Occlusion, Bruxism, and Dental Implants: Diagnosis and Treatment for Success

Regarding implants, Glenn Gittelson, DDS, has a simple philosophy: “If you think implants, you will do implants. If you do implants, do them right with science.”

“With science,” Gittelson believes, “you never have to guess.” The sciences essential to implants, according to Gittelson, are the sciences of occlusion and of bruxism, especially as the latter relates to occlusion. “I’m a firm believer that before you can diagnose and create a treatment plan for success, you must know how implants fail.”

Why Implants Fail

Basically there are three types of implant failures. The first involves a lack of integration of the implant-bone interface for pure surgical reasons (with no prosthesis fabricated and no load applied). At some point, from the time the implant is placed, prior to it being loaded, the implant is lost.

The second type of implant failure involves a loss of integration after restoration. With this type of implant failure the implant integrates, a prosthesis is fabricated, and under load the implant-bone interface is lost. This is an occlusal load or bite force issue.

The third way an implant reconstruction can fail is known as structural or component failure. This involves broken prosthetic and implant components including broken porcelain, screws, abutments, and implant bodies. This is also an occlusal load or bite force issue.

Therefore, two of the three ways that an implant reconstruction can fail have to do with occlusion. Understanding the basics of occlusion and then implant occlusion is the key to implant longevity.

Occlusion and Implants: Bruxism

Stedman's Medical Dictionary defines occlusion as: “The relationship between the occlusal surfaces of maxillary and mandibular teeth when they are in contact.” Although accurate, this definition is actually incomplete, according to Gittelson. Figure 1 shows four interlocking rings around the front teeth, the back teeth, the elevator muscles, and the temporomandibular joint (TMJ). This diagram illustrates that occlusion is not just about the effect teeth coming together have on themselves, but also the effect teeth coming...
together have on the muscles that control jaw movement as well as the TMJs. Adding an implant into the mixture, Gittelson explains, introduces a fifth interlocking ring, which must then be considered along with its ability to alter the other four rings in either a positive or negative fashion.

Why is the ability to diagnose the bruxing patient relevant to implant dentistry? In Dr. Carl Misch’s textbook, Contemporary Implant Dentistry, Misch writes: “Bruxing and clenching are the most critical factors to evaluate in any implant reconstruction. No long-term success will be obtained with severe parafunction of bruxism or clenching. Therefore, the dentist should always make an effort to diagnose the presence of these conditions.”

Why Teeth Are Lost

According to Gittelson, it is important to ask potential implant patients how they lost their teeth. According to Drs. Frank Ranouard and Bo Rangert’s textbook, Risk Factors in Implant Dentistry, there is an association between implant predictability and the reason for tooth loss (see Figure 2). A patient who lost teeth due to trauma can be expected to do well with implants if there is no accompanying occlusal or bacteria issues. A patient can also lose teeth due to caries. This patient would also be expected to do well because there is no accompanying bacterial or occlusal issues.

This may not be the case with a patient who lost teeth from periodontal disease. This type of patient presents a risk as a potential implant patient because the same bacteria that can dominate the periodontally diseased mouth also can cross-infect an implant site. Therefore, it becomes critical to recognize and treat any potential periodontal pathology.

Finally, a patient can lose teeth due to bruxism and subsequent fracture. Implant predictability for this patient is lowest because bruxism in its purest form is uncontrolled, increased contact time between teeth with the potential to overload the prosthesis and the implant-bone interface. “However,” Gittelson notes, “not all bruxers lose teeth. What places the implant patient at increased risk relative to bruxism? The answer is this: Implants are not teeth. Clinicians must know and respect the difference.”

There are at least seven differences between implants and teeth. These differences are nature’s built-in, protective mechanisms and alarm systems that help teeth survive in the mouth under load. Differences include issues involving the periodontal ligament (which can act as a shock absorber), pulpal tissue (for thermal and pain feedback), the neck (for reducing stress on the ridge), a tapered root (which directs forces apically), the size and number of roots (for surface area and support), Lamina dura (cortical bone issues), and structural composition (flexing dentin).

Gittelson notes, “Implants lack these built-in, protective mechanisms and alarm systems. Even though an implant is harder than the bone it is sitting in and the tooth that it is replacing, the fact that it lacks these built-in, protective mechanisms and alarm systems actually makes an implant reconstruction more fragile in the mouth and, therefore, more dependent on the surgeon to place properly, the lab to fabricate the prosthesis properly, and the restorative doctor to assemble the pieces in the mouth and control the bite forces properly.” He adds, “When it comes to an implant reconstruction, if a problem arises, by the time it is recognized, there’s a chance it may be too late.”

Types of Occlusion

There are two types of occlusion. The first is a physiologic, non-destructive, stable occlusion. The second is a pathologic, destructive, unstable occlusion (see Figure 3). If the restoring doctor does not know how to diagnose and create treatment plans for the occlusal issues properly and only focuses on what ceramic system, bonding agent, or implant system to use, the risk is...
potential catastrophic failure.
Gittelson adds, “The bottom line is this: Occlusion beats adhesion every time.”

Understanding Bruxism
An initial discussion of bruxism requires understanding several working definitions. The first one is the “envelope of motion,” the maximum mandibular range of motion in all directions, which is dictated by ligaments and muscles attachments. Next is the “dental envelope of function,” which is the range of mandibular motion determined by the guiding inclines of the teeth (i.e., the way the jaw moves is dictated by the angle at which the teeth come together). Next, is the “neuromuscular envelope of function,” which is the range of mandibular motion for functional purposes without dental interference (i.e., the brain is telling the jaw to move a certain way regardless of the way the teeth want to guide the jaw for functional purposes such as chewing and speaking). Finally, there is the “envelope for parafunction,” which is the range of mandibular motion for non-functional purposes (i.e., the brain is telling the jaw to move a certain way independent of function or tooth contour).

Gittelson notes that occlusal stability can be defined as “when the dental envelope of function is in harmony with the neuromuscular envelope of function” (i.e., harmony between the way the teeth guide the mandible during movement and the way the brain is telling the jaw to move.)

Gittelson says that bruxism in its purest forms can be broken down into three basic etiologies: occlusal etiology, which is correctable and curable; emotional etiology, where stress increases bruxism; and central nervous system (CNS) etiology, which is by far the most difficult to encounter.

With occlusal etiology, something in the occlusion is triggering the bruxing habit which, if the clinician can identify it, can be corrected and
cured. With the emotional etiology, under times of duress or stress, most people might clench or grind their teeth. The clinician cannot predict such stress, but it can also lead to a bruxing habit. With CNS etiology, the patient's brain is telling him or her to move the jaws a certain way. No matter what the clinician does to the teeth, such bruxism cannot be stopped.

Looking at the three causes of bruxism, the occlusal etiology would respond most favorably to intervention because clinicians can identify the occlusal trigger, correct it, and eliminate the habit, increasing implant predictability. However, in a 1993 study by Holmgren, in which thousands of bruxing patients were studied, only 33% of bruxers were of occlusal etiology while 66% were of CNS etiology. Importantly, to treat occlusal pathology requires the ability to diagnose it, which in turn requires the ability to recognize the signs of an unstable or pathological occlusion.

**Signs of Unstable Occlusion**

There are five basic symptoms of an unstable occlusion: joint pain, muscle pain, broken teeth, worn teeth, and mobile teeth. Gittelson warns, "It is possible for a patient to have muscle pain and joint pain independent from what is occurring in the mouth. However, if teeth are breaking down, excessively worn, or mobile and splaying, these are the classic signs of unstable occlusion."

The clinician must approach diagnosis and treatment planning of occlusal issues by considering the interlocking rings of occlusion (see Figure 1). Knowing that an occlusal evaluation must account for the TMJs, the muscles, and the teeth, the clinician must have an armamentarium and an order in which to use it when diagnosing a pathologic occlusion (see Figure 4).

Gittelson notes, "All occlusal evaluations must begin with an evaluation of the TMJs. The TMJs are the positioning elements of the mandible during closure. If the jaw
joints are not functioning properly, a stable occlusal scheme cannot be designed." He draws the following analogy: "A stable occlusion cannot be built to an unstable jaw joint, no more than a door could be built to a door frame if the hinges holding them together are not functioning properly." It is with the fully edentulous population that this concept is most important. The fully edentulous patient has a decreased bite force capability. When an implant supported prosthesis is delivered, bite force capability goes back up and so does the load to the TMJ joint. Many of these patients have chronically diseased but stable joints. With the increased load to the joint, there is a chance the jaw joint can become acutely inflamed and unstable.

With this in mind, Gittelson reasons, "The easiest way to evaluate the jaw joints is with a Doppler, which is an ultrasonic listening device, and the corresponding Piper Joint Classification System, which allows the clinician to quantify the jaw joints from a restorative point of view." All the clinician needs to know is that the medial load-bearing pole of the TMJ assembly is functioning properly. The lateral pole functions under translatory movement and is not as critical a component when diagnosing whether an occlusion can be built to a presenting TMJ. The Doppler is used to listen for three things: blood flow, disk displacement, and bone-to-bone sounds. When using a Doppler, a healthy joint is a quiet joint with the only discernable sound being the heartbeat via the superficial temporal artery. As joint pathology increases, so does the potential for increased blood flow to the joint (a sign of inflammation), disk displacement, and bone-to-bone sounds. The Doppler is a very simple diagnostic instrument to use yet gives a tremendous amount of diagnostic and treatment planning information.

Additionally, to diagnose occlusal pathology properly, the...
clinician must utilize a semi-adjustable articulator, face bow, and concurrent centric relation bite record as defined by Dr. Peter Dawson. According to Gittelson, “Dr. Dawson’s definition of centric relation has remained unchanged for nearly 30 years. It is the relationship of the mandible to the maxilla, when the properly aligned condylar disk assemblies are in their most superior-anterior position against the eminentia irrespective of tooth position or vertical dimension, which is pain-free when loaded.” Figure 5 shows the angle the masseter muscle contracts at, in conjunction with the condylar, disc, fossae and articular eminence morphology.

If the teeth are not in the way to block it from happening, by nature’s own design, the condylar disc assembly will be carried to this most superior-anterior position in the glenoid fossae.

The significance of this definition is that centric relation is a border, bone-braced position: The mandible hinges and rotates from this position. Since the condylar disc assembly can go no higher up into the glenoid fossae, the clinician has the ability to control all tooth contacts from this position.

Centric relation also is a reproducible position. This reproducibility is not just about verifying a bite record in the mouth. It also includes the fabrication of a prosthesis outside the mouth with a specific occlusal scheme in mind, which can then be transferred back to the mouth and function the same way it was designed on the articulator.

Finally, this centric relation position is the only position which shuts off the inferior head of the lateral pterygoid muscle. The lateral pterygoid muscle has two heads, a superior head and an inferior head. The superior head is a disc-stabilizing muscle, which is primarily active during closure, while the inferior head is inactive. The inferior head is active during opening and translatory movements including positioning the mandible down the
eminence, while the superior head is inactive. To function properly, these two muscles must work in opposites (i.e., while one muscle contracts the other must be at rest and vice versa). These two muscles begin to act antagonistically (contracting at the same time) when the teeth make contact prior to the condylar disc assembly reaching that fully seated centric relation position. This type of tooth contact is referred to as a centric interference and is the most common cause of occlusal muscle pain.8

According to Gittelson, "Centric relation is the only position from which all tooth contacts can be controlled, therefore it is the only position from which an occlusion can be properly analyzed and therefore, it is the only position from which an interference-free occlusion can be built."

**Trial Therapy for the Bruxing Patient**

A key question for the clinician becomes how to diagnose whether the bruxing habit has an occlusal etiology or a CNS etiology. The answer is trial therapy. With trial therapy, the assumption is made that the bruxing etiology is an occlusal one. Trial therapy involves altering or correcting the occlusion and then monitoring the response. Trial therapy then enables a clinician to determine whether a bruxing habit is occlusal (curable) or CNS-based (essentially non-curable). The easiest way to accomplish this goal is with appliance therapy.

To fabricate a properly made diagnostic appliance requires that several parameters be satisfied. The appliance must be fabricated from a set of models mounted on a semi-adjustable articulator, with a face bow transfer of the upper and a centric relation bite record. Gittelson explains, "Again, we take that centric relation bite record because it is the only position from which all tooth contacts can be controlled."

The appliance must be rigid and flat and have an anterior disclusing ramp (see Figure 6).

Once the appliance has been delivered, the patient’s response is monitored over several months. By assuming that the patient’s habit is an occlusal one, the clinician can create an ideal occlusion on the appliance and then monitor the patient’s response to the appliance. The response will dictate which type of diagnosis is made. The patient wears the appliance for approximately three months. It is then checked for the reproduction of wear facets similar to those observed on the teeth. If pain symptoms have abated and/or no wear is present on the appliance after three months, the diagnosis is that of an occlusal bruxer. Gittelson explains, "If the clinician corrects the occlusion on the appliance, and the patient fails to reproduce the symptoms of the bruxing habit on the appliance, the diagnosis is an occlusal bruxer." (See Figure 7.)

**Occlusal Triggers to Bruxing Habits**

There are three occlusal triggers to a bruxing habit. The first occlusal trigger to bruxism is pain from the jaw joint. There are at least four sources of pain from the jaw joint. When a patient has TMJ pain, they tend to posture the mandible forward to get relief. When they feel better, the muscles relax and the condyles reseat themselves. If pain occurs again, they posture forward again. This type of repetitive movement due to TMJ pain can create a sustained protrusive bruxing habit.

The second trigger to an occlusal bruxing habit is a centric prematurity, which, as previously described, is a tooth contact that occurs during closure prior to the condyle reaching that fully seated centric relation position. Again, this is a very common cause of occlusal related muscle pain.

The third trigger to an occlusal bruxing habit are eccentric prematurities, which are balancing and working side posterior tooth contact interferences that occur during jaw movement. These types of occlusal interferences are also potent occlusal muscle triggers, which, if left unchecked long enough, can lead to muscle spasms and ultimately trigger points, referring pain to the head, neck, and face, creating the so-called idiosyncratic myofacial pain patient.9,10

The significance of occlusion as a causative agent in these pain patients can not be over-emphasized. The interlocking relationship between the teeth, the muscles, and the TMJs as described in Figure 1 can never be ignored when diagnosing and treating occlusal pathology. With a properly made appliance and an understanding of occlusion, the dental clinician gains the ability to diagnose, treat, and cure disease where conventional medicine has perhaps failed.

**The CNS Bruxer**

If the patient reproduces the wear habit on the appliance as it was observed in the mouth, the diagnosis is that of a CNS bruxer (see Figure 8). This is the patient whose brain tells the jaws to move a certain way independent of tooth contact or function. To treat these patients properly requires that the envelope of parafunction now be identified and incorporated into the occlusal treatment plan.

CNS bruxing patients have one of two distinctly different non-overlapping types of occlusal wear. They can be categorized as either CNS horizontal bruxers or CNS vertical bruxers.12

CNS horizontal bruxers have wear facets that traverse the buccal cusps of posterior teeth, across the cusp tips of canines, and across the incisal edges of anterior teeth (see Figure 9). They present with a decrease in the overbite (the teeth appear to be getting shorter), and a broad range of mandibular motion during function and excursive movements. These types of bruxers
are difficult to treat because the clinician must account for this broad range of movement when fabricating a prosthesis. CNS horizontal bruxers require a permissive occlusal scheme, which is an occlusal scheme of shallow contact angles and shallow guidance that allows mechanical freedom for the bruxing habit (see Figure 10).

"CNS vertical bruxers are entirely different from the CNS horizontal bruxer," says Gittelson. In this group, the wear facets are on the linguals of the maxillary anterior teeth and facials of the lower anterior teeth. There is an increase in the overbite, and a narrow range of mandibular motion (see Figure 11). Due to this narrow range of mandibular motion, the CNS vertical bruxer is easier to treat and restore compared to the CNS horizontal bruxer.

The occlusal scheme however is entirely different. CNS vertical bruxers require a lingual maxillary centric stop that is 90° to the lower incisal edges with enough overjet for the mandible to move when they brux and no incline centric stops (see Figure 12). Gittelson notes, "Since they wear the linguals of the uppers against the facials of the lowers, an improper way to restore these types of patients would be to just restore the missing tooth structure. If the clinician does this, the risk is the patient will eventually wear this down as well." By providing a maxillary centric stop that is 90° to the lower central incisors, the clinician can keep these bruxers from wearing the teeth or prosthesis back down.

**Bruxism and Contraindications for Implants**

Certain bruxing patients are at great risk if treated with implants. For example, the patient who presents with big, square bulging jaw muscles, the inability to keep lateral forces off the posterior teeth, and for whom appliance therapy has diagnosed a CNS horizontal bruxer, should be treated with great caution (see Figure 13). In such cases, according to Gittelson, "the clinician should consider only treating canines and any other biological problems, and to just maintain the existing dentition."

**A Summary of Bruxism**

To diagnose occlusal pathology and the bruxing patient, the TMJs must first be evaluated, specifically the load-bearing capability of the medial pole. Next a functional analysis should be performed. This set of face bow mounted models on a semi-adjustable articulator in conjunction with a verified centric relation bite record allows the presenting occlusion to be properly analyzed and lends itself to the fabrication of a properly made diagnostic occlusal appliance. The ability to distinguish the occlusal bruxer from the CNS bruxer can now be accomplished with the appropriate occlusal scheme ultimately being designed. Gittelson cautions, "If the diagnosis is made of the CNS-type bruxer, you cannot stop the CNS bruxing habit, you must create an occlusal scheme that allows the teeth to survive the habit."

**A Clinical Case**

A patient presented with a chief complaint of wanting to improve the appearance of his smile (see Figure 14). Using the previously described diagnostic criteria, the patient’s jaw joints were first evaluated via Doppler auscultation and found to be stable at the medial pole. A functional analysis was performed. Appliance therapy was carried out and the occlusal bruxer diagnosis was made. Following established aesthetic and functional guidelines, which included opening the VDO, the patient’s entire dentition was restored with fixed prosthetics (see Figure 15). Gittelson opines “the true test of the restorative clinician’s diagnostic capabilities is not so much about how good the prosthesis looks at the delivery appointment, but rather how stable the prosthesis is over a multi-year period." (See Figure 16.)

**References**

5. Piper Joint Classification System—Mark A. Piper MD, DMD. 111 Second Ave. NE, Suite 1000, St. Petersburg, FL 33701.

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