td>
<td>34,84</td>
<td>1:1</td>
</tr>
<tr>
<td>Posttransplant lymphoproliferative disorder (PTLD)</td>
<td>2</td>
<td>7,31</td>
<td>0:2</td>
</tr>
<tr>
<td>B-Cell lymphoma not otherwise classified</td>
<td>1</td>
<td>66</td>
<td>0:1</td>
</tr>
</tbody>
</table>

**TABLE 2**
Location of Lesions

<table>
<thead>
<tr>
<th>Site</th>
<th>No. of cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buccal Mucosa</td>
<td>8 (17.0%)</td>
</tr>
<tr>
<td>Maxilla</td>
<td>7 (14.9%)</td>
</tr>
<tr>
<td>Palate</td>
<td>7 (14.9%)</td>
</tr>
<tr>
<td>Tongue</td>
<td>6 (12.8%)</td>
</tr>
<tr>
<td>Gingiva</td>
<td>6 (12.8%)</td>
</tr>
<tr>
<td>Mandible</td>
<td>5 (10.6%)</td>
</tr>
<tr>
<td>Vestibule</td>
<td>5 (10.6%)</td>
</tr>
<tr>
<td>Lip</td>
<td>2 (4.3%)</td>
</tr>
<tr>
<td>Floor of Mouth</td>
<td>1 (2.1%)</td>
</tr>
</tbody>
</table>
post-transplant lymphoproliferative disorder had received a cardiac transplant. Three of the patients with a diagnosis of plasma cell neoplasm had a known history of plasma cell myeloma. Exposure to bisphosphonates was reported in one case of plasma cell myeloma of the mandible in which the clinician suspected osteonecrosis.

Additional Testing
The presence of Epstein-Barr virus (EBV) was evaluated in 16 cases using Epstein-Barr virus-encoded small RNAs (EBER) in situ hybridization. Five cases were found to be positive. These included all three cases of plasmablastic lymphoma, as well as the two cases of post-transplant lymphoproliferative disorder.

Discussion
Lymphomas
Lymphomas comprise the second most common malignancy within the oral cavity. Despite this ranking, the occurrence of lymphoma within the oral cavity is relatively rare, since the vast majority—over 90% of oral malignancies—represent squamous cell carcinomas. In a large population-based review, Epstein et al. reported that lymphomas of the oral cavity account for only 3.5% of all oral malignancies.

In reviewing cases diagnosed over a 15-year period at our institution, 42 intraoral biopsies were diagnosed as lymphoma. This is in comparison to over 500 oral squamous cell carcinoma diagnoses rendered at this institution during the same time period. We found that lymphoma comprised just over 5% of oral malignant lesions diagnosed at our institution.

Up to 48% of non-Hodgkin lymphomas occur at extra nodal locations and 3% to 5% involve the oral cavity. Often the oral lesions are not the initial presentation of disease. Although the amount of information provided on the biopsy requisition form by the submitting clinician was limited, approximately one-half of the cases had a prior history of non-Hodgkin lymphoma, implying that the oral lymphoma was a secondary manifestation or, as revealed in one case, a recurrence at the same site. No diagnoses of intraoral Hodgkin lymphoma were made during the period reviewed. A literature search revealed only 10 case reports of Hodgkin lymphoma occurring within the oral cavity, three of which occurred in the tonsils.

Non-Hodgkin lymphoma primarily affects adults. All of our cases, except for one post-transplant lymphoproliferative disorder case, occurred in adult patients. Based on the Surveillance, Epidemiology and End Results (SEER) report from 2004–2008, the median age at diagnosis of non-Hodgkin lymphomas in the U.S. was 66 years. In our series, the median age of patients with non-Hodgkin lymphoma at time of biopsy was 71. This is slightly older than the SEER mean; however, our mean represents the age at which the oral lesions were biopsied and as mentioned above, at least half of our patients had a prior history of lymphoma. Therefore, the true median age at diagnosis was likely younger.

In our series, the vast majority of patients were over 60 years of age, except cases of plasmablastic lymphomas where the ages of the three patients were 29, 35 and 49 years, and five non-Hodgkin lymphoma cases occurring in patients ≤40 years. Two of these patients, one of which was a child, age 7, were status post-iatrogenic immunosupression secondary to heart transplantation, which is a known risk factor for developing lymphoma.

Non-Hodgkin lymphoma is also known to show a slight male predilection. Our non-Hodgkin lymphoma patients were almost equally divided based on gender, with 19 males and 17 females. Our results with regard to gender and prior history of lymphoma correlated with a similar review of 31 cases reported by L. Eisenbud et al. In their review, the male-to-female ratio was almost equal; 19 of their patients had a prior history of lymphoma. However, these authors included lymphomas involving the tonsils in their series, which accounted for three cases. Interestingly, Burkett’s lymphoma was the diagnosis in four of their cases, and in six cases, patients were under 16 years of age.

The presence of Epstein-Barr virus (EBV) was evaluated in 15 of our cases using Epstein-Barr virus-encoded RNAs (EBER) in situ hybridization. All three cases of plasmablastic lymphoma were positive for EBV. Two of these patients were known to be HIV positive. In addition, both patients who were immunosuppressed secondary to organ transplant also had EB-positive lymphomas. EBV infection is a known cooperating event in the pathogenesis of post-transplant lymphoproliferative disorder. Our results were in accordance with prior studies, which reported a lack of EBV infection in oral non-Hodgkin lymphoma of immunocompetent individuals.

Within the oral cavity, non-Hodgkin lymphoma can present either within soft tissue or bone. When affecting the soft tissues of the oral cavity, the most common locations have been reported to be the buccal vestibule, posterior hard palate and gingiva. In the U.S., 5% to 10% of all cases of primary or secondary non-Hodgkin lymphoma have been reported to involve Waldeyer’s ring, which includes the lymphoid tissue on the base of the tongue (lingual tonsil). We found the buccal mucosa, base of tongue and palate to be the most common soft tissue sites of involvement; however, as stated previously, tonsils were not analyzed in our series.

Plasma Cell Neoplasms
Extradural plasmacytoma, solitary osseous plasmacytoma and plasma cell myeloma comprise a clinical spectrum of clonally expanded, terminally differentiated B-cells. Plasma cell myeloma is the most common plasma cell neoplasm, and up to 30% of patients develop manifestations within the jaw bone. The occurrence of either extraneous (extradural) or solitary osseous
plasmacytoma within the oral cavity is much rarer. Similar to non-Hodgkin lymphoma, plasma cell neoplasms primarily affect adults, albeit of an older age. All of our plasma cell neoplasm cases occurred in adult patients. In our series the median age at time of biopsy for patients was 65.8

Although extramedullary plasmacytoma has a predilection for the head and neck, it has been reported to comprise fewer than 1% of head and neck tumors, with the nasopharynx, paranasal sinuses and tonsils the most common sites. Solitary osseous plasmacytoma is less common in the head and neck than extramedullary plasmacytoma. In a review conducted by Kanazawa et al., solitary osseous plasmacytoma was found to account for 4% of myelomatous diseases of the mandible. Many cases of solitary plasmacytoma of bone eventually progress to plasma cell myeloma. It has been reported that approximately 30% of plasma cell myeloma cases show manifestations within the oral cavity. Within the oral cavity, plasma cell neoplasm can present either within soft tissue or bone. When affecting bone, the mandible is the most frequent site of oral involvement. Three of our five cases occurred within the jaws, two within the mandible and one within the maxilla. Two of these cases had a disclosed prior history of plasma cell myeloma. The remaining three cases were localized as a soft tissue mass within the oral cavity, two occurring within the buccal mucosa and one within the gingiva. One of our patients presenting with a soft tissue lesion had a known history of plasma cell myeloma.

Within the oral cavity, both lymphoma and plasma cell neoplasm can have a variety of clinical manifestations that clinicians need to be aware of. Only slightly more than one-third of clinicians provided clinical description/information at the time of biopsy, but in most cases it was limited. An enlarging soft tissue mass was the most common description provided. The presence of surface ulceration can lead clinicians to suspect squamous cell carcinoma. Therefore, it is not surprising that squamous cell carcinoma was the second most frequent clinical diagnosis provided by the clinicians in our review; after all, it is the most common malignant lesion to occur within the oral cavity.

A total of 12 cases occurred within bone. Despite having limited clinical data, the jaw lesions were confirmed as secondary manifestations in 7 of the 12 cases. Jaw lesions often present as ill-defined radiolucencies and can cause pain and/or paresthesia often leading clinicians to suspect inflammatory processes, odontogenic tumors and/or metastases. Radicular cyst, periapical pathology and ameloblastoma were suspected in three of the intraosseous cases for which the clinician provided a clinical diagnosis. Osteonecrosis was the suspected clinical diagnosis in a patient with a reported history of intravenous bisphosphonate exposure and plasma cell myeloma.

Despite being relatively uncommon in the oral cavity, lymphoma and plasma cell neoplasm do manifest in soft tissues of the mouth and within the jaws, typically in adult patients over 60 years of age. The clinical presentation may be variable and the disease can be either primary or secondary. Clinicians need to be aware of this in order to better evaluate patients with oral lesions and to consider lymphoma when formulating differential diagnoses.

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REFERENCES

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Diagnosing the Parotid Lipoma

Case Report

Ashley Houle, B.S.; Louis Mandel, D.D.S.

ABSTRACT

The clinical features of the rarely reported and diagnostically challenging parotid gland lipoma are described. Presurgical diagnosis is aided by CT scan imaging.

Lipomas are benign tumors of adipose tissue that usually involve the upper back, shoulder and abdomen. These benign growths represent the most commonly occurring mesenchymal soft tissue tumors, with 13% to 20% involving the head and neck regions. Only 5% of benign oral tumors are classified as lipoma.

Fat tissue tumors are found more frequently in males than females, in a 5:1 ratio, and tend to become clinically apparent in the fifth to sixth decades of life.

Initially, the lipoma was thought to originate after trauma. However, development of a true neoplastic lipoma following trauma is now discounted. Those that develop following trauma, usually in the thigh or pelvis area, are not true neoplasms and are not encapsulated. These masses are pseudolipomas and result from a prolapse of normal adipose tissue through a deficiency in Scarpa’s fascial layer following a traumatic incident. It has also been theorized that trauma causes an inflammation with fat necrosis that incites a proliferation of pre-adipocytes to form the pseudolipoma.

Lipomas of the parotid salivary gland are relatively rare findings, with the reported incidence varying from .6% to 4.4% of benign parotid neoplasms. Those that involve the parotid gland are usually located in the superficial lobe and rarely occur in the gland’s deep lobe. A specific preoperative diagnosis can be difficult because the lipoma has no unique clinical features. The lipoma is known to be painless and slow growing. When close to the surface, palpation indicates that it is soft and doughy in tone, circumscribed and freely movable.

Head and neck lipomas average 3 cm in size, although some can be as large as 8 cm. Because they are painless, patients often seek attention only when functional problems or cosmetic issues become a concern.

A presurgical diagnosis of a lipoma is facilitated with CT scan imaging. The density value of the tumor corresponds to that of fat and has been reported to vary from −50 to −150 Hounsfield units. There is no contrast enhancement, and the growth will be noted to have well-defined margins. The displacement of the surrounding soft tissue serves as an indication of tumor expansion and differentiates the lipoma from the infiltrating presence of normal fat accumulations. The CT scan can only suggest a diagnosis because no specific characteristic signs are available. Final diagnosis awaits histologic examination of a presurgical biopsy or the excised surgical specimen.

From the Salivary Gland Center, Columbia University College of Dental Medicine, New York, NY.
Histologically, the true parotid lipoma is surrounded by a thin fibrous capsule that serves to isolate this neoplasm from the surrounding normal parotid gland tissue. Connective tissue septa can be observed partitioning the lipoma into a lobular configuration, which is helpful in distinguishing the lipoma from simple fat aggregations. Sheets of mature adipocytes with a clear cytoplasm are seen, with little variation in cell size. Small flattened nuclei are located peripherally.

Because of its rarity and the absence of significant diagnostic features, the authors wish to call attention, via a case report, to the existence of and diagnostic challenge associated with a parotid gland lipoma.

Case Report
A 53-year-old male was referred to the Salivary Gland Center of Columbia University College of Dental Medicine because of the presence of a left parotid area swelling (Figure 1). A medical history indicated that the patient was in excellent health. He had no systemic medical problems, and his only medication was the daily use of 81 mg aspirin. Questioning indicated that the left facial swelling had been present for at least eight years. During this period, it had grown slowly, but was always painless. Recently, because of its continued growth, the patient has become concerned about his appearance.

Extraorally, a visible swelling, measuring 3 cm x 3 cm, was apparent, involving the left parotid area. Palpation revealed that the mass was soft, circumscribed and painless, and involved the superficial lobe of the parotid gland. When palpated, the other salivary glands proved to be normal in tone and painless. There was no facial palsy or cervical lymphadenopathy. Intraorally, the mucosa was normally moist, and a normal salivary return through the left parotid duct orifice was observed when the left parotid gland was aggressively massaged. A panoramic radiograph added no diagnostic information related to the swelling. A CT scan was ordered. The report stated that a circumscribed, poorly hypodense mass (-110 Hounsfield units) was present in the parotid’s superficial lobe, consistent with a diagnosis of lipoma (Figure 2).

The patient was referred for surgical removal of the pathologic lesion. Careful dissection resulted in enucleation of the tumor, along with a narrow rim of parotid tissue. The microscopic findings confirmed the presence of a thin fibrous capsule separating a tumor of fat from normal parotid gland tissue (Figure 3). Lobules of mature adipocytes were observed, with the lobules separated from each other by thin fibrous connective tissue bands. The final diagnosis was lipoma.

Discussion
Because confusion with other pathologic entities exists, differential diagnosis of a lipoma must include the possible presence of a pseudo...
dolipoma or lipomatosis. As indicated, the pseudolipoma has its origin in a traumatic event. Its differentiation from a true lipoma rests in the fact that it is not encapsulated and usually is located in the thigh and pelvic areas. Lipomatosis of the parotid gland is also characterized by the absence of a capsule. In lipomatosis, a diffuse fat infiltration of the parotid tissues, often bilateral, is seen. The condition, also called salaladenosisis, is frequently associated with alcoholism, diabetes, malnutrition or an underlying metabolic or hormonal abnormality. Variants of the lipoma have also been reported and include sialolipoma, angiolipoma and fibrolipoma. These entities probably represent entrapment of normal adjacent tissues and are not true neoplastic variants.

Differential diagnosis also must include consideration of the existence of the malignant liposarcoma. Malignant transformation from a benign lipoma is rare. Imaging features of the malignant liposarcoma include its large size and absence of a capsule. Variants of the lipoma have also been reported and include sialolipoma, angiolipoma and fibrolipoma.

Treatment

Removal of a parotid lipoma is most frequently achieved via a superficial parotidectomy. However, because the lipoma is benign and well-circumscribed by its capsule, enucleation of the tumor with incorporation of a rim of normal parotid gland tissue is an option. When the parotid’s deep lobe is involved, surgery becomes difficult because a meticulous dissection with preservation of the facial nerve becomes mandatory.

Queries about this article can be sent to Dr. Mandel at LM7@columbia.edu.

REFERENCES


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