

Egyptian Prosthodontic Association (EPA Newsletter)

Rethinking Implant Occlusion: From Implant-Protected Occlusion to Contemporary Clinical Recommendations



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The occlusal behavior of implant-supported restorations differs from that of natural teeth. Natural teeth are supported by the periodontal ligament (PDL), which contains mechanoreceptors that provide sensory information regarding tooth contact, food texture, and functional loading, contributing to the regulation of mandibular movements and occlusal forces. In contrast, osseointegrated implants lack a functional PDL and consequently exhibit markedly different sensory and biomechanical responses to occlusal loading. Natural teeth may demonstrate approximately **25–100 μm of axial displacement**, whereas osseointegrated implants exhibit substantially less movement, generally in the range of **3–5 μm** .

These differences have important implications for the design of implant-supported restorations. The absence of a functional PDL, together with the limited mobility of implants, may increase the susceptibility of implant restorations to unfavorable loading and biomechanical complications. Consequently, occlusal design should aim to control the **magnitude, direction, and distribution of occlusal forces** while maintaining compatibility with the patient's existing occlusal

scheme.

To address these biomechanical considerations, **Implant-Protected Occlusion (IPO)** was introduced by **Misch and Bidez in 1994** as a systematic approach to the occlusal management of implant-supported prostheses. IPO incorporated principles related to the control of occlusal contacts, cusp inclination, occlusal table dimensions, and the direction of loading to optimize force distribution at the implant–bone interface. These principles have subsequently been further discussed and refined in contemporary implant prosthodontic literature, including the work of **Elani (2021)**.

A **conformative approach** may also be adopted, whereby the implant-supported restoration is integrated into the patient's existing occlusal scheme without unnecessary alteration of established occlusal relationships. Thus, contemporary implant occlusion should be viewed not simply as the establishment of occlusal contacts, but as an attempt to achieve a **biomechanically favorable and clinically maintainable occlusal relationship**.

Factors That May Reduce Occlusal Stress in Implant Prostheses

(a) Elimination of Premature Contacts

Premature occlusal contacts should be identified and eliminated, particularly during **maximum intercuspation and centric occlusion**. Avoiding premature contacts may help reduce localized and uneven loading of the implant-supported restoration.

(b) Timing of Occlusal Contacts

Natural teeth and osseointegrated implants exhibit different patterns of movement under occlusal loading. Natural teeth demonstrate immediate displacement under relatively light forces, whereas implant movement is considerably more limited. Consequently, an implant restoration may experience a relatively greater load when occlusal contacts are established simultaneously with adjacent natural teeth.

In light occlusion, particularly when the implant restoration is located between natural teeth, the implant contact has traditionally been recommended to be **lighter than the contacts on the adjacent natural teeth**. Under heavier loading, contacts should provide an appropriate and balanced distribution of occlusal forces.

In first light contact of the natural teeth, shimstock holds between the molar teeth with the green dots, just pulls through between the upper premolar crown and lower premolar tooth and implant with the yellow

dot, and pulls through easily between the opposing implant molar crowns with the red dot. (Figure 1)

(c) Implant Diameter, Number, and Supporting Area

Increasing implant diameter increases the available bone-implant contact area and may improve load distribution. Occlusal stress may also be influenced by the **number and distribution of implants** and by splinting multiple implants when clinically indicated. In addition, reducing the width of the occlusal table may decrease the magnitude of forces transmitted to the supporting structures.

(d) Cusp Inclination

Cusp inclination influences the direction of occlusal forces and the resulting bending moment. **Reduced cusp inclination** and an occlusal morphology that directs forces more closely along the long axis of the implant may help minimize unfavorable lateral loading. Occlusal contacts are therefore ideally positioned over the implant body and on surfaces that favor **axial force transmission**.

(e) Implant Crown Contour

Implant position should be considered when designing the definitive crown contour. Ridge resorption may result in implants being positioned more **palatally or lingually** than the corresponding natural teeth. Reproducing the full contour of a natural tooth in such situations may create a **buccal cantilever**, increasing the

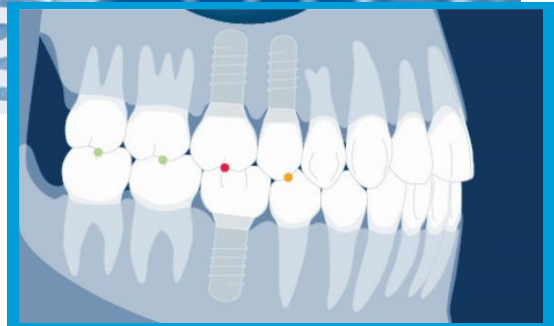


Figure 1: Illustration of graded contact on the implants and teeth

potential for non-axial loading.

Depending on the clinical circumstances, alternative approaches such as **modified occlusal morphology, crossbite articulation, or horizontal ridge augmentation** may be considered to improve the relationship between implant position and the direction of occlusal loading.

(f) Position of Occlusal Contacts

Because the clinical crown is frequently wider than the implant body, contacts positioned far from the implant axis may generate a cantilever effect. Traditional implant occlusal recommendations therefore favor placing the **primary occlusal contact within the implant diameter**, preferably near the central fossa, with secondary contacts positioned close to the implant periphery. The overall objective is to minimize the moment arm and promote a more favorable distribution of occlusal forces.(Figure 2)

Suggested Clinical recommendations

The following recommendations are primarily based on **biomechanical principles, laboratory investigations, and computational modeling**, rather than high-level clinical evidence demonstrating the superiority of one occlusal scheme over another. Accordingly, these protocols should be regarded as **clinical guidelines rather than universally validated rules**.

Occlusal contacts should be evaluated using **thin articulating paper and shimstock**. Shimstock, approximately **10 µm** in thickness, should demonstrate slight resistance during withdrawal rather than tearing or pulling through freely. Existing natural tooth contacts should be evaluated before implant restoration delivery and reassessed after insertion to ensure that the restoration integrates with the established occlusal relationship.

1. Posterior Single-Implant Restoration Bounded by Natural Teeth

Natural teeth: shimstock hold
Implant restoration: shimstock drag

The implant restoration should have relatively lighter occlusal contact than the adjacent natural teeth. **No implant contact is recommended during lateral excursion.** Periodic reassessment is important because eruption or positional changes of the opposing tooth may subsequently alter the occlusal relationship.

2. Kennedy Class III: Two Splinted Posterior Implants Bounded by Natural Teeth

Natural teeth: shimstock hold
Implant restorations: shimstock drag

Splinting the implants distributes occlusal forces over a larger supporting area and may reduce

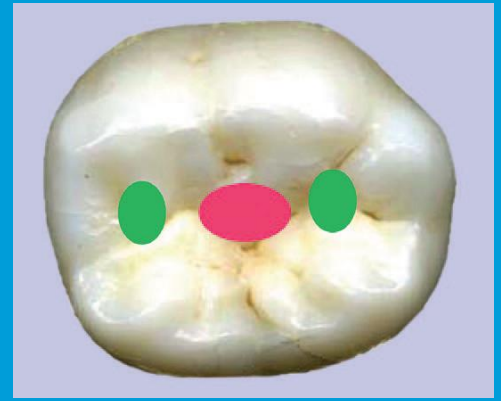


Figure 2: Centric stop should be placed over central fossa, and marginal ridge contacts should be avoided. The red oval contact point represents the centric stop, while green ovals represent secondary centric contacts (placed 1 mm away from periphery of the implant).



horizontal loading at the implant–abutment interface. **No implant contacts should be present during lateral excursion**, which should remain compatible with the patient's existing dentition.

3. Kennedy Class I

Natural teeth: shimstock hold
Implant restorations: shimstock hold

In distal-extension situations, implants may provide additional posterior support. Consequently, implant-supported restorations may be designed to participate more actively in centric occlusal support. Splinting may further distribute the applied load. **Lateral contacts on the implant restorations should generally be avoided.**

4. Kennedy Class II

Natural teeth: shimstock hold
Implant restorations: shimstock hold Similar to Kennedy Class I, implants in a distal-extension area may provide posterior support. Splinting can distribute forces over multiple implants, while the lateral excursion should remain compatible with the existing occlusion and avoid unfavorable horizontal loading.

5. Kennedy Class IV

Natural teeth: shimstock hold
Implant restorations: shimstock drag

Anterior implant restorations may participate in **lateral and protrusive guidance**. Particular attention should be given to **vertical and horizontal overlap and the presence of buccal**

cantilevers. When implant position is substantially palatal because of ridge resorption, a lighter occlusal scheme may be appropriate to minimize unfavorable loading.

6. Single Canine Implant Restoration

Natural teeth: shimstock hold
Implant restoration: shimstock drag

Where feasible, lateral guidance should be distributed toward the **premolars** rather than concentrated exclusively on the canine implant, thereby reducing horizontal forces. Protrusive guidance should primarily involve the **incisors**. When the canine morphology or overlap prevents redistribution of guidance, multiple teeth may be used to share the functional load.

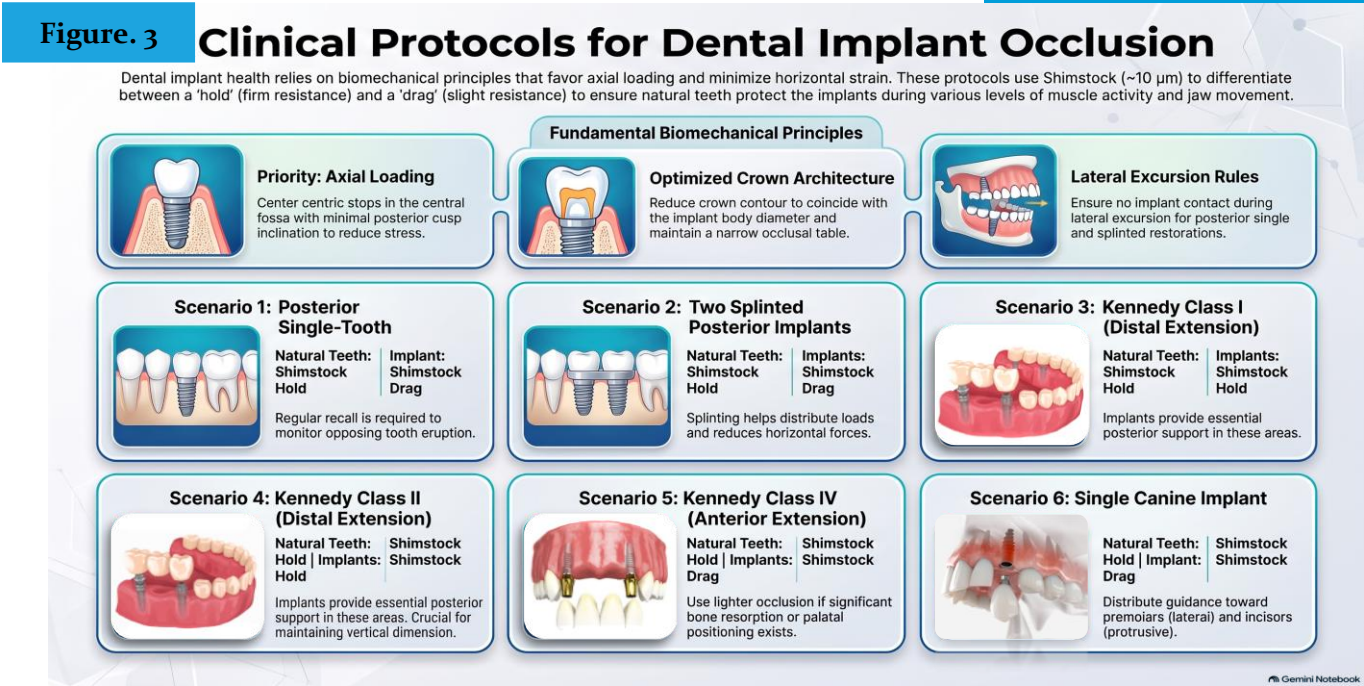
Deep canine overlap may increase horizontal loading of the implant components and potentially contribute to **screw loosening**. In such situations, a screw-retained restoration may facilitate subsequent retrieval and management of prosthetic complications. A protective night-time appliance may also be considered in patients with increased functional or parafunctional loading.

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