

AAID NEWS

Trends in Technology

INSIDE

- A Report from the Front: The Specialty and Advertising Battleground
- Tooth Fracture and Bite Force Capability: A Retrospective Study
- JU's Comprehensive Oral Implantology Residency Program



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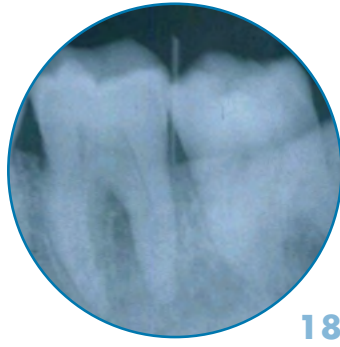
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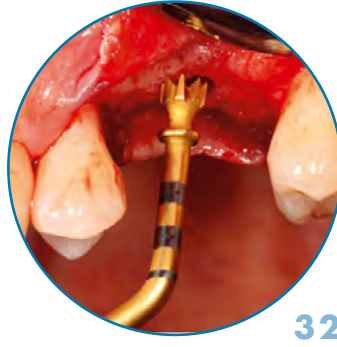




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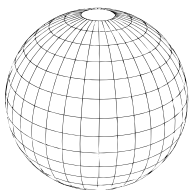
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AMERICAN ACADEMY
OF IMPLANT DENTISTRY

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By Dennis Flanagan,
DDS, MSc, FAAID, DABOI/ID,
AAID Editor

EDITOR'S NOTEBOOK

JOI: Peer Reviewers Needed

The *Journal of Oral Implantology (JOI)* is published by the American Academy of Implant Dentistry. The mission of the *JOI* is to advance the knowledge base of oral implantology. The *Journal* is an important service provided by the AAID. The AAID is working to provide the highest credibility for the *JOI*. The *Journal* relies heavily on a rigorous peer review process.

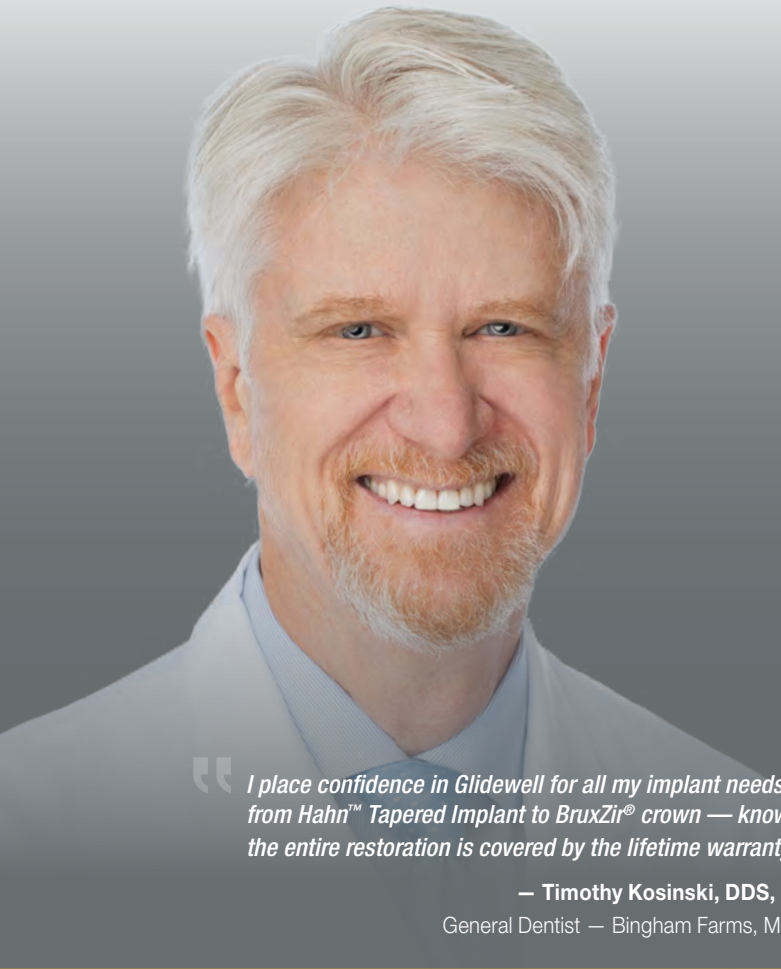
Each manuscript submission is scrutinized first by the Editor. If the manuscript passes this scrutiny, it is sent to an associate editor for inspection by an appropriately selected reviewer. The reviewers evaluate the manuscript for accuracy, logical sequencing, grammar, and readability. Even when a submission is scientifically accurate, the information should be presented in a form that is as easy as possible to read and understand. Generally, manuscripts should be written so that a lay person can read and understand the text, needing only to consult a dictionary for unknown terms.

The review process is necessary to ensure credibility. The review is done routinely to increase and maintain the credibility and viability of *JOI*; thus, it is incumbent on our membership to make themselves available as reviewers. Kind and gentle critical evaluation is important for manuscripts sent to the *JOI*. The review process leads to publication of relevant and important information to edify our readership. The AAID will provide our membership with the most useful and reliable information to implement in the practice of implant dentistry.

If you have the time and expertise, please volunteer to be a reviewer for *JOI*. For detailed information about how to become a reviewer, please visit <https://meridian.allenpress.com/joi/pages/Reviewers>.

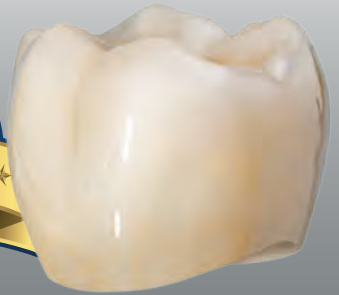
“The review process is necessary to ensure credibility. The review is done routinely to increase and maintain the credibility and viability of *JOI*; thus, it is incumbent on our membership to make themselves available as reviewers. Kind and gentle critical evaluation is important for manuscripts sent to the *JOI*.”

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By Shane Samy, DMD
AAID President 2023

PRESIDENT'S MESSAGE

Dear Academy Members,

I am so excited for all of us to gather at in-person meetings again this year. The pandemic changed the world and kept us apart for too long. Now, with things returning to normal more and more each day, we can breathe a collective sigh of relief and feel true enthusiasm for what's ahead.

In 2023, the AAID will proudly host the Central District Meeting at the Marriott Marquis Chicago June 9–11 and the Annual Conference at Caesars Palace in Las Vegas November 1–4. With other organizations seeing increased attendance at their meetings, we anticipate the same uptick for AAID meetings this year.

The Chicago meeting, *Freehand vs. Guided: From Start Finish*, will be an intimate program covering the many challenges with free-hand and guided surgery in patients with inadequate bone. Join your implant dentistry colleagues for three days of education and networking while enjoying summer in the Windy City. And thanks to the generosity of three sponsors, the first 100 people to register for the event will receive a free ticket to watch Dead & Company perform live at iconic Wrigley Field from the comfort of a neighboring rooftop. There's nothing more Chicago than that!

In the fall, we'll take off for exciting Sin City to again join our peers at the 2023 Annual Conference, *Trends in Transformation*. The 73rd Annual Conference promises to be one for the history books, as we descend upon the City of Lights for four days of educational sessions, hands-on workshops, and a variety of social events. I can't wait to see all of you there!

I wholeheartedly believe that 2023 will be an amazing year for the Academy and for the profession of implant dentistry. I am thrilled and humbled to be in your service as president this year. There are great things to come!

Thanks for being who you are in serving patients.

Sincerely,

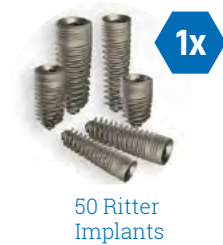
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COVER
STORY

Trends in Technology



Dental implants have come a long way since the Mayans developed the first implant in 600 AD. In the centuries between then and now, dentists have made tremendous improvements in materials and techniques to make implantology one of the safest and effective dental procedures.

However, making progress can be a bit challenging/controversial because proponents of new ideas must pass the test of peer review and the double-edge sword of word-of-mouth. Nowhere was this battle more apparent than at the 2022 AAID Conference where titanium implants squared off against zirconia.

For decades, implant dentists have relied on titanium screws as the foundation for their implants, and this metal has proven to be reliable and safe. But as implantology evolves and dentists strive to develop improved materials and methods, alternatives to titanium have emerged. One of the current materials vying for dentists' attention is zirconia. Like titanium, zirconia is a metal that, through processing, becomes ceramic.



Dr. Aman Bhullar



Dr. Paresh Patel

During the 2022 AAID Annual Conference, Dr. Aman Bhullar and Dr. Paresh Patel squared off in a boxing-themed battle of wits to determine which material was best.

Dr. Bhullar opened the debate with a litany of clinical trial research information supporting titanium's claim as the reigning champion. He pointed to well-established, peer-reviewed research from several journals stating titanium is safe and reliable.

Dr. Bhullar also cited three systematic reviews of titanium implants by Dr. Bjarni Pjetursson in 2014 that demonstrated a single unit crown with a five-year survival rate of 97 percent, bridges with a 10-year survival rate of 93 percent, and overdenture with a 10-year survival rate of 96 percent.

He then hit zirconia with a body blow: In 2001, the FDA issued a recall for zirconia hip implants after a study showed a 67 percent failure rate and 63 percent survival rate among hip surgeries.

"It's important to learn from these examples in medicine," Dr. Bhullar said.

Dr. Patel responded with a flurry of counter punches in support of zirconia.

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COVER STORY

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Dr. Patel said that there are 82 literature references on two-piece zirconia implants, documenting a 98 percent competitive success rate over 10 years.

“This is an evolving field,” Patel said. “Think about whether the titanium implant you are using today is the same implant that was studied 30 years ago. We are not using the same pure titanium or thread design. We are using aluminum toughened zirconia that we know integrates.”

Dr. Patel pointed out that many patients are sensitive to titanium ions that can float off implants and lodge into the soft tissue, creating peri-implantitis. He also emphasized that zirconia is more compatible with soft tissue than titanium.

Studies show that blood flow around a zirconia implant is the closest to a natural tooth and better than the blood flow around a titanium implant.

“You should be able to develop tissue that is happy with your implant and in perfect balance with that implant for long-term stability,” Dr. Patel said.

New Technology Introduced to Aid Implant Procedures

The ability for more implant dentists to offer patients either titanium or zirconia is enhanced by new imaging and software technologies.

These technologies include:

- **Cone Beam Computed Tomography (CBCT)**, a type of 3D-imaging that provides a detailed view of the jaw and teeth, including the location of nerves and other important structures. This allows dentists to plan implant placement with greater accuracy and avoid potential complications.

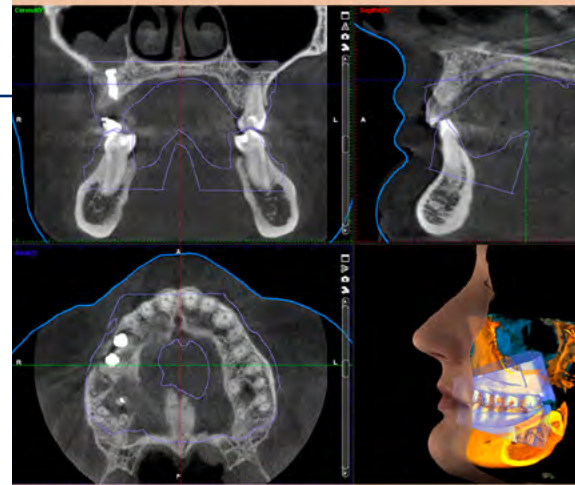
- **Digital X-rays**, which are faster and more convenient than traditional film. They also produce higher-quality images that can be manipulated and enlarged on a computer screen, making it easier for dentists to see details that might be difficult to spot with traditional X-rays.
- **Intraoral Scanners**, handheld devices that can produce 3D-images of the teeth and gums. This allows dentists to see the entire mouth in high resolution, which can be especially useful when planning implant placement.
- **Guided Surgery Systems**, which use computer technology to help dentists plan and execute implant placement with greater precision. The systems can produce detailed images of the jaw and teeth and use special software to plan the optimal placement of implants.
- **Exocad**, a prosthetic design software that can be used in combination with intraoral scanners and other measurement tools, such as the Zygo or Pterigoids, to design and fabricate dental restorations, including crowns, bridges, and implant-supported prosthetics.

“It is my sense that guided surgery is very accurate but expensive and is probably most appropriate for multiple and full-arch cases,” said AAID member Dr. Dennis Flanagan.

AAID member Dr. Cody Gronsten reported that the strongest trend he sees is the use of Exocad (or similar) prosthetic designing software to intraoral scanners.

“I also have found that bone level stackable guides, such as Chrome, though not new to the implant scene, are trending,” he said.

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COVER STORY

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Exocad software allows dentists to create digital models of the teeth and gums, and then design the restoration to fit the patient's mouth precisely. This leads to better fitting, more aesthetically pleasing restorations that are less likely to cause discomfort or complications.

The use of Exocad and other similar software in combination with intraoral scanners and measurement tools has helped dentists fabricate dental restorations, making the process faster, more efficient, and more accurate, which leads to better outcomes for patients.

Dr. Flanagan recommends that AAID members who are interested in learning more can refer to an article by Drs. Danny Domingue, Cory Glenn, Michael Strait, and Reid Turpin in a recent issue of *AAID News* about stackable guides (Issue 4.2022).

Other Developments in Implant Technology

Dentists and researchers strive to make implants safer, more accessible, and easier to place. Some of the newer technologies worth mentioning include:

- 1. 3D-printing Technology** is being used to create custom dental implants that are precisely designed to fit an individual patient's mouth. This leads to better outcomes, more comfort, and quicker healing times.
- 2. Computer-Guided Surgery:** Dentists can plan and perform implant surgery with greater precision. This leads to less invasive procedures, fewer complications, and faster healing times.

3. Immediate Loading Implants: In the past, patients had to wait several months after having an implant placed before a crown or other restoration could be attached. With immediate loading implants, restorations can be placed on the same day as the implant surgery.

4. All-on-4 Implants: This technique involves placing just four dental implants to support a full arch of replacement teeth. This can be a cost-effective and time-efficient solution for those needing to replace an entire row of teeth.

5. Mini Implants: Mini dental implants are smaller in size and can be used to support dentures or other dental restorations. They can be placed quickly and easily, making them a good option for those who want a non-invasive solution.

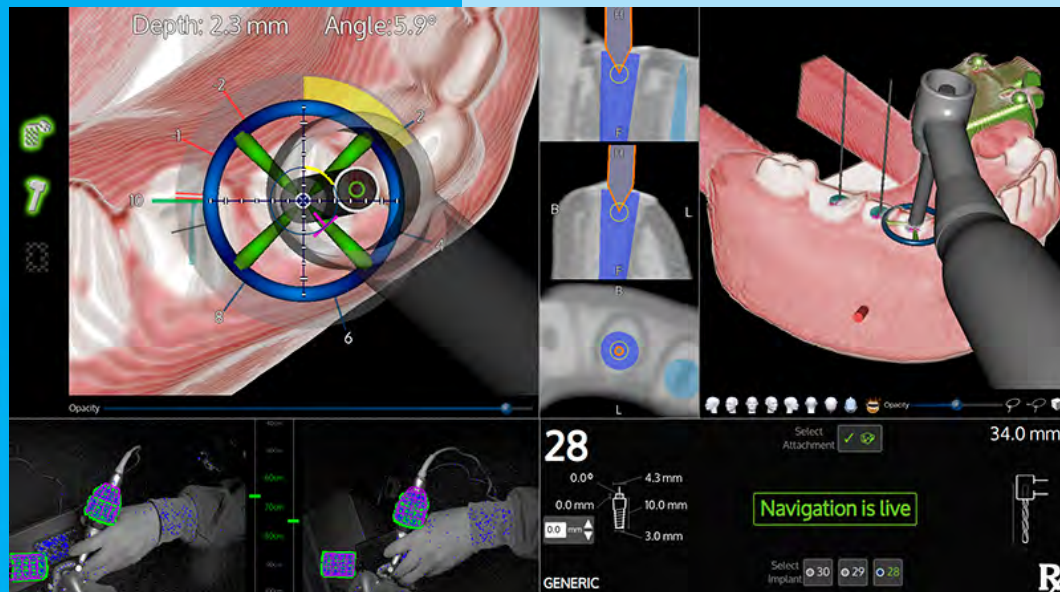
Robotic Implant Surgery

As Dr. Bhullar pointed out in the debate with Dr. Patel, dentists can look to the medical profession to see if new technologies have applications in dentistry. For instance, robotic surgery is now used to help, but not replace, surgeons who perform some abdominal surgeries. Questions that should be asked are: Is robotic surgery a viable option for implant dentists? Is it ready for prime time?

Advocates of robotic dental implant surgery claim that it offers several benefits over traditional surgical techniques, including increased accuracy, faster healing times, and reduced risk of complications. However, there is still limited research available on the effectiveness of robotic surgery for dental implants, and it is not yet widely available.

Overall, while the use of robotics in dental implant surgery is an exciting development, more research is needed to fully evaluate its benefits and risks.





Dental Technology Companies Worth Watching

There are many companies involved in the development and manufacture of dental implant technology. Some of the leading companies in the field include:

- Biohorizons, which specializes in the development and manufacture of dental implants and other restorative solutions.
- Dentsply Sirona, which offers a wide range of implant systems, as well as other dental products and services.
- Instaria, which makes an extra oral, hand-held scanner that produces an accurate scan of your patient's face and teeth which can work with the dentist's IOS and CBCT.
- Navtech, one of a few companies that specialize in dental navigation. Its products are well-regarded in the dental industry. Dental navigation is an emerging technology that uses 3D imaging and computer-aided design to assist dentists in placing dental implants with greater accuracy and precision.
- Nobel Biocare, which specializes in the development and manufacture of dental implant systems and restorative solutions.
- Osstell, which develops and sells implant stability measurement systems and other tools for the placement of dental implants.
- Planmeca, which offers a wide range of dental products and services, including dental imaging systems, and CAD/CAM systems. In recent years, Planmeca has expanded its product line to include dental implant planning and placement software, as well as other tools for the placement of dental implants.
- Straumann, which offers a wide range of dental implant systems, including bone level and tissue level implants, as well as a variety of restoration options.

Is there a company we missed? Send us your feedback at editor@aaid.com and we'll keep this list updated.



By Max G. Moses,
JD, CPA, MBA

A Report from the Front: The Specialty and Advertising Battleground

In the beginning, the American Dental Association (ADA) exclusively designated dental specialties. Over time, however, how dental specialties are recognized as well as their standards have evolved.

The American Board of Dental Specialties (ABDS), with the support of the American Academy of Implant Dentistry (AAID) and the American Board of Oral Implantology/Implant Dentistry (ABOI/ID) (the implant dentistry specialty board), has played an important role in changing how specialty status is determined.

The specialty and advertising landscape has changed since 1951 when the ADA recognized seven specialties. The ADA's recently-created National Commission on Recognition of Dental Specialties and Certifying Boards (NCRDSCB) now recognizes 12

specialties. There exists an alternative specialty recognition entity—the American Board of Dental Specialties—which recognizes four specialties (three are also recognized by the NCRDSCB; implant dentistry is the only one not recognized by both NCRDSCB and ABDS).

Advertising Implant Credentials

Through 2015, the AAID strategy focused on gaining the ability for credentialed dentists to advertise their implant dentistry credentials. In 2016, the strategy changed with the filing of a lawsuit in the state of Texas contending that deferring the definition of specialties solely to the ADA, a private association, was unconstitutional. That lawsuit was won but the State of Texas appealed. In 2017, the 5th Circuit U.S. Court of Appeals (covering the states of Texas, Louisiana, and Mississippi) determined the appeal was without merit and the decision of the U.S. District Court should be upheld. This repositioned the battleground to the individual state legislatures, dental boards, and often the courts.

A few states allow dentists to refer to themselves as a specialist. Other states only allow dentists to advertise that they hold bona fide credentials in implant dentistry (e.g., Fellow or Associate Fellow of the AAID and/or Diplomate of the ABOI/ID). The list published with this article includes the 18 states that allow advertisement of a specialty.

In the beginning, the American Dental Association (ADA) exclusively designated dental specialties. Over time, however, how dental specialties are recognized as well as their standards have evolved.

AAID strategies have been so successful that as of March 30, 2023, 18 states now allow dentists to advertise specialty status. States with an asterisk below require a disclaimer.

Be sure to check the rules in your own state before advertising specialty status to make certain that nothing has changed since the publishing of this chart.

- Alaska
- California
- Colorado *
- Delaware
- Illinois *
- Indiana
- Iowa
- Kentucky
- Maine
- Michigan
- Nebraska
- North Carolina
- North Dakota *
- Ohio
- Oregon
- South Carolina *
- Texas
- Wyoming *

* requires a disclaimer

The court victory in Texas that was upheld by the 5th Circuit of the U.S. Court of Appeals was viewed at the time as the golden ticket to overturning state dental board regulations and state laws to allow greater recognition of dental specialties other than those recognized by the ADA. The reality is that it has become a ground war with each state presenting its own separate battleground.

Key State Issues

While a lot of ground has been covered, the battle still continues.

MICHIGAN

Notably, in the State of Michigan, a Diplomate was sued by the state for advertising as a specialist. The AAID was able to effect an agreement by the State that Michigan-licensed dentists were entitled to advertise themselves as a “specialist” or “Board Certified” or “having a specialty” in implantology/dental implants, provided that the designation was accurate based on credentials awarded by the AAID, the ABOI/ID, or another organization recognized by the American Board of Dental Specialties.

OREGON

Recently, Oregon attempted to circumvent the decision reached by the 5th Circuit Court by extending the ability to advertise as a specialist only to those dentists who had “completed an advanced education program that is at least two years in length and is recognized by the United States Department of Education.” Because the Department of Education relies on the ADA to decide which programs to recognize, this was tantamount to deferring to the ADA. The AAID negotiated an agreement by which the state agreed to:

1. Not enforce its specialty advertising regulations against AAID members.
2. Repeal specialty advertising regulations that prohibit advertising as a “specialist” in specialty areas of dentistry not recognized by the ABDS.
3. Recommend to the Governor the repeal of statutory specialty advertising restrictions in the Governors 2023 legislative agenda.

As a result, ABOI/ID Diplomates may advertise as specialists. Additionally, AAID-credentialed members who are not also Diplomates may advertise that they practice implant dentistry and are exempt from any further requirement that they identify themselves as a general dentist or a specialist in another specialty.

SOUTH DAKOTA

South Dakota has proposed legislation similar to that which Oregon enacted – i.e., to limit advertisement as a specialist to those dentists who complete an advanced education program of at least two years. The AAID appeared in opposition. A decision will be made at the June 2023 meeting of the South Dakota Dental Board.

continued on page 16

Legal Bite

continued from page 15

The AAID, through its Legal Oversight Committee, is dedicated to battling in these key states and ultimately winning the war of recognition for ABOI/ID Diplomates and AAID Fellows and Associate Fellows and their right to advertise their bona fide credentials.

OKLAHOMA

Recently, independent of any action by the AAID, a unique approach has reared its head in Oklahoma. The approach is one that requires further thought and discussion by the Committee.

Rather than deciding who may advertise as a specialist, it goes further to address the fundamental question of who should even be allowed to provide implant placement treatment. The expressed concern behind the proposed legislation is the perceived lack of quality of care standards for implant placement.

Sen. Lonnie Paxton (R-Dist. 23) introduced Senate Bill 754 (S.B. 754) in the Oklahoma Senate on January 25, 2023, intended to address the perceived lack of quality by those providing implant placement surgery treatment.

Within the bill AS INTRODUCED is the following language:

E. 1. Beginning May 1, 2025, a dentist placing implants must have an implant designation included on his or her license. Between the effective date of this act and May 1, 2025, every dentist shall provide proof of a minimum of eighty (80) hours of continuing education or a certification program specific to implants.

2. Specialists licensed in oral and maxillofacial surgery, periodontics, prosthodontics, and endodontics are exempted from the requirement in paragraph 1 of this subsection.

*3. Current certification as an **associate fellow, fellow or diplomate of the American Academy of Implant Dentistry (AAID) or the American Board of Oral Implantology (ABOI) shall be automatically granted an implant designation. (emphasis supplied)***

As of March 24, 2023, S.B. 754 passed the Senate and was sent to the House. In the Senate, it was amended significantly to remove all the above language.

Instead, existing language that provided penalties for dentists who represented themselves as a specialist when that was not true was removed. In its place, the following language was substituted:

Practicing below the basic standard of care of a patient which an ordinary prudent dentist with similar training and experience within the local area would have provided including, but not limited to, failing to complete proper training and demonstrate proficiency for any procedure delegated to a dental hygienist or dental assistant;

Dentistry Today published an article on February 28, 2023 entitled "Oklahoma and Oregon Dental Boards to Require Education Minimums for Dental Implant Surgery," authored by Michael W. Davis, DDS. Although the article prematurely reported that the law had been enacted, other states might decide to take a closer look at the approach of a designation on the dentist's license to even perform implant surgery much less advertise as a specialist.

Future AAID Goals

Despite the favorable decision in the 5th Circuit, the state of Texas is making noises of requiring those dentists who are not from ADA-recognized specialties to be required to advertise as general dentists. Furthermore, Louisiana and Mississippi, which were directly covered by the 5th Circuit decision, have been slow to the spirit of the court's decision. They are both on the LOC's radar.

The court victory in Texas that was upheld by the 5th Circuit of the U.S. Court of Appeals was viewed at the time as the golden ticket to overturning state dental board regulations and state laws to allow greater recognition of dental specialties other than those recognized by the ADA. The reality is that it has become a ground war with each state presenting its own separate battleground.

The AAID, through its Legal Oversight Committee, is dedicated to battling in these key states and ultimately winning the war of recognition for ABOI/ID Diplomates and AAID Fellows and Associate Fellows and their right to advertise their bona fide credentials.

Max G. Moses retired as the Executive Director of the Academy of General Dentistry and prior to that was the Director of Communications and Marketing for the AAID.

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2023 ISSUE 1



By Dennis Flanagan,
DDS, MSc, FAAID, DABOI/ID

CLINICALBITE

Tooth Fracture and Bite Force Capability: A Retrospective Study

ABSTRACT

The objective of this work is to find if bite force capacity can be related to tooth fracture.

This is a retrospective of patients who presented with tooth cracks and fractures in a private dental practice. Most tooth cracks and fractures were seen in patients with a bite force capacity above 100 newtons. It appears that most patients have a bite force capacity above 100 newtons, so there are apparently other factors that are associated with tooth fracture.

More research is needed to correlate the multiple parameters that may be related to tooth fracture. Cusp height, enamel-dentin phenotype, musculature, functional and parafunctional issues, bite force capacity, and other factors are implicated.

Key words: tooth fracture, bite force, restoration, enamel, dentin, cusp height, diet.

INTRODUCTION

With the advent of public water fluoridation and improved personal and oral hygiene, people are maintaining their teeth and living longer than in the past (1, 2). This means that there is a longer time for teeth to undergo cyclic occlusal loading from mastication and parafunction and a longer time opportunity for a crack generating incident. Chronic load cycling may impact the structural integrity of teeth and create a potential for vertical tooth cracks and fractures (2) (Fig.1,2).

The recent pandemic and social restrictions have caused psychological stress for many people. This can result in increased clenching and bruxing which can result in tooth fractures (3, 4). The psychological stress of unemployment and social isolation can lead to severe bruxism that can predispose patients to dental cracks and fractures (4).

The concept of bite force as it relates to dental treatment is not a new idea (5). In 1960, Lawson published an article on how bite force capacity (BFC) affects oral function, teeth, and prosthetic longevity (5).

Empirically, a tooth is made of a natural physiologic material and has a compressive strength of about 372 newtons/mm², that when imparted, can cause a crack or fracture of the subjected tooth (6). The compressive strength of enamel-dentin-pulp is about 384 newtons/mm², slightly higher than unsupported enamel. Contact from the opposing cusp may be a point or small area that bears down on the subject cusp, inclined plane, or marginal ridge to cause a separation of the enamel crystal and create a crack or fracture. The compressive strength of enamel has been shown to be as high as 1850 newtons, thus not all human enamel is equal. Some enamel is not well formed and may be prone to cracks and fractured (7). The enamel-dentin interface can suppress and resist cracking (7).



Figure 1.

Compression strength of enamel and dentin is measured in newtons/square mm (or mega pascals). The jaw force capacity is measured in newtons. Because a measuring device is equipped with pads to prevent the patient's teeth from injury, there is no per square mm measurement, only a gross measurement in newtons against the tooth occlusal surface. Nonetheless, under function, the newton force capacity would be delivered to a small area on the tooth surface, perhaps by a square mm of contact.

The dentin-enamel junction (DEJ) is 1-150 microns thick and is important in crack resistance into dentin and fracture toughness. This range of thickness is produced in the tooth bud and may be variable (8,9).

Crack paths are deflected away from dentin by the DEJ. The enamel is harder than dentin and the DEJ acts as a buffer between these layers. The DEJ acts to prevent enamel flaws (tufts) from propagating into dentin (8, 9). The range of DEJ thickness may be indicative of a resistance to cracking or fracture.



Figure 2.

Macrofractures can start from tufts on the undersurface of enamel next to the DEJ and then revert back into the enamel, and so a meso-fracture is formed. Additionally, there is an inner layer of decussing enamel that helps to contain cracks. Dentin is isotropic and enamel is anisotropic, so they behave differently under crack propagation (10).

When extracted human teeth are submitted to compression overload in the central fossa, radial cracks form from the dento-enamel junction to the occlusal surface and from the occlusal contact points to the dento-enamel junction (11).

Cracks can be initiated at any point on a tooth. Most symptomatic cracked teeth occur in the fifth decade of life (1, 12, 13). Empirically, an increased bite force capability may incur more of a risk for vertical root fracture. Maxillary premolar teeth are most susceptible to vertical root fracture (14).

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There are ranges of patient Bite Force Capacity (BFC) that have been reported (15). BFC is the maximum voluntary physiologic load capability of a particular patient (15). Before recent pressure sensors were introduced, Lyons measured bite force in humans (15). Lyons et al found that there was a variance of BFC found among human patients (15). Transcutaneous electrical stimuli were applied to selected sites on masseter muscles with a controlled isometric bite force. This was measured on a unidirectional force transducer placed between the anterior teeth. It was measured in newtons and found to range from 153N to 593N (15). Interestingly, it was also found that the masseters have spare force-generating capacity which patients may not be able to voluntarily activate (15). Thus, a patient may have a BFC that may be measured as one value, but the patient may be capable of a higher magnitude during an involuntary or emotional bite down. A high BFC may be a causative factor in framework fracture of zirconia supported full arch implant supported prostheses (16).

A tooth fracture may not be visible on plane film radiography unless the fracture line is in perfect alignment with the radiographic beam. So, tooth-radiation beam alignment is important on plane film radiography. Thus, cone beam computerized tomography (CBCT) may be useful in detection of vertical root fractures since tooth position orientation may not be important for fracture detection with CBCT (17). A minority of cracked teeth progress to a fracture and this fractured tooth population could be measured for BFC to find a potential association with tooth fracture and BFC (18,19).

Cracks can progress to involve the pulp. Cracks can induce irreversible pulpitis and necrosis by advancing into the pulp chamber (20). In less than 6 months, 20% of teeth with a marginal ridge crack can potentially propagate into the pulp causing the need for endodontic therapy or extraction (20). When the crack is superficial, these teeth may be treated pre-emptively with crack removal

and a restoration or full crown. Nonetheless, there is no criterion to predict which crack should be treated as such. In a patient with a cracked marginal ridge with a high bite force magnitude, full crown treatment may be seriously considered.

A “true” vertical root fracture is defined by the American Association of Endodontists as “a complete or incomplete fracture initiated from the root at any level, usually directed buccolingually” (21). Nonetheless, a tooth crack or fracture can occur in a variety of directions.

The objective of this work is to find the importance, if any, of BFC as a diagnostic parameter. BFC may be an important pre-operative parameter for treatment planning for materials and occlusal schemes. This parameter may become a factor in legal torts such as in restaurant tooth fractures and also in the aging process as related to tooth cracks and fractures.

MATERIALS AND METHODS

Retrospectively (2019-2021), in a private suburban dental group practice in Connecticut, USA, 23 patients who sustained tooth fractures were measured for BFC. In this dental practice, BFC is routinely measured as a part of patient assessment. Only non-restored or minimally restored teeth (small Class 1 or small Class 5 restorations) were considered. Endodontically treated or extensively restored teeth were excluded. Patients with more than ten missing teeth were excluded as well. No patients with an opposing complete or partial denture were included. No patients who complained of muscle or temporomandibular symptoms were included. All symptoms were isolated to the tooth in question. Symptoms included fracture, diffuse pain, sharp pain, occasional pain, hot and/or cold sensitivity, no pain or symptoms, percussion tenderness, and no percussive pain. Due to difficulty in measuring and the lack of an accepted standard, cusp heights were not measured but cusp

heights were qualitatively judged as low, moderate, or high.

BFC was measured at the time of extraction or restoration, or shortly prior or after. BFC was measured with a calibrated FUTek (Irvine, Ca.) bite force device and expressed in newtons. This was the only device used. Bite sites were on or very near the tooth in question or at the contralateral mate. The BFC sites were selected to minimize or eliminate any patient factors related to reluctance to maximally bite down for any reason.

Patients' presenting complaints were of any one or combination of symptoms: hot and/or cold sensitivity, pain on biting, tooth mobility, constant pain, occasional pain, sharp pain, and dull pain. All patients denied vegetarian diet. Only one admitted to ice chewing and popcorn consumption. Teeth that were obviously vertically fractured and unrestorable were extracted with local anesthesia (Articaine, Septocaine). Teeth that were deemed cracked and deemed treatable were locally anesthetized (Articaine), and all apparent cracks removed to the dentin-enamel junction. If the tooth was deemed to be restorable, an amalgam or composite resin (Filtek) restoration was performed. If a crack was found to be on a proximal or facial or lingual surface and not below the cemento-enamel junction, then an amalgam restoration was placed after conservative crack removal. A composite resin was placed if the crack was above the gingival margin. If a crack had progressed on two or three or four surfaces and was not below the cemento-enamel junction, a full crown restoration was performed. Cracks that were found to have progressed below the cemento-enamel junction and across the pulpal floor were deemed to be unrestorable. After an informed consent discussion with the patient and after the patient agreed, the tooth was extracted. Implants may or may not have been subsequently placed.

RESULTS

After 3 weeks, all patients had experienced ease of pain and symptom relief.

The results of this retrospective data collection of 23 patients are summarized in Table 1 below. Eight patients sustained symptomatic cracks that were treated with amalgam, composite resin or full crown restorations.

There were 15 patients who sustained a complete or partial tooth fracture. Gender distribution was 13 males and 10 females. Age distribution range was 30-77 years. Average age was 51.25 years. Only one patient admitted to ice chewing or popcorn consumption. All periodontal readings were 4mm or less.

There were 19 teeth with three or more surface cracks or fractures, of which 12 were deemed unrestorable and extracted, 5 were crowned, and 1 was restored with composite resin. There were 5 teeth with proximal-occlusal cracks that were treated with an amalgam restoration and cusp reduction and fluoride treatment.

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TABLE 1

Patient	Gender	Age	Tooth #	Symtom	Crack/ fracture Locale *=below CEJ	Bite force capability newtons	Parafuction	Cusp height	Occlusion Class	Treatment
AE	F	77	5	PT	M-O-D*	169	no	high	I	Extract
MK	M	55	18	PT	M-O-D*	120	no	moderate	I	Extract
SF	F	30	14	CS	M-O	216	no	high	III	MO Amal + Cusp reduction
BV	F	53	3,13	PT	M-O-D*	83	bruxism	low	I	extract
RV	M	62	31	PT	M-O-D*	115	no	moderate	1	extract
PT	F	61	18	PT	M-O-D*	103	no	moderate	1	extract
RB	M	61	12	CS	M-O-D	231	bruxism	high	1	crown
NM	M	63	13	CS	M-O-D*	156	no	moderate	2	extract
RF	M	49	19	CS	OL	212	clenching	low	1	OL amalgam + Cusp reduction
RB	M	59	4	PT	M-O-D*	154	clenching	moderate	1	extract
JK	F	42	12	CS	M-O-D	57	clenching	high	1 bimax protrusive	Composite resin + Cusp reduction
JN	F	56	31	CS	M-O-D-L-F	180	no	low	1	crown
ER	M	56	18	CS	M-D-F	160	clenching	high	1	MOD amalgam + Cusp reduction
RF	M	61	18	CS	MOL*	169	none	high	1	extract
AS	F	72	5	CS	M-O-D	243	Anterior, open bite, clenching	moderate	1	crown
TR	M	65	14	CS	M-O-D fracture	224	clenching	moderate	1	crown
KRW	M	40	32	CS	M-D-L*	263	clenching	moderate	1	extract
ER	M	47	30	CS	DO	254	Hard foods	high	1	DO amalgam + Cusp reduction
DG	F	54	3	PT	M-O-D-L*	406	clenching	moderate	1	extract
JL	M	51	31	CS	DO	181	clenching	moderate	1	DO amalgam + Cusp reduction
TS	M	53	13	PT	MOD	146	clenching	high	1	extract
SE	F	61	18	PT	MODBL	120	clenching	high	1	extract
DC	F	58	18	none	MOD	184	Ice, popcorn	low	1	crown

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DISCUSSION

Discussion of Results

The patients had a BFC $\geq 103\text{N}$ with two outliers with less than 103N and one outlier (a female dentist) with a BFC of 406N .

This high BFC was higher than any other subject. This may be a result of a perceived high-stress in dentistry, causing clenching and well-developed clenching muscles.

One 30-year-old female patient sustained a vertical fracture of the maxillary left first molar necessitating extraction. She had a BFC of 216N . This age is young for this type of fracture, but the BFC was relatively high, and the cusp height was deemed high as well. This patient was admonished to be circumspect during mastication of certain foods and to refrain from ice and popcorn chewing.

The average female BFC was 176.7N . The average male BFC was 183.5N . Males had only a slightly higher BFC average.

There are limitations with this case series assessment in that it is a retrospective with a small number of patients and there are ancillary parameters that could not be or were not measured. There are other parameters that may influence the incidence of tooth fracture that include diet, habits, muscle tonus, psychological personality factors, temporomandibular condyle to tooth length-leverage, and enamel-dentin complex properties (2,3,4).

There may be variation in a patient's BFC measurement due to variations in an emotional state (2,3,4). Thus, a BFC measurement taken on a day of quiescence may be different than on a day of an aggressive state of mind (2,3,4). Symptoms can be variable depending on a patient's state of mind (2,3,4).

Removing cracks and filling the prepared cavity may be an appropriate method for repairing a cracked tooth (22).

Masticatory Musculature

The maximum bite force is a result of the action of the jaw muscles and may be an indicator of the functional state of the masticatory system (23).

The reliability of these measurements may vary with the presence of pain, temporomandibular disorders, gender, age, cranio-facial morphology, issues of occlusion, and physiological factors (23). Recording devices and techniques are variable so there may not be comparable outcomes among devices (23). There is a wide range of bite force recording devices and there is little or no correlation for accuracy or inter-instrument comparison (24). Thus, comparison or meta-analysis of research may be difficult or impossible. For consistency, measurements should use only one calibrated device for any one data set.

The temporalis and masseter muscles are capable of producing multiple mechanical effects. The sarcomeres of these muscles contract and produce an occlusal load. The sarcomeres contract with the various excursions during jaw movements. This causes differences in excursion ranges and BFC. Thus, the patient can vary both the magnitude and the direction of occlusal load by activation of selected muscle fibers by intention or reflex (25).

The anterior temporalis and the superficial and deep masseter can generate increased forces during biting and chewing. These muscles are primarily responsible for BFC. The posterior temporalis and the anterior and posterior deep masseter deliver precise forces and movements for latero-trusive and protrusive/retrusive movements (25)

Dental Composition and Anatomy

Teeth have an outer enamel layer and an inner supporting dentin layer (Fig. 3). The enamel layer is in the form of a crystal that can fracture (Fig.4).

Mammalian posterior teeth have complex occlusal configurations that increase tooth durability. This may be an outcome of evolutionary dietary and food type availability stresses (26). Posterior teeth with multiple cusps can adequately resist high occlusal loads when there are simultaneous cusp contacts that "share the load" (26). This durability may be compromised when there is no tandem effort. Thus, cracks and fractures may be initiated when a patient bites down and only two opposing teeth engage the orthodont. If there is not a sharing of the load impact, then a crack or fracture can be initiated. The load point on cusp height is an important factor here (26). Increased cusp height can allow a greater exposure for an off-axial load point that may be an increased risk for crack or fracture (26).

The extracellular matrix leucine rich proteoglycans in dentin contributes to tooth toughness. The proteoglycan polymers can increase the dentin extracellular matrix resistance to tearing. This may contribute to fracture resistance by inhibiting tooth crack propagation. Additionally, this may be an evolutionary development to prolong tooth survival under normal cyclic mechanical loading and stress dissipation (27).

Two parameters—enamel thickness and dentin horn angle—may be associated with molar crown area, body mass, and gender. These two anatomical parameters may additionally be associated with tooth bite force resistance (28). There may be a relationship between enamel thickness and fracture resistance, but this is controversial (28, 29).

The nanoscale responses of teeth to mastication loads are not well understood. The etiology of enamel resistance to fracture may be related to the nanostructure of enamel, that is, the reaction of tooth hydroxyapatite nanofibers to variable and multidirectional loads. Hydroxyapatite nanofibers are composed of chains of connected nanospheres.

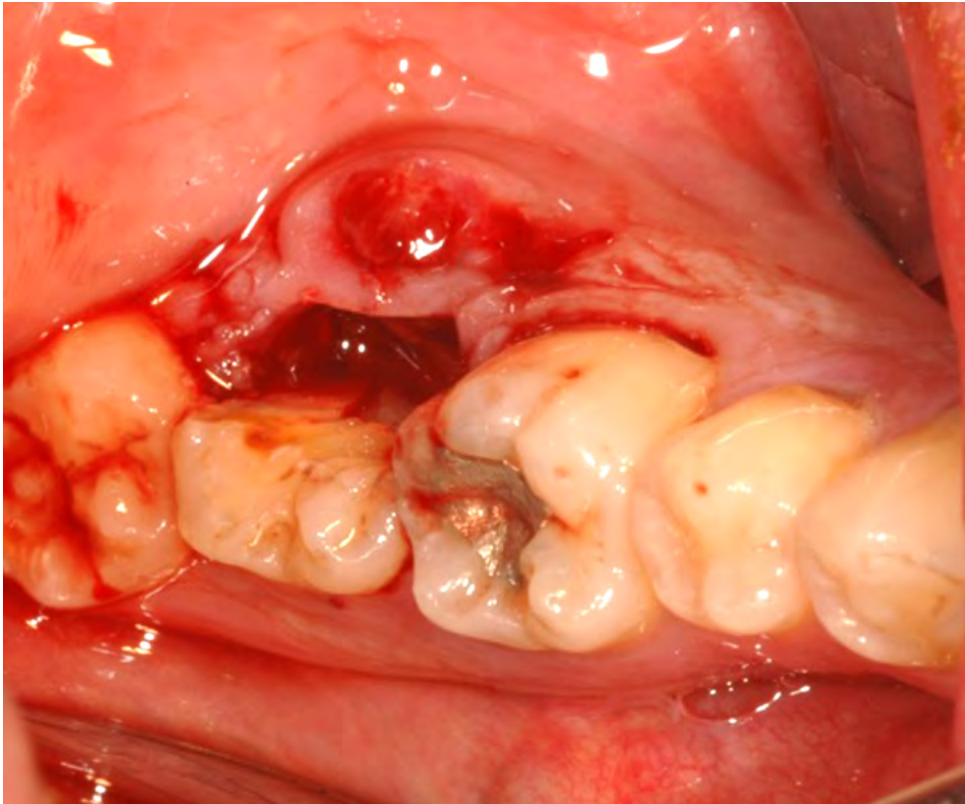


Figure 3.



Figure 4.

These are elemental units of enamel. The nanofibers may respond to occlusal loading by loss of nanospheres when the protein adhesion is overloaded. Additionally, plastic deformation, depending on the occlusal force magnitude and direction, can cause a fracture of the nanofibers that bond nanoparticles into nanospheres. Thus, the interpolymeric nanostructure of enamel plays an important role in enamel integrity with regard to variable occlusal loads (30).

Enamel and dentin are not homogenous and tooth fractures may cease to propagate at the enamel-dentin junction (29). The pulp volume and diameter may influence the biomechanics of tooth fracture by effecting enamel-dentin thickness (31).

The risk for vertical root fracture increases with age. Molecular cross-linking of interpolymeric chains of collagen increases with age in the apical third and there is an increase in the mineral-to-collagen ratio in the middle third of teeth (29,30,31). This results in a reduction of mid- and apical-root fracture tolerance due to this change, especially in endodontically treated dentin microstructure (29,30,31). Thus, dentin microstructure can change with aging. Since fractures can initiate at any point in the tooth anatomy, this may indicate more resistance to root-initiated fracture with aging.

Generally, there are no significant variations in bite force measurements between the right and left sides or eating and non-eating preferential sides. There are, however, significant correlations of posterior maximum bite force and the inclinations of the lower first molars and the lower canines. (32)

There is a significant BFC difference between a single tooth force measurement versus the measurement of multiple teeth (32,33). This difference may be due to a perception of one tooth bearing the load versus multiple teeth bearing the load and the associated sensation causing a reflexive muscle relaxation (32,33).

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Patients with severely worn dentition due to bruxism have high BFC due to inordinately strong masticatory muscles and a mechanically advantaged jaw morphology (34). Although, the jaw morphology may be an anatomical accommodation due to the parafunction and the increased muscle strength.

Diet

Eating hard food is associated with cracked teeth (35). An occlusal restoration in molars and cusp inclinations is linked to cracked teeth. Interestingly the mesiobuccal cusp of molars is not linked significantly. A high inclination of the distolingual molar cusps and lingual cusps in premolars are predictive of a cusp crack (35).

Parafunction

Patients with parafunction may not be aware of their habit. Nonetheless, parafunction can predispose a patient to tooth cracks and fracture (35).

Crack Detection

Many cracks can be detected by direct visualization. Transillumination can be helpful in the evaluation of tooth cracks and fractures (36). Transillumination generally demonstrates enamel cracks but may not be indicative of structurally compromised tooth structure (18,19). Dyes are available to demonstrate the presence of cracks and fractures (37). Nonetheless, there is no reliable method for tooth crack diagnosis (37).

Cracks and Loading

If the compressive strength of enamel is 372 newtons/mm², then any patient who can impart that magnitude of load on a tooth will probably fracture teeth. However, that published compressive strength value is an average of samples tested (6). Some patients will have enamel that may not be as well formed and may crack or fracture under a much lesser load.

Tooth fracture is a relatively rare occurrence (18,19). The overwhelming majority of tooth cracks do not develop into fractures (18,19). About 12% of cracks do progress into a fracture (18,19). Wear facets that wear enamel and excursive interferences are associated with tooth fracture (18,19). Crack propagation is more common in males, and in teeth with multiple cracks and molars with steep cusp inclines. Cracks that can be “sensed” with an explorer are more likely to fracture (18,19). According to Hilton et al, maxillary molars more commonly sustain fractures, but mandibular molars are more likely to sustain cracks. Hilton et al. state “There was no commonality between characteristics associated with tooth fracture and those associated with crack progression” (18). Nonetheless, BFC was not considered in Hilton’s excellent National Practice-Based Research Network work. BFC may be the commonality that connects crack progression and fracture.

Sound molars of both jaws in one study were shown to incur cusp or vertical fractures when cyclically loaded under high loads in chewing simulators (38). These simulators produced fractures in 50% of the tested teeth up to 2981N. These tests did not include sudden impact loads that may be seen in mastication on seeds, popcorn kernels, and other foods that may contain small hard parts that may cause a sudden sharp occlusally directed force. Such a sudden impact may induce a fracture in a sound molar or premolar. This issue can occur in restaurants where a small stone is inadvertently left in food. This author has been a consultant in legal torts where diners have fractured a tooth apparently on a small hard substance rendering the tooth unrestorable.

During mastication, axial tooth loads of 133-135 N and off-axial loads of 39-44 N were found by de las Casas and coworkers (39). These load magnitudes may represent a “normal” functional bite capacity and larger magnitudes may indicate a potential overload of the enamel-dentin complex with subsequent crack formation. Under cyclic functional loads, normal chewing, and with time, a crack may develop into a fracture (39).

Nondestructive analysis of enamel crack behavior using 3D optical coherence tomography was done on 80 various types of human teeth for enamel crack patterns. The enamel crack patterns were classified as superficial, horizontal, vertical, and complicated (40). Superficial and complicated cracks were found on the occlusal contacting surfaces of incisors, cusps of canines, and functional cusps of posterior teeth. The vertical cracks were found on non-contacting surfaces of incisors and canines and nonfunctional cusps of posterior teeth. Thus, there was a strong correlation among crack patterns, tooth types, and the location of the crack on the tooth (40).

The presence of microcracks in non-endodontically treated incisors does not predispose these teeth for fracture (41). This may be due to the direction of the functional force vectors. These vectors are generally directed from the lingual and are imparted by the mandibular incisor incisal edges to the maxillary incisor lingual surface. This does not create a compression, but it does create an off-axial load. Crack susceptibility in anterior teeth may be low due to their position in the arch and anatomical geometry (41). Finite elemental analysis shows that incisors and canines may be less prone to vertical fracture by virtue of their elongated anatomical geometry (42). This anatomy may protect these teeth from vertical fractures when under axial and off-axial loads (42). Molars and premolars do not enjoy an elongated anatomy, and their truncated anatomy may predispose them to vertical fracture. Incisors and canines may vertically fracture but the fracture may not propagate more than 1/3 the root length. The increased tooth height of anterior teeth may be protective against vertical root fracture when exposed to cusp tip axial loads (31). Additionally, the occlusal load in the anterior jaws is about 1/2 to 1/3 of the force in the posterior jaws (43). This obviously imparts a higher load on posterior teeth.

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Vertical root fractures (VRF) occur mostly in patients older than age 40 and cusp fractures mostly occur in patients older than 60 years (1,12). Apparently, fractures are a rare occurrence in young people. Thus, chronic cyclic loading may be a contributing factor.

The relationship between cusp inclinations in cracked tooth and tooth fracture was studied by Xie and coworkers (30). The cusp inclination on 40 maxillary premolars was measured by digital radio-visiography. Cusp inclinations were set in groups buccal 59°: palatal 50°, buccal 64°: palatal 55°, and buccal 69°: palatal 60°, and a control group. All teeth had compressive loading tests. Most fractures were VRF in the three test groups. Coronal cusp fractures occurred in greater numbers in the control group with the number of palatal cusp fractures greater than buccal cusp fractures (30). Cusp inclination is a critical cause of structural tooth fracture. A steep cusp incline induces an increase in tensile stress at the central fossa and cervical, causing a decussation of the dento-enamel junction. This then can lead to a crack or fracture (30). Xie recommends crack removal and conservative restoration for localized cracks and fractures, full crown restoration for coronal fractures, and endodontic therapy and full crown for fractures involving the pulp. Crown lengthening osteotomies are recommended for some coronal fractures that extend to or below the cemento-enamel junction. Fractures that extend deep into the root body should be extracted (30). A tooth with a root fracture may have additional small or incipient cracks or fractures that go undetected by the clinician. Thus, a thorough investigation of the tooth is warranted before any restorative or endodontic treatment is initiated.

Contradicting Hilton, Gao found VRFs occur predominately on the mandibular first molar mesial roots (44). A finite element analysis revealed that a 200 N of bite force applied to the first molar occlusal surface at 15° causes the largest stress concentration and the greatest risk for VRF (44).

High resolution CBCT may be more accurate in detecting root cracks and fractures (45, 46,47). A zirconium implant adjacent to a tooth suspected of VRF may interfere with the CBCT imaging and preclude an appropriate diagnosis (48). Thus, the use of the lowest tube current is recommended to minimize this negative effect (48).

Magnification, tactile examination, transillumination, and diagnostic dyes are useful in detecting enamel cracks (49). Restorative treatment with occlusal reduction, a restoration, crown, or onlay may be indicated to prevent propagation of a small less invasive crack (49, 50). Nonetheless, the patient should be informed that such treatment may not absolutely prevent a fracture from occurring. Most early treated cracked teeth can remain asymptomatic for about 3 years (49,50,51). It may be best to brace the crack to minimize cusp flexion by providing a full coverage crown with control of occlusal off-axial loading, but this does not mean the crack would be arrested (49,50,51). Operative removal of a tooth crack may be important during preparation to minimize the effects of the crack and prevent propagation or re-initiation of the crack.

Signs and symptoms of VRF are inconsistent. Endodontic therapy may not relieve symptoms on teeth with VRF, and radiographically, there may be a range of no change to extensive bone loss on these teeth. Flap reflection can reveal fractured roots and bony defects filled with granulomatous tissue. This may be an indication for extraction (52).

It may be difficult to diagnose a tooth structural fracture. Duration and type of symptoms vary. Maxillary second premolars and mesial roots of the mandibular first molars may be most susceptible to VRF, although some studies report variations (53). Duration of symptoms until diagnosis can be 1-40 months (53). If a VRF is suspected, the array of treatment and the consequences of each should be explained to the patient (53).

Natural teeth have an energy absorber in the form of a periodontal ligament (PDL). The PDL protects the tooth from sudden impact load of some magnitude (54). Thus, the tooth-periodontal complex has viscoelastic properties that dissipate energy loads and can attenuate structural load failure (54). This may serve as a protective physiologic mechanism against tooth fracture.

In the study herein, most of the tooth fractures of maxillary premolars had what were deemed as high cusp height. Of the seven premolar fractures, five had high or moderate cusp heights. High cusp height 3mm or more may predispose a particular maxillary premolar to increased strain and subsequent vertical fracture (55). Alhamdan found that there was an increased strain on teeth with a cusp height of 3mm or more, under a 130N load (55). Some patients are capable of more than 130N, and these patients may be at risk for tooth fracture.

A patient's diet may influence the occurrence of cracks and fractures. A vegetarian diet, especially of raw vegetables, may cyclically load teeth and induce fractures. The "stiffness" of food apparently does not significantly affect the stress distribution of restored or sound teeth (56). Nonetheless, un-popped kernels of popcorn or ice fragments may be accidentally bitten into to initiate a tooth crack.

Endodontic treatment may be indicated under some situations (57). When the crack has progressed into the root below the epithelial attachment, endodontic therapy may not be the best treatment (58, 59,60,61). In a private general dental practice, there can be economic issues with performing endodontic therapy and a subsequent extraction after an endodontic failure less than 5 years later. An endodontic therapeutic success rate of 75-82% may be satisfactory for some dentists, but the economics and reputational issues of an 18-25% failure rate may make some private practitioners uneasy (61,62).

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Thus, it is appropriate to ensure the patient is well informed as to the potential for failure and extraction if root canal therapy is to be instituted. Private practitioners may need to be circumspect and highly selective in determining on which cracked teeth to perform endodontic therapy. Pulpal involvement or a 6mm or greater periodontal pocket may be indicators of a poor prognosis (58,59,60,61). Nonetheless, many cracked teeth can be restored with endodontic therapy and/or cusp protection (57). A treatment decision is arrived at between the clinician and patient working in tandem.

Patients with dental implant-supported crowns and fixed dentures may be prone to have cracks and fractures in the retained teeth (63). Implants have no PDL and so there is no proprioception for loading. Thus, a patient may bite down and not sense an overload and thus overload a nearby natural tooth that may fracture (63).

Patients with craniomandibular disorders do not have an outlying range of BFCs as compared to the general population (33,34). Patients with unilateral brain infarction show no differences in BFC of the paralyzed side versus the unaffected side, although there may be differences in the motor performance of the muscles of mastication (64).

Patient JK, in the study herein, had a low BFC (57N). This patient is a hospital administrator and admits to psychological stress and clenching. The patient denied popcorn or ice chewing habits. Perhaps high frequency low load clenching in patients with high cusp heights is detrimental. Patient BV also had a low bite force capability but is a bruxer with low cusp height. Again, loading chronicity may be a factor in tooth fracture as opposed to a sudden biting impact such as on ice or un-popped popcorn kernel. Additionally, these patients may have an enamel-dentin phenotype that is inadequately structured for certain textured foods (65).

Amalgam expands slightly during setting, but this setting expansion is not sufficient to induce a crack (66). However, the weakening of the tooth structure from the cavity preparation may have a crack-inducing capability.

There is a panoply of unknown issues. When does BFC peak in human development? Does it remain static throughout life? Does it decline with age or frailty? Does a high cusp height phenotype predispose a patient to tooth fracture, and does the patient have a severe predisposal to fracture if they also have a high BFC? Should cusp height and BFC be a consideration in legal torts when a diner fractures a tooth during mastication of a meal at a restaurant? Should young patients be warned of potential tooth fractures if they have high cusp height and/or high BFC, and should these cusps be prophylactically reduced? MRI may be the best modality for detection of cracks (67).

CONCLUSIONS

Most tooth cracks do not progress to fracture. This retrospective case series demonstrates that bite force capability may potentially predispose a patient to tooth fracture or vertical root fracture. Nonetheless, there may be a panoply of other factors involved. Bite force capacity may be one of several parameters that cause a tooth fracture. It may be that patients with a bite force capability higher than about 100N may be most at risk for a vertical tooth fracture, but this group may include a majority of patients. Cusp height reduction may be indicated when cracks are small and less invasive. High cusp height of maxillary premolars may be a predisposing factor for fracture. Additionally, cusp height reduction and operative removal of the tooth crack with a restoration may be important to mitigate the effects of the crack and possibly prevent a crack propagation, reoccurrence, or a fracture. Cusp protective restorations may be indicated for some cracked teeth. Extraction may be performed where a crack extends below the CEJ with a periodontal

pocket of 6mm or more or when the clinician and patient deem the tooth unrestorable. Cracks that extend below the CEJ and through the pulp chamber should probably be extracted.

Because of bite force measurement device differences, comparisons among bite force studies may be improbable. Nonetheless, further study is needed to find the true importance of bite force capacity. Based on past research, future research should study multiple parameters that include bite force capacity, cusp height, inter-cusp distance, dietary habits, opposing tooth cusp height, parafunction, enamel, and enamel and dentin quality and thickness.

Nonetheless, the measurement of maximum bite force may become a routine assessment parameter of the functionality of the masticatory musculature. This parameter may become important for dental and prosthodontic restorative designing and planning.

The author declares that he has no conflict of interest.

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Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors. All procedures performed in studies involving human participants were in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: This study is based on the author's patient records and informed consent for use of this retrospective data is not required.

Abbreviations: BFC=bite force capacity, VRF=vertical root fracture, CBCT=cone beam computerized tomograph

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Clinical Bite

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Editor’s Note: Because of busy schedules, you may not have time to read the dozen or so articles in each issue of the *Journal of Oral Implantology*. In this section of *AAID News*, we selected a few articles that have broad applicability to the daily practice and provide a brief summary of key points so you can decide if you wish to read the complete article. The following articles are from Volume 49, Issue 1 (2023).

CASE REPORT

Prosthetically Driven Computer-Guided 1-Piece Zirconia Implant Placement and Restoration Replacing Missing Central Incisor: A Case Report

In this case report, authors describe the fully guided planning and placement of a 1-piece zirconia implant replacing a missing central incisor on a 21-year-old nonsmoking male patient. They learn that a Zirconia dental implant could be an optimal alternative for tooth replacement!

Shatha Alshali, Rayan Asali, and Ammar A. Almarghlani, *Journal of Oral Implantology*. 2023;49(1):8-12.



2&3-week Crown Adjustment

CLINICAL REPORT

Immediate Implant and Customized Healing Abutment Promotes Tissues Regeneration: A 5-Year Clinical Report

In this article, researchers replaced a fractured upper first premolar with an immediate implant and a customized healing abutment from this case they report on the clinical and radiologic outcome of an immediate implant with a custom healing abutment over a period of time.

Francesco Corrado, Simone Marconcini, Saverio Cosola, Enrica Giammarinaro, and Ugo Covani, *Journal of Oral Implantology*. 2023;49(1):19-24.



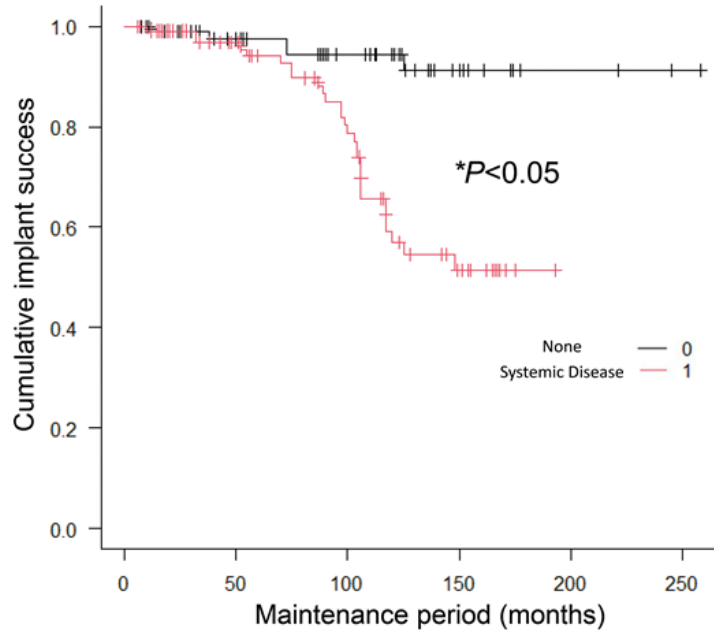
CT Scans of Tooth Fracture

COHORT STUDY

Clinical Evaluation of the Relationship Between Systemic Disease and the Time of Onset of Peri-Implantitis: A Retrospective Cohort Study

Authors conducted this study to evaluate survival rates of implants that compromised adjoining teeth. They also discuss complications associated with these invaded adjoining teeth and the results of long-term assessment of radiographic characteristics of complications using orthopantomographic images.

Keisuke Seki, Akira Hasuike, and Yoshiyuki Hagiwara, *Journal of Oral Implantology*. 2023;49(1):55-61.



Number at risk

0	102	70	53	19	5	2
1	114	75	51	15	0	0

Kaplan-Meier Survival Curves

CLINICAL ARTICLE

Expanding the Surgeon’s Armamentarium: Use of the Tubing Technique to Preserve the Inferior Alveolar Nerve During Transposition Procedure

Authors conducted this study to evaluate survival rates of implants that compromised adjoining teeth. They also discuss complications associated with these invaded adjoining teeth and the results of long-term assessment of radiographic characteristics of complications using orthopantomographic images.

Fares Kablan, Daniel Oren, Asaf Zigran, Idan Redenski, and Samer Srouji, *Journal of Oral Implantology*. 2023;49(1):62-69.



IAN position assessment by CBCT

continued on page 34

JOI Sampler

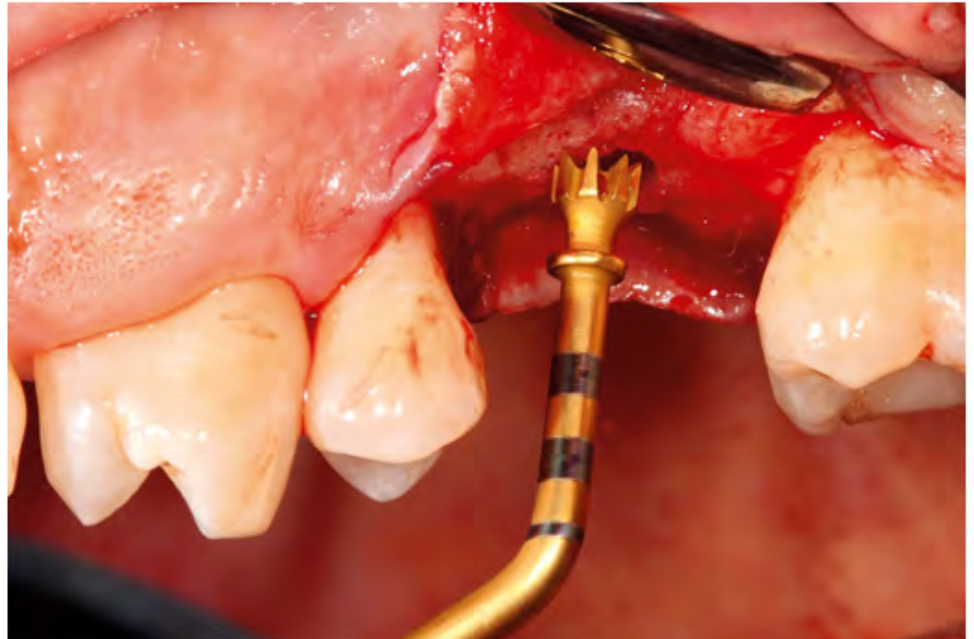
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CASE REPORT

Comparison of Implant Stability Between Conventional Drilling and Piezosurgical Implant Bed Preparation Techniques

In this case report, authors describe the treatment of peri-implantitis lesions through a minimally invasive surgical procedure using a peri-implant excisional procedure and access surgery (PEAS). Further studies with a bigger sample size were determined to be needed to analyze the reliability and validity of this innovative technique.

Martin Kjaergaard, Vinh Giap Nguyen, Jan Brandt, Joanne Pouchet, and Paul Martin Weigl, *Journal of Oral Implantology*. 2023;49(1):79-84.



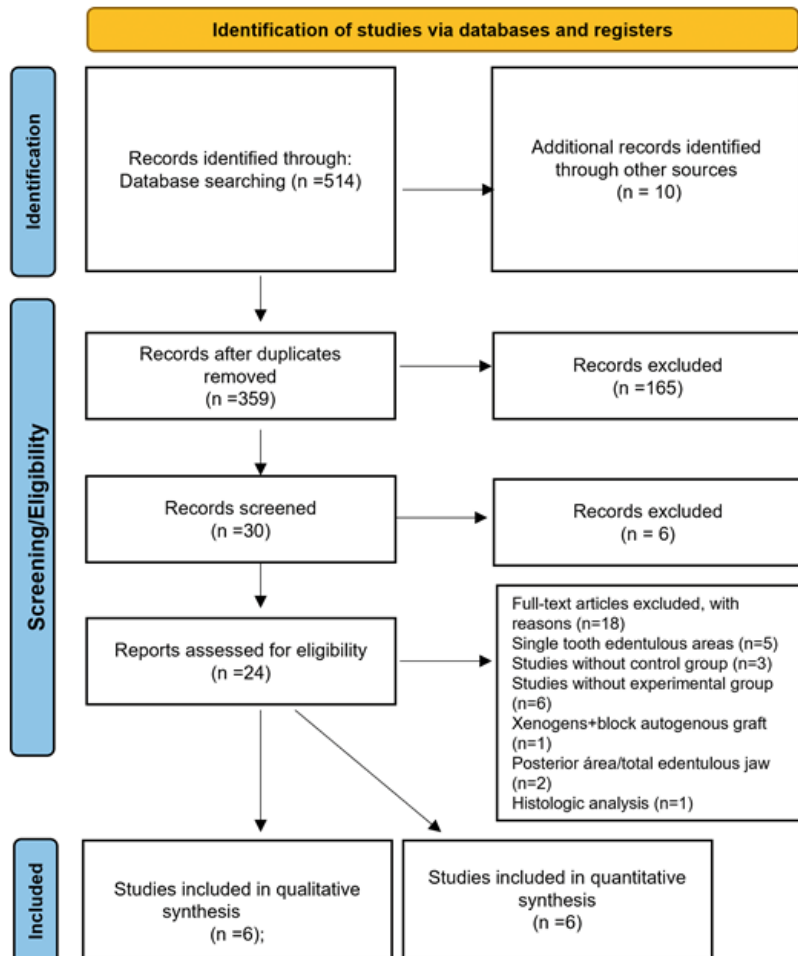
Prep of Implant w IM3P insert

CLINICAL ARTICLE

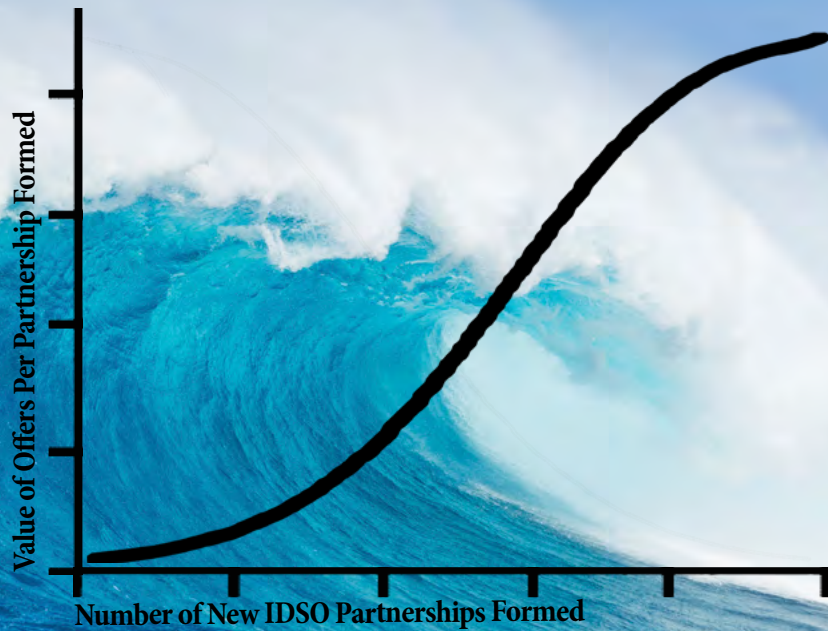
Bone Substitutes Graft for Regeneration of the Anterior Maxillary Alveolar Process: A Systematic Review

Researchers conducted a study to figure out the prevalence of the best anatomy for palatal emergence of an immediate flapless implant in the maxillary central incisor post-extraction site. This was done partly by using 3D implant planning software.

Naida Zanini Assem, Victor Fabrizio Cabrera Pazmiño, Miguel Augusto Riquelme Rodas, Eliana Aparecida Caliente, Gisele da Silva Dalben, Simone Soares, Joel Ferreira Santiago Jr., and Ana Lúcia Pompéia Fraga de Almeida, *Journal of Oral Implantology*. 2023;49(1):102-113.



Search & Selection Flowchart



Practice Consolidation Is Cresting

Make Time to Learn the Value of Your Practice

Silent Partners Buy Part of Your Practice

Dozens of Invisible Dental Support Organization (IDSO) silent partners, in all 50 states, are paying record values for partial interests in larger practices.

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Practice Values in Today's Consolidation Frenzy

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AAID Announces

Opening of Award Applications

As the foremost organization in implant dentistry, the American Academy of Implant Dentistry (AAID) is home to the most prominent leaders in the discipline. Every year, the AAID recognizes accomplishments in the field of implant dentistry through various awards.

Terry Reynolds Trailblazer Award

The Terry Reynolds Trailblazer Award was created to recognize Dr. Reynolds' vast contributions to the profession of implant dentistry. Dr. Reynolds conceptualized, developed, and founded the implant MaxiCourse®, which has become the gold standard for implant education and is trademarked by the AAID. He was the first MaxiCourse director and, in 1998, became the first African American to serve as AAID president.

The award recognizes an AAID member who epitomizes the spirit of Dr. Reynolds' work through:

- Demonstrating leadership in implant dentistry
- Achieving accomplishments and accolades as an innovative educator in the art and science of implant dentistry
- Embodying the spirit of inclusion, outreach, and selfless service through humanitarian efforts within the dental community, fostering training, knowledge, and compassion for better patient care worldwide

The submission deadline is May 1.

Honored Fellows

The Honored Fellows Committee is seeking nominations of AAID members to be distinguished as AAID Honored Fellows in 2023. Members may self-nominate, nominate another member, or be nominated by their peers.

To be eligible, members must have been voting members (Associate Fellow, Academic Associate Fellow, or Fellow) in good standing for at least eight years.

In determining the 2023 Honored Fellows, the Committee will review nominees' AAID leadership and volunteer experience alongside their body of work in the dental community, as well as other leadership or volunteer roles.

Honored Fellows are selected based on the following criteria:

- Distinguished professional, clinical, research, or academic endeavors. Examples include: speaker at AAID conferences and/or other meetings; teacher of AAID or other course; published author for *JOI* or other academic journals; as well as academic qualifications, research endeavors, leadership in other dental societies, and community efforts
- Noteworthy accomplishments within the field of implant dentistry, such as special awards or recognitions
- Demonstrated support of the AAID, including but not limited to District involvement, committee service, and/or AAID Foundation volunteerism

The submission deadline is May 1.

Please consider nominating an AAID member for these accomplishments. The AAID website [aid.com/awards](https://www.aid.com/awards) has the most current information on the selection process, including how to submit nominations.

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Jacksonville University's Comprehensive Oral Implantology Residency Program completes its inaugural first semester

GUEST CONTRIBUTOR

*Marguerite Schimmel
Senior Academic Strategist
Jacksonville University*

This past summer, Jacksonville University's Comprehensive Oral Implantology program, also known as the Alfred L. "Duke" Heller & O. Hilt Tatum Comprehensive Oral Implantology Residency Program, began its inaugural first semester with a cohort comprised of 14 residents located at different clinical sites across North America.

To kick off their first semester, residents of the Jacksonville University Comprehensive Oral Implantology program (COI) traveled to Jacksonville, Florida for a week in June 2022 where they were greeted by campus and community leaders including Dr. Hilt Tatum, co-founder of COI and AAID past president (1994), Dr. Duke Heller, co-founder of the COI and AAID past president (2021), and Tim Cost, Jacksonville University President. The week was spent networking with instructors and clinical site directors, connecting with their cohort; touring Jacksonville University's facilities; and working in JU's Healthcare Simulation Center.

"We've got a lot of didactic out there, but what separates this program is the fact that you're going to do hands-on dentistry," said Dr. Heller. "You're going to look at it [the patient's plan], you're going to kind of design what's going to happen, and then you and the doctor, your instructor, together are going to serve this patient's needs."

During their week in Jacksonville and as a part of their didactic training, residents participated in moderate sedation training that was held at the JU Healthcare Simulation Center (HSC) and facilitated by Dr. Henry Ferguson, Mr. Randy Pigg, and trained HSC simulators. Residents were able to practice and build their competencies in compromised airway management and treating medically compromised patients in controlled scenarios with trained HSC simulator staff.

After the training, residents returned to their clinical sites to work with their instructors in creating care plans for patients. Dr. Jim Gibney, JU Clinical Site Director, shared that his resident was able to perform his first lateral wall sinus graft.

"If you love surgery and you love to push yourself and you love to grow your craft, I think this would be a wonderful program for you," said Dr. John Shin, a JU COI Resident.

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KSONVILLE UNIVERSITY

Jacksonville University

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Dr. Tatum was critical in the development of Jacksonville University's COI program. Multidisciplinary and hands-on, Jacksonville University's COI curriculum includes surgical, periodontal, prosthetic, and long-term maintenance training. At the completion of the program, residents will have earned a Certificate in Comprehensive Oral Implantology alongside a Master of Science in Dentistry.

"The revolutionary reconstruction of the entire oral masticatory process – bone, soft tissue, and teeth - utilizing implants and dental restorations, is an advanced field of surgery taught only in this program," said Dr. Tatum.

Jacksonville University's COI program is a 36-month paid residency program, supported by the Comprehensive Oral Implantology Residency Foundation (COIRF), which combines cutting-edge clinical residency experience with advanced training through online courses instructed by world-renowned practitioners. Residents of this program receive training in two- and three-dimensional radiographic imaging systems, biomechanics, biomaterials related to implantology, digital laboratory technology, basic and advanced alveolar reconstructive surgery, and more.

"Passion surrounds everything that we do. It surrounds our field of study, it surrounds our education, our friendships, our connections with people, and our connection with Jacksonville University," said Dr. Andrew MacConnell, Program Director of COI program and President of COIRF. "Jacksonville University has a philosophy of 'dare to be bold,' and they were. They took a chance on us, and we took a chance on them, and we were able to create this program."

Jacksonville University is accepting applications for the Master of Science in Dentistry and Certificate in Comprehensive Oral Implantology program. To apply for JU's COI program, prospective residents will need:

- Doctor of Dental Surgery (DDS) / Doctor of Dental Medicine (DMD), or equivalent
- U.S. National Board scores Part I & Part II
- Letters of recommendation (2) from:
 - Dental School Chair or Dean
 - Dental School Faculty, or Professional Colleague who can attest to the character and background of the applicant
- Mandatory personal essay (max. 500 words)
- One-way recorded interview

International dental students must also provide additional items to meet the criteria. Applications for this program are being accepted online at ju.edu/implant.

Jacksonville University is offering a scholarship for residents of this program. When awarded, the scholarship will provide \$10,000 for the first year a resident is in the program. Individuals interested in applying for the scholarship will need to submit a personal essay attached to their application for the program.

“This is a wonderful opportunity for me to grow my skills and move into a specialty where I can share my knowledge and my experience and be able to offer more to my patients,” said Dr. Kathryn Nicholson, a JU COI Resident.



newmembers

The AAID is pleased to welcome the following new members who joined between November 21, 2022 and February 21, 2023. The list is organized by state, with the new member's city included. International members are listed by country and province (if applicable). If you joined the AAID recently and your name does not appear below, it will be listed in the next issue of *AAID News*.

PLEASE WELCOME THESE NEW MEMBERS IN YOUR AREA.

Alabama

Robin Hollon, Fairhope
Kim Shannon, Alabaster

Alaska

Arne Krogh, Anchorage

Arizona

Calvin Brown, Glendale
James Chaffin, Glendale
Daniel Dela Cruz, Phoenix
Shahin Javidi, Phoenix
Lakshmi Nallamothu, Phoenix
Priscilla Rivera Canastillo, Tempe
Jasmyne Samuels, Scottsdale

Arkansas

Dawson Urrutia, Alma

California

Rowida Abdalla, Los Angeles
Tariq Alasman, Port Hueneme
Bernabe Ambrosio, San Diego
Carmela Ambrosio, San Diego
Devin Anderson, Loma Linda
Raffi Dadaian, Los Angeles
Steven Darmstadt, Anaheim
Neda Esmaili, Los Angeles
Bryan Fisch, Ventura
Marco Garcia, Bakersfield
Sukhit Gill, Delhi
Edward Givens, Bonita
Matthew Gotaas, San Diego
Sarmad Habboush, El Cajon
David Hakim, Los Angeles
Franco Hernandez, Mountain View
David Kang, Artesia
Krish Karia, Artesia
Sami Kashou, Santee
Bryce Kato, Rowland Heights
Steven Le, San Jose
Brian Le, Westminster
Jiawei Li, Millbrae
Michael Lien, Westminster
Naveed Mohammed, Palmdale
Vishal Pandya, Modesto
Nilesh Patel, Rancho Cordova
Ravi Patel, Fresno
Abhishek Ranjan, Modesto
Carlos Rivero, San Diego

David Rutgard, San Diego
Shorouq Sahawneh, Irvine
Surdeep Singh, Clovis
Matthew Soeherman, San Ramon
Prakash Sojitra, Modesto
Dipak Suri, Berkeley
Derek Tang, Santa Clara
Mina Youssef, Orange

Colorado

Thomas Fow, Westminster
Adam Kwiatkowski, Broomfield
Forum Jobanputra, Rocky Hill
Rajeev Kaur, Milford
Sharon Kuriakose Lype, Shelton
Sung Nam, Stamford

District of Columbia

Scott Brewster, Washington

Florida

Lorena Alemany, Miami
Jeffrey Allen, Tampa
Marines Alvarado, Medley
Alejandro Alvarado, Medley
Liliana Alvarez Mesa, Miami Springs
Ronald Arocha, Kissimmee
Justin Bard, Highland Beach
Jonathan Colucci, Tampa
David Doering, Tampa
Ahmed Elgalady, Palm Coast
Naoko Fukushima, Orlando
Raul Garcia, Miami
Yeendy Gil, Hialeah
Jose Gonzalez, Clearwater
Antonio Gonzalez Acosta, Miami
Carmen Goulet, Port St. Lucie
Doris Gutierrez, Miami
Zayda Hubert Reyes, Clermont
Takashi Koyama, Ft. Pierce
Ilya Ladovsky, Hollywood
Julio Lima, Hialeah
Dayne Martell, Coral Gables
Yannelys Martin, Pembroke Pines
Lester Martinez, Hialeah
Javon McKenzie, Stuart
Juan Morales, Port St. Lucie
Fernando Munoz, Boca Raton
Frank Murias, Hialeah
Jose Novoa, Miami

Florida

Johnny Peralta Lee, Miami Lakes
 Roymar Perez, Miami Beach
 Marciel Perez, Weston
 Yanelis Perez, West Palm Beach
 Gustavo Piedra, Hialeah
 Fadi Raffoul, Brandon
 Sanket Rathod, Port Richey
 Emil Ricart, Miami
 Jim Skaff, Davie
 Anabel Tirado Torres, Miami
 Olga Tron, Jacksonville
 Joseph Vanderbosch, Naples
 Viviana Waich, North Miami

Georgia

Vatsala Jajoo, Roswell
 Kyanduktha Kalantari, Marietta
 Terry Lemons, Cumming
 Raphael Lior, Brookhaven
 Thomas Suitt, Atlanta

Illinois

Marco Colella, Batavia
 Sidney Lee, Addison
 Isabel Llamozas Otamendi, Chicago
 Ulka Patel, Geneva
 Mahtab Sadrameli, Chicago
 Purvi Vadaliya, Lake Bluff
 Nassif Youssef, Chicago

Indiana

Elizabeth Harmon, Carmel
 Lucas Trout, Monticello

Kansas

Daniel Tsao, Wichita

Kentucky

Mackenzie Brindley, Covington

Louisiana

Matthew Clement, Thibodaux
 Chedly Schatzie Vincent, New Orleans

Maine

Nicole Cividanes, Brewer
 Kaitlin Clark, Scarborough
 Maria Mesquita, Townsend
 Spencer Valley, Bangor
 Brody Valley, Bangor

Maryland

Puneet Agarwal, Fulton
 Omua Angole-Wynn, Greenbelt
 Gary Arrindell, Hyattsville
 Amin Soolari, Potomac
 Jason Yi, Bethesda

Massachusetts

Swati Agnihotri, Southborough
 Judley Alphonse, Dracut
 Thalita Andenmatten, Billerica
 Arjun Chawdry, Somerville
 Jacob Donohue, Franklin
 Inkyu Han, Boston
 Joseph Hannawi, Attleboro
 Gustavo Infante, Sudbury
 Ashna Khera, Quincy
 Annie Le, Edgartown
 Yujin Lee-Knowles, Dartmouth
 Amirtha Minisandram, Boston
 Laszo Prince, Newton
 Pauline Reilley- Lake, Peabody
 Priyal Shah, Boston
 Jiangyun Sheng, Plymouth
 Michael Taher, West Boylston
 Markam Youssef, Braintree

Michigan

Obed Galla Pimental, Berrien Springs
 Joseph Szymanski, Rochester Hills
 Diana Whittaker, Grosse Pointe Park

Minnesota

Zachary Conklin, Rice
 Erik Engelbrektson, Minneapolis
 Peter Thurnau, Lakeville
 Mitchell Wilkinson, Saint Paul

Missouri

Jeffrey Gardner, Maryville
 Adam Hallam, Independence
 Adis Hasanagic, St. Louis
 Bradley Laird, Joplin

Montana

John Tecca, Livingston

Nebraska

Jama Obermiller, Grand Island

Nevada

Wilyum Abdelmalik, Las Vegas
 Jorge Marquez, Las Vegas
 Daniel Moore, Henderson
 Seyed Rezaei, Las Vegas
 Gregory Steiner, Henderson
 Matthew Thacker, Las Vegas
 Robert Vong, Reno
 Jun Yuan Xiao, Las Vegas
 Zhongtang Xu, Las Vegas

New Hampshire

Christopher McCormack, Berlin
 Emilia Vajda, Windham

New Jersey

Monica Andrews, Fords
 Ashlee Apratim, Metuchen
 Mariam Beshara, Nutley
 Laura Fuentes, Edison
 Ilan Gamburg, Englishtown
 Feiyi Guo, Jersey City
 Mariam Habib, Nutley
 Paul Haggan, Somerville
 Eoin Halpin, Hamilton
 Suhair Hasan, Voorhees Township
 Brady Huang, Fort Lee
 Elizabeth Kilpatrick-Fox, Swedesboro
 Haroutioun Kotchinian, Jersey City
 Shalini Mandapatti, Princeton
 Jennifer Martin, Hillsborough
 Nipa Parikh, North Brunswick Township
 Viviana Portillo, Hackensack
 Maria Lupe Poussin Pascua, Montclair
 Delfi Romani, Washington
 Gurjinder Singh, Woodbridge Township
 Lucy Slutsky, Livingston
 Collin Suh, Hackensack
 Asmat Syed, Edison

New Mexico

Aaron Standing, Clovis

New York

Badr Alshabebi, Buffalo
 Renee Andre, Cohoes
 Richard Dennis, Saratoga Springs
 Kathleen Hofmann, Eastchester
 Tony Le, New York
 Maryna Luchin, Staten Island
 Thomas Mahar, North Syracuse
 Mohit Modgil, Bayport
 Vincent Pannone, Staten Island
 Tara Pette, West Nyack
 Alina Robbiano, Delmar
 Andrew Sarowitz, Bronxville
 Arshdeep Singh, Richmond Hill
 Kenan Taweel, Yonkers
 Vadim Vasserman, Bronx

North Carolina

Cameron Campbell, Charlotte
 Theodore Limerick, Jamestown
 Elizabeth Limerick, Jamestown
 Nirjal Patel, Winterville

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New Members

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Ohio

Dania Alfathi, Solon
Annette Bauer, Urbana
Dominik Berdysz, Brecksville
Leah Butler, Strongsville
Matthew Earich, Silver Lake
Dev Patel, Cleveland

Oklahoma

Kevin Kunz, Edmond

Oregon

Marlo Bulza, Portland
Leigh Colby, Redmond
Matthew Pavlovich, Bend
Todd Weil, Beaverton

Pennsylvania

Pooja Ahuja, Malvern
Mhd Ghayath Alhalabi, Whitehall
Veena Ananthasayanam, Erie
Ryan Dellagio, Waverly
Kyle Durante, Lancaster
Diane Feng, Ambler
Gerard Genco, Pittston
Scott Gradwell, Allentown
Kevin Hicks, Lititz
Susan Koh, Philadelphia
John McGuire, Mount Cobb
Chandani Patel, Yardley
Lusai Qiu, Williamsport
Laura Spence, Wilkes-Barre

Rhode Island

Ahmed Abdelaal, Cranston
Floyd Lopez, West Greenwich

South Carolina

Dominick Bear, Summerville
Paul Gawrych, Mount Pleasant
James Swick, II, Columbia

South Dakota

Collin Palmquist, Watertown

Tennessee

Zach Fields, Gallatin
Presto Harris, Antioch
Ramin Heidari, Nashville
Jayson Tabor, Hendersonville

Texas

Cameron Blair, Sunnyvale
Stephen Chan, Plano
Jaden Danos, San Antonio
Tanner Dice, Grapevine
Ali Faiz, Frisco
Varghese George, Mesquite
Xiang Hu, Flower Mound
Nashwa Jalal, Plano
Kunal Karan, San Antonio
Saurabh Mankotia, Dickinson
Andreina Sananez, Cypress
Kayla Scott, Arlington
Haitham Wehbe, Bellaire

Utah

Margaret Hyams, Salt Lake City

Vermont

Riley Hanson, Barre
Mark Knott, Woodstock

Virginia

Daniel Lee, Tysons
Babak Salahbin, Oakton
Deepak Singh, Arlington
Vivek Vjj, Burke

Washington

Travis Hunt, Sheilacoom
Jiyeon Lee, Bellevue
Paige Moorhead, Tacoma
Helena Soomer Lincoln, Bainbridge Island
Donald Sunde, Olympia

West Virginia

Thomas Condron, Clarksburg

Wisconsin

Kolver Matos, Allenton

CANADA

Ontario

Anas Alsayouti, Ottawa
Nadia Awais, Ottawa
Harshdeep Bhaila, Brampton
Raj Bharkhada, Caledon
Punit Biala, Mississauga
Nelson Chan, Toronto
Bassel Dannan, Mississauga
Marc Farid, Cambridge
Iman Janemi, Glencoe
Mireille Kaprilian, Maple
Mohammed Kiblawi, Kitchener
Eunji Kwon, Oakville
Mohammed Latifi, Hanover
Oleksii Makarin, Burlington
Geoff McIntosh, Brandon
Kunsang Namgyal, Mississauga
Charo Pabalan, Brampton
Shailendra Singhal, Ottawa
Vaishali Thareja, Mississauga
Ajeet Verraich, London
Praveen Verghese, Milton
Khamsum Wangdu, Mississauga

Saskatchewan

Troy Muench, Saskatoon

Nova Scotia

Manbir Sandu, Yarmouth

INTERNATIONAL

El Salvador

Ricardo Aguila

Georgia

David Motoban

Kuwait

Askara Jacob
Lamees Nour El Dean
Nouman Ukaye

Mexico

Xochipilli Bojorquez

Pakistan

Fatma Banday

Saudi Arabia

Abdurhman Abusaq
Murtadha Alali
Abdulmonem Alkhamis
Faiez Almaslamani
Abdulkarim Alshehri
Ayham Alturk
Adel Huzaimi
Afraa Murriky

South Korea

Cheolhun Jang
Hyeon Sik Kim
Jungchul Lee

Tunisia

Mohamed Mnif

United Arab Emirates

Ahmad Abu Baker
Ahmed Ahmed
Akram Abdelkhalek
Abdullah Abdulaziz
Fatima Al Ali
Omar Al Kamcheh
Housam Al Masalmeh
Basma Al Rawi
Amr Ali
Uday Alle
Nooruldeen Alnokheili
Mohammad Altaani

Aktham Alzghair
Syed Anwar
Honey Arora
Mohamed Badran
Riam Bin Berek
Hanan Elkhatib
Huwayda Fouad
Soha Hassan
Walid Ishraideh
Lin Jandali
Karim Khaled
Ahmed Khalifa
Osman Khalifa
Nardine Makram
Adeeb Mohammad
Geetha Muniraju
Seyed Nejat
Omar Radwan
Jumana Rai
Ebadullah Raidullah
Omar Ramadan
Asmaa Taleb
Amgad Tawfik

STUDENT MEMBERS

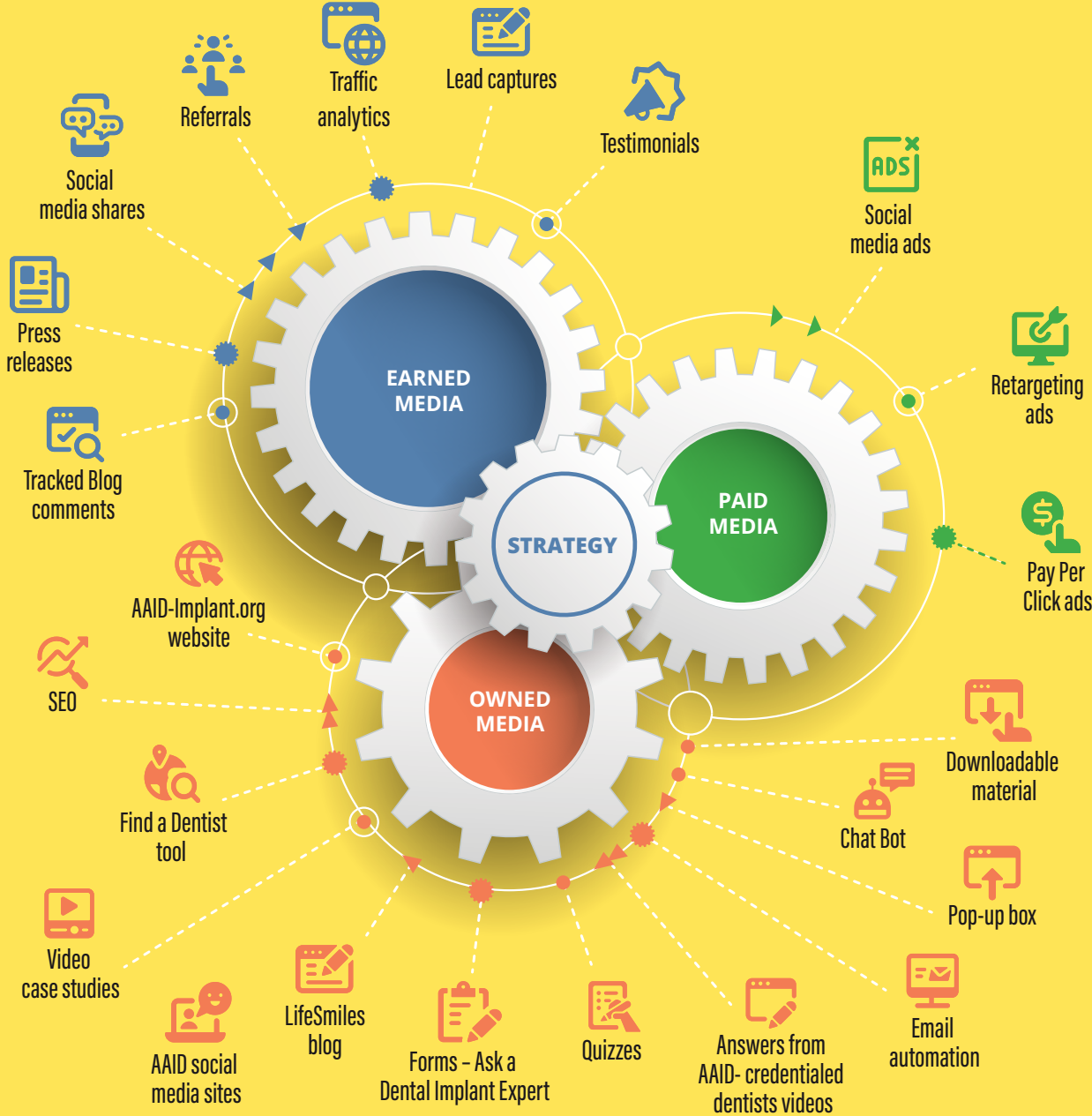
Jared Allen
Nada Almaqadma
Ami Reza Bahador
Martha Liliana Bedoya Leal
Jose Briceno
Alexa Briggs
Soochan Chung
David Cifelli
Ethan Cook
Spencer Cooper

Ronald Corcuera
Alexandra Cozzarin
Shaili Dave
Karim El othmani
Lemuel Feceu
Joshua Frazer
Sylvia Gerges
Andee Goldstein
Sean Halbo
Connor Henderson
Chanelle Holder
Charles Husaini
Shadi Jaber
Sejal Jain
Paola Jarvis
Sravani Kilaru
Michael Korleski
Paulo Laino
Dariel Liakhovetski
Johnny Moraes
Tevin Moreno
Alireza Oryan
Manushi Parikh
Jun Tae Park
Tram Phan
Victoria Quizon
Ankita Rajpurohit
Deven Rawlani
Bowen Ressler
Carolina Rivera
Lovleen Sidhu
Ginovelli Silvestre
Rebecca Vaeth
Evan VanBlargen
Rebecca Vizzi
Anthony Zapata

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 Assistant Director: Dr. Ninette Bandy
 Email: drsiyer@aol.com
 Phone: 908-527-8880
 Website: www.maxicourseasia.com

Augusta University AAID MaxiCourse®

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 Email: lbthigpen@augusta.edu
 Phone: 706-721-1447
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Bangalore AAID MaxiCourse®

Bangalore, India
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 Assistant Director: Dr. Ninette Bandy
 Email: drsiyer@aol.com
 Phone: 908-527-8880
 Website: www.maxicourseasia.com

Boston AAID MaxiCourse®

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 Director: Dr. Brian Jackson
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 Location: Harvard Club of Boston
 Website: www.bostonmaxicourse.com
 Instagram: bostonmaxicourse_bic
 Facebook: Boston MaxiCourse

Chicago AAID MaxiCourse®

Chicago, IL
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 Assistant Director: Dr. Frank Caputo
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 Phone: 773-236-2352
 Website: www.aaidchicagomaxicourse.com

Las Vegas AAID MaxiCourse®

Las Vegas, NV
 Director: Dr. John Minichetti
 Assistant Director: Dr. Shankar Iyer
 Contact: Sarah Rock
 Email: sarah.inglewooddental@gmail.com
 Phone: 201-871-3555
 Website: www.dentalimplantlearningcenter.com

Long Island AAID MaxiCourse®

West Islip, NY
 Director: Dr. Mike Calderon
 Assistant Director: Dr. Marcelo Calderon
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 Phone: 631-328-5050
 Website: www.longislandmaxicourse.com

Nagoya, Japan AAID MaxiCourse®

Nagoya, Japan
 Director: Dr. Yasunori Hotta
 Assistant Directors: Drs. Hiroshi Murakami, Koji Ito, Komatsu Shinichi, and Takashi Saito
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 Email: hotta-dc@ff.ij4u.or.jp
 Phone: +81-52-794-8188
 Website: www.hotta-dc.com

New York AAID MaxiCourse®

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 Assistant Director: Dr. Joseph C. D'Amore
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 Phone: 201-871-3555
 Website: www.dentalimplantlearningcenter.com

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Newport Beach, CA
 Director: Dr. M. Ali Mostafavi
 Assistant Director: Dr. Shankar Iyer
 Contact: Megan Gutierrez
 Email: megan.gutierrez@glidewell.com
 Phone: 866-791-9539
 Website: www.maxicourseca.com

Nova Southeastern University College of Dental Medicine Implant AAID MaxiCourse®

Fort Lauderdale, FL
 Director: Dr. Jack Piermatti
 Assistant Director: Dr. Shankar Iyer
 Contact: Linnette Dobbs-Fuller
 Email: dentalce@nova.edu
 Phone: 609-314-1649
 Website: dental.nova.edu/ce/courses/

Rutgers School of Dental Medicine AAID MaxiCourse®

Newark, NJ
 Director: Dr. Jack Piermatti
 Assistant Director: Dr. Shankar Iyer
 Contact: Janice Gibbs-Reed, MA
 Email: gibbs@sdm.rutgers.edu
 Phone: 973-972-6561
 Website: cde.sdm.rutgers.edu/maxicourse/

Salt Lake City AAID MaxiCourse®

South Jordan, UT
 Director: Dr. Bart Silverman
 Assistant Director: Dr. Shankar Iyer
 Contact: Dr. Rachana Hegde
 Email: rhegde@roseman.edu
 Phone: 973-709-5835
 Whatsapp: 201-238-5438
 Website: www.maxicourseutah.com

San Juan, Puerto Rico AAID MaxiCourse®

San Juan, PR
 Director: Dr. O. Hilt Tatum
 Assistant Director: Dr. Jose Pedroza
 Contact: Miriam Montes
 Email: prmaxicourse@gmail.com
 Phone: 787-642-2708
 Website: www.theadii.com

Washington, DC AAID MaxiCourse®

Washington, D.C.
 Director: Dr. Bernee Dunson
 Contact: Keonka Williams
 Email: dcmaxi@dunsodontal.com
 Phone: 404-897-1699
 Website: www.dcmmaxicourse.com

Waterloo, Ontario AAID MaxiCourse® The TI-MAX Institute

Director: Dr. Rod Stewart
 Assistant Director: Dr. George Arvanitis
 Contact: Chantel Furlong
 Email: info@timaxinstitute.com
 Phone: 905-235-1006
 Website: www.timaxinstitute.com

Vancouver AAID MaxiCourse®

Vancouver, BC
 Director: Dr. William Liang
 Contact: Andrew Gillies
 Email: andrew@implant.ca
 Phone: 604-330-9933
 Website: www.vancouvermaxicourse.com

AAID Active Study Clubs

UNITED STATES

AAID Bergen County Dental Implant Study Group

Location: Englewood, NJ
 Director: Dr. John Minichetti
 Contact: Lisa McCabe
 Phone: 201-926-0619
 Email: lisapmccabe@gmail.com
 Website: bit.ly/2rwf9hc

Alabama Implant Study Club

Location: Brentwood, TN
 President: Dr. Michael Dagostino
 Contact: Dr. Sonia Smithson
 Phone: 615-337-0008
 Email: aisgadmin@comcast.net
 Website: www.alabamaimplant.org

Bay Area Implant Synergy Study Group

Location: San Francisco, CA
 Director: Dr. Matthew Young
 Phone: 415-392-8611
 Email: young.mattds@gmail.com
 Website: www.youngdentalsf.com

Calderon Institute Study Club

Location: Queens, NY / Oceanside, NY
 Director: Dr. Mike E. Calderon
 Contact: Andrianna Acosta
 Phone: 631-328-5050
 Email: calderoninstitute@gmail.com
 Website: www.calderoninstitute.com

Hawaii Dental Implant Study Club

Location: Honolulu, HI
 Director: Dr. Michael Nishime
 Contact: Kendra Wong
 Phone: 808-732-0291
 Email: mnishimedds@gmail.com
 Website: www.advancedrestorativedentistry808.com

Hughes Dental Implant Institute and Study Club

Location: Sterling, VA
 Director: Dr. Richard E. Hughes
 Contact: Victoria Artola
 Phone: 703-444-1152
 Email: dentalimplant201@gmail.com
 Website: www.erhughesdds.com

Implant Study Club of North Carolina

Location: Clemmons, NC
 Director: Dr. Andrew Kelly
 Contact: Shirley Kelly
 Phone: 336-414-3910
 Email: shirley@dentalofficesolutions.com
 Website: www.dentalofficesolutions.com

Mid-Florida Implant Study Group

Location: Orlando, FL
 Director: Dr. Rajiv Patel
 Contact: Dr. Rajiv Patel
 Phone: 386-738-2006
 Email: drpatel@delandimplants.com
 Website: www.delandimplants.com

SMILE USA® Center for Educational Excellence Study Club

Location: Elizabeth, NJ
 Director: Dr. Shankar Iyer
 Contact: Terri Baker
 Phone: 908-527-8880
 Email: dentalimplant201@gmail.com
 Website: www.malosomeusaelizbeth.com

CANADA

Vancouver Implant Continuum

Location: Surrey, BC, Canada
 Director: Dr. William Liang
 Contact: Andrew Gillies
 Phone: 604-330-9933
 Email: andrew@implant.ca
 Website: www.implant.ca

OTHER INTERNATIONAL

Aichi Implant Center

Location: Nagoya, Aichi-Ken, Japan
 Director: Dr. Yasunori Hatta
 Phone: 052-794-8188
 Email: hotta-dc@ff.ij4u.or.jp
 Website: www.hotta-dc.com

Beirut AAID Study Club

Location: Beirut, Lebanon
 Director: Dr. Joe Jihad Abdallah
 Phone: 961-174-7650
 Email: beirutidc@hotmail.com

Courses presented by AAID credentialed members

UNITED STATES

The Dental Implant Learning Center - Basic to Advanced Courses in Implant Dentistry

Dr. John C. Minichetti
 Contact: Jennifer Yang
 Phone: 866-586-0521
 Email: jenn.inglewooddental@gmail.com
 Website: www.dentalimplantlearningcenter.com/ce-courses/register-online

California Implant Institute

Dr. Louie Al-Faraje, Academic Chairman
 Phone: 858-496-0574
 Email: master@implanteducation.net
 Website: www.implanteducation.net

Connecticut Dental Implant Institute

Location: Manchester, CT
 Various courses available
 Dr. Joel L. Rosenlicht
 Contact: Michelle Marcil
 Email: michelle@jawfixers.com
 Website: www.jawfixers.com

Courses presented by AAID credentialed members

UNITED STATES

East Coast Implant Institute

Location: Manchester, CT
 Various Courses available
 Dr. Brian J. Jackson
 Contact: Jana Selimovic
 Phone: 315-922-2176
 Email: education@bostonmaxicourse.com
 Website: eastcoastimplantinst.com/upcoming-courses/

Implants in Black and White

Drs. Daniel Domingue & Jerome Smith
 Contact: Maggie Brouillette
 Phone: 337-235-1523
 Email: maggie@jeromesmithdds.com
 Website: www.blackwhiteimplants.weebly.com

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 Phone: 201-840-7777
 Email: info@shulmandds.com
 Website: www.adiseminars.com

Midwest Implant Institute

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 (411) The All Inclusive Live Surgical Course
 (601) Bone Grafting & Sinus Elevation
 (603) Implant Prosthetics
 (605) Digging Out of Problems
 Phone: 614-505-6647
 Email: samantha@mii1980.com
 Website: www.midwestimplantinstitute.com

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 September through July, biweekly
 Phone: 908-527-8880
 Email: terri@smileusa.com
 Website: www.smileusacourses.co

Pikos Implant Institute

Dr. Michael A. Pikos
 Soft Tissue Grafting Sinus Grafting Alveolar Ridge
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 Contact: Kali Kampmann
 Phone: 727-781-0491
 Email: learn@pikosInstitute.com
 Website: www.pikosinstitute.com/programs-and-courses/coursecontinuum-overview

Stanley Institute for Comprehensive Dentistry

Dr. Robert Stanley
 Contact: Megan Carr, Interim Director of
 Continuing Education
 Phone: 919-415-0061
 Email: megan@stanleyinstitute.com
 Website: www.stanleyinstitute.com

Train for Success: Live! Dental Implant Continuum

Dr. Joseph A. Leonetti
 Contact: Scott Lauer
 Phone: 949-257-5696
 Email: scottlauer@implantedco.com

University Implant Educators Live Patient Surgical Course (All Inclusive) 4 Day Live Patient Surgery Courses

40 CE Hours, San Diego, CA
 Professor Francis Jones (University of Nevada Las Vegas)
 Contact: Grace Terrazona
 Phone: 877-709-6623
 Email: info@universityimplanteducators.com
 Website: www.universityimplanteducators.com

CANADA

Pacific Implant and Digital Dentistry Institute

Dr. Ron Zokol
 Contacts: Barbara Cox & Dr. Faraj Edher
 Emails: barbara.cox@ddidental.com
 faraj.edher@ddidental.com
 Website: www.ddidental.com

Toronto Implant Academy Taming The Old Dragons of Implant Prosthetics - 3 Part Virtual Webinar Series

Dr. Emil LA Svoboda
 Contact: Christine Wade, Communications Officer
 Phone: 416-432-9800
 Email: info@reversemargin.com
 Website: www.reversemargin.com

OTHER INTERNATIONAL

Beirut Implant Dentistry Center

Location: Beirut, Lebanon
 Drs. Jihad Abdallah & Andre Assaf
 Contact: Mahia Cheblac
 Phone: 961-1-747650
 Phone: 961-1-747651
 Phone: 961-1-747652
 Email: beirutids@hotmail.com

Cancun Implant Institute: Comprehensive Oral Surgery Training for Modern Dental and Implant Practice

Drs. Joseph Leonetti & Bart Silverman
 Phone: 01-800-757-1202
 Emails: Jal3658@aol.com
 Bsilver293@aol.com
 Website: www.cancunimplantinstitute.org

Mini-Residency in Implants in Sri Lanka and Malaysia

Dr. Shankar Iyer
 Contacts: Dr. Prasad Amarantunga, Sri Lanka
 Dr. Ahmed Shugey, Malaysia
 Emails: pgdasrilanka@gmail.com
 shugey64@gmail.com
 Website: www.smileusacourses.com

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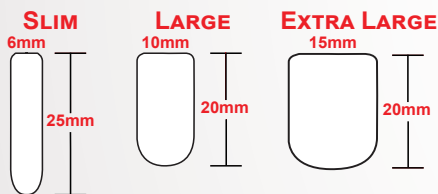
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1. Spivak, J Biomed. Mater Research, 1990; 2. Ricci, J Oral Maxillofacial Surgery, 1992; 3. Valen, J Oral Implantology, 2002.

Clinical Case Example

Clinical images courtesy of German Murias DDS, ABO/ID

1. Tooth #15, set to be extracted.

2. Remove the entire pathologic periodontal ligament and flush socket twice. Use #6 carbide bur, make holes through the Lamina Dura to trabecular bone and establish Regional Acceleratory Phenomenon.

3. Insert Large or Slim sized OsteoGen® Bone Grafting Plugs and allow blood to absorb.

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5. OsteoGen® is a low density bone graft and the OsteoGen® Plugs will show radiolucent on the day of placement.

6. As the OsteoGen® crystals are resorbed and replaced by host bone, the site will become radiopaque.

7. The collagen promotes keratinized soft tissue coverage while the OsteoGen® crystals resorb to form solid bone. In this image, a core sample was retrieved.

8. Implant is placed. Note the histology showing mature osteocytes in lamellar bone formation. Some of the larger OsteoGen® crystals and clusters are slowly resorbing. Bioactivity is demonstrated by the high bone to crystal contact, absent of any fibrous tissue encapsulation.

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