Implant Occlusion in the Digital Age of Dentistry

A look at the state of implant dentistry today with real cases from dentists who utilize technology to manage implant occlusion.

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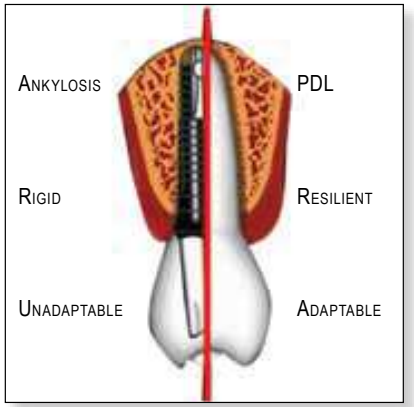
Managing Implant Occlusion: A "Dual" with Nature by Dr. Sangiv Patel

A constant in biology is the duality of nature. This is organizationally magnified in the treatment of partially and fully edentulous dental patients. The clinician must understand, plan, and manage the entire stomatognathic system for functional and esthetic prosthetic success and longevity of dental implants and their restorations. The duality with implant occlusion is that the clinician needs to think about managing two environments simultaneously:

1. **The implant restoration**
2. **The natural teeth with or without restorations**

There are significant and numerous variables accountable for implant restoration longevity. Dental implants and their restorations are not adaptable, but are surgically placed and restored with the goal of adaptation by the stomatognathic system around the implant and its restoration. Once adapted, the longevity is primarily determined by management of materials, mechanics, and bacteria that affect the implant restoration. This is based on the fact that implants and their restorations are inorganic, synthetic, and more rigid in contrast to natural teeth and the stomatognathic system, which is organic and resilient.



Managing Implant Occlusion

Key Differences Between how Natural Teeth Differ from Inorganic, Synthetic Implants[4]

1. **Natural teeth and roots are a modified bone tissue, while implant fixtures are made of titanium**
2. **Natural teeth have a periodontal ligament, while implants are ankylosed to the bone without a periodontal ligament.**
3. **Natural teeth are protected via an enamel cover with a very specific stress strain curve for adaptation, while implant restorations vary in materials. These materials are usually more rigid and unadaptable.**
4. **Natural teeth have an organic bond between dentin and enamel, while implant restorations are cement retained or screw retained.**
5. **Natural dentition is resilient via individual teeth and root systems for each tooth type that allows for resilient energy transfer and vitality, while implant restorations are a rigid, non-vital, single rooted solution that is often splinted for full arch restorations.**
6. **The principles of mandibular flexure is compromised with splinted full arch restorations, especially magnified in implant restorations.**
7. **There is a statistically significant increase in parafunction noted with dental implants.**

The greatest and most immediate adaptive capacity of the stomatognathic system is lost with implant restorations due to a lack of the periodontal ligament. The periodontal ligament is a highly cellular fibrous connection between the cementum of the tooth and alveolar bone via the principal fibers. Functionally, there is a very specific neural, vascular, and hydrodynamic fluid exchange that is responsible for the adaptive capacity. The shock absorbing effect is a multistage mechanism, and the initial "cushioning" to light occlusal forces is provided by intravascular fluid leaving the blood vessels within the periodontal ligament.

Moderate occlusal loads are managed by extravascular fluid leaving the periodontal ligament space and entering the bone marrow. Once these two hydrodynamic mechanisms are exhausted, the principal fibers then engage to accept and manage the heaviest occlusal loads. They do this by converting compressive forces into tensile forces, secondary to the specific orientation of the fibers involved in function within the periodontal ligament.

The periodontal ligament is innervated by proprioceptive fibers that provide a functional biofeedback loop for the temporomandibular joints and muscles of mastication, as well as nociceptive fibers that elicit pain secondary to inflammation and infection. Finally, it is important to comprehend that the most resilient part of the stomatognathic system is the periodontal ligament. It has the highest concentration of undifferentiated ectomesenchymal stem cells lining the blood vessels in the periodontal ligament. This provides the ability to model and remodel teeth and bone via formation of necessary blast and clast cells, in response to the environmental stressors.

The moment a tooth is extracted, the primary proprioception, nociception, biomechanical load management, and adaptive capacity are lost and never regained. Insertion of a non-vital inorganic titanium fixture may provide secondary proprioception via the transmission of energy through the bone into the osteocytes, which can serve as a feedback loop; however the accuracy and efficiency are vastly diminished. There is also a statistically significant increase parafunction that is documented secondary to dental implant restorations, and may be related to the loss of proprioception in the periodontal ligament.

The current standard of "**Implant Protected Occlusion"** (IPO) was designed to protect the implant and the restoration from failure secondary to occlusal forces and trauma. In 2004, Kim Y, Oh T-J, Misch CE, Wang H-L. published "Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale". They state:

"implant-protected occlusion has been proposed strictly for implant prostheses (Misch & Bidez 1994). This concept is designed to reduce occlusal force on implant prostheses and thus to protect implants. For this, several modifications from conventional occlusal concepts have been proposed, which include providing load sharing occlusal contacts, modifications of the occlusal table and anatomy, correction of load direction, increasing of implant surface areas, and elimination or reduction of occlusal contacts in implants with unfavorable biomechanics. Also, occlusal morphology guiding occlusal force to the apical direction, utilization of cross-bite occlusion, a narrowed occlusal table, reduced cusp inclination, and a reduced length of cantilever in mesio-distal and bucco-lingual dimension have all been suggested as factors to consider when establishing implant occlusion.

Basic Principles of Implant Occlusion:

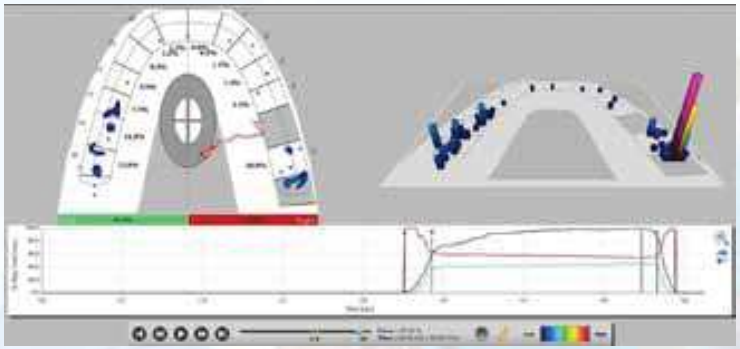
1. *Bilateral stability in centric (habitual) occlusion*
2. *Evenly distributed occlusal contacts and force*
3. *No interferences between retruded position and centric (habitual) position*
4. *Wide freedom in centric (habitual) occlusion*
5. *Anterior guidance whenever possible*
6. *Smooth, even, lateral excursive movements without working/non-working interferences*

Managing Rigid vs Resilient Duality of Time-Delayed Loading of Dental Implants

1. **The natural teeth and dentition should be loaded first.**
2. **Next, the implant restorations engage.**
3. **Lastly, all teeth and restorations are loaded fully without hyper-occlusion, premature contacts, and excursive interferences with a the most acceptable concurrent center of force trajectory as possible, based on the patient's physiology.**

The rationale is based on the data that natural teeth move 56-108 microns laterally and depress 28 microns vertically (Parfitt), while implants only move 10-50 microns laterally and depress 5 microns vertically (Sekine). It is based on these statistics that splinting of natural teeth to dental implants has fallen out of favor. Time-delayed loading of dental implants enhances the principles of IPO and assures that all dental implant restorations are in function with respect to physiology.

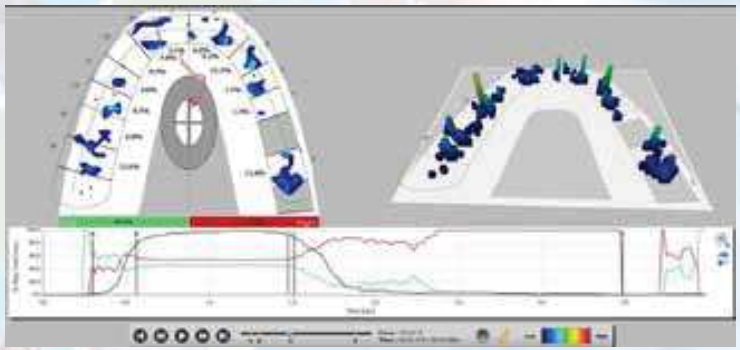
Pre-Restoration



COF begins on the first right maxillary and mandibular bones (teeth #3 and #30) and proceeds distally to the left as the occluding cycle leads to MIP. Also, there's an obviously premature hyper-intense contact on the second molars.

Post-Restoration

With the T-Scan data, the dentist was able to adjust the implant in order to produce more even occlusal contact.



Images courtesy of Dr. Patel.

Dr. Sangiv I. Patel, DDS is the founder and developer of The Innovative Smile. He is a general dentist in private practice since 1993, has served as faculty at the Advanced Dental Implant Institute's AAID Maxicourse in Puerto Rico, and formerly served on the faculty at Loyola University of Chicago- School of Dentistry and Brevard Community College. He is among 30 clinicians worldwide to have received Mastership in Dental Biometrics. He is a published author and international lecturer. He has served as a beta tester for BioRESEARCH Inc., Tekscan Inc., and CEREC 3D by Sirona, and collaborated with Carestream the manufacturers of CBCT technology. His experience in cutting-edge dentistry runs long and deep. Dr. Patel offers a physics-based model on the principles of rigid vs. resilient dynamics in the stomatognathic system, that paves a road for logical, predictable, and evidenced based diagnostics and restorative single-visit dentistry.