The introduction of osseointegrated implants has completely altered the prosthetic treatment of partially and fully edentulous patients. Besides other aspects that form a part of Implantology as a science, planning and delivering the optimal occlusion is an integral part of implant supported restorations.

Due to lack of the periodontal ligament, osseointegrated implants, unlike natural teeth, react biomechanically in a different fashion to occlusal force. Dental implants are more prone to occlusal overloading, which is often regarded as one of the potential causes for peri-implant bone loss and failure of the implant/implant prosthesis. The special conditions unique to implants necessitate developing an occlusion that places minimum stress on the implant, the implant- restoration interface and the restoration per se. The types and basic principles of implant occlusion have largely been derived from occlusal principles in tooth restoration. These occlusal concepts (i.e. balanced, group-function, and mutually protected occlusion) have been successfully adopted with modifications for implant-supported prostheses.

This paper discusses the role of occlusion as related to implantology and provides clinical guidelines for choice of occlusal schemes for implant retained restorations

| Key words: | IMPLANTS, OCCLUSION |

The literal definition of occlusion is ‘the act of closure or state of being closed or shut off’

Unfortunately in dentistry the term connotes a static morphologic tooth contact relationship. However the term should have in its definition the concept of a multi factorial relationship between the teeth and the other components of masticatory system.

**Terminologies:**

**Anterior Guidance:**

Anterior guidance refers to the dynamic relationship of the lower anterior teeth against the lingual contours of the maxillary anterior teeth in centric, long centric and in their protrusive, latero-protrusive, and lateral excursions. Along with centric relation and vertical dimension, anterior guidance must be regarded as the most important factor in reconstructing the stomatognathic system.

**Ideal Occlusion:**

*Ideal occlusion* is an occlusion compatible with the stomatognathic system providing efficient mastication and good esthetics without creating physiologic abnormalities.

Dawson (1974) also described five concepts important concepts important for an ideal occlusion:

1. Stable stops on all the teeth when the condyles are in the most superior posterior position (Centric Relation)
2. An anterior guidance that is in harmony with the border movements of the envelope of function.
3. Disclusion of all the posterior teeth in protrusive movements.
4. Disclusion of all the posterior teeth on the balancing side.
5. Non interference of all posterior teeth on the working side with either the lateral anterior guidance or the border movements of the condyles.

There is no one occlusal pattern for all individuals but an appropriate pattern can be found based on the above criteria. There are three accepted and recognized ideal occlusal schemes that describe the manner in which the teeth should and should not contact in various functional and excursive positions of the mandible. These include balanced occlusion, mutually protected occlusion and group function occlusion.

**Bilateral balanced occlusion:**

This is useful in construction of complete dentures, in which contact on the non working side is important to prevent tipping of the denture. It was also later utilized in complete occlusal rehabilitation with an objective of sharing the stress on more number of teeth. However it was soon discovered that it was difficult to achieve and it resulted in excessive frictional wear of the teeth.

A balanced occlusion in natural dentition with normal periodontium is difficult to find. When seen, it is usually the result of advanced attrition.

![Balanced Occlusion](image2.png)

Fig.2 Balanced Occlusion: All teeth contact during centric and eccentric movements.

(Red mark shows contact points between maxillary and mandibular teeth during lateral movements.)

**Group Function Occlusion:**

Destructive forces associated with nonworking side contacts were first observed by Schuyler who concluded that they were traumatic to the natural dentition, causing neuromuscular disturbances, temporomandibular joint dysfunction, accelerated or increased periodontal breakdown and excessive wear. Further work by other investigators resulted in balanced occlusion being replaced with unilateral balanced occlusion, otherwise known as ‘group function’.

The group function on working side distributes the occlusal load. Absence of contacts on non working side prevents those teeth from being subjected to the destructive, obliquely directed forces found on the non working side. Beyron has shown that it prevents excessive wear of the centric holding cusps thus helps in maintenance of occlusion.

![Group Function Occlusion](image3.png)

Fig3. Group Function Occlusion: Horizontal pressures during lateral movements are distributed to one half of the arch from central incisor through molar on the working side.

**Mutually protected Occlusion**

Mutually protected occlusion is also called as canine protected occlusion or organic occlusion. In this occlusal scheme, maximum intercuspation coincides with the optimal condylar position of the mandible (centric relation). The posterior teeth are in contact with forces being directed along their long axis. During lateral or protrusive excursions, the six anterior maxillary teeth, together with the six anterior
mandibular teeth guide the mandible so that no posterior occlusal contacts occur. The desired effect of this is the absence of frictional wear.

We can thus see how this occlusion is mutually protective—the posterior teeth protect the anterior teeth at centric relation, while incisors protect the canine and posteriors in protrusion while canines protect the incisors and posterior teeth during lateral excursive movements.

The differences between the natural teeth and the implants can be summarized as follows:

<table>
<thead>
<tr>
<th>Natural Tooth</th>
<th>Implant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>Osseointegration, functional ankylosis</td>
</tr>
<tr>
<td>Proprioception</td>
<td>Osseoperception</td>
</tr>
<tr>
<td>Tactile sensitivity</td>
<td>High</td>
</tr>
<tr>
<td>Axial mobility</td>
<td>Low</td>
</tr>
<tr>
<td>Movement phases</td>
<td>Two phases: Primary: non-linear and complex Secondary: linear and elastic</td>
</tr>
<tr>
<td>Movement patterns</td>
<td>Primary: immediate movement</td>
</tr>
<tr>
<td></td>
<td>Secondary: gradual</td>
</tr>
<tr>
<td>Fulcrum to lateral force</td>
<td>Apical third of root</td>
</tr>
<tr>
<td>Load-bearing characteristics</td>
<td>Shock absorbing function</td>
</tr>
<tr>
<td></td>
<td>Stress distribution</td>
</tr>
<tr>
<td>Signs of overloading</td>
<td>PDL thickening, mobility, wear facets, fremitus, pain</td>
</tr>
<tr>
<td></td>
<td>Screw loosening or fracture, abutment or prosthesis fracture, bone loss, implant fracture</td>
</tr>
</tbody>
</table>

Occlusal considerations for Implantology

Introduction of osseointegrated implants in early 1980's altered the way in which partially and fully edentulous patients are treated prosthetically. Dentures are more stable with attachments on implants and implants can act along with natural dentition as abutments or can stand alone to support fixed prostheses.

Because of the special conditions unique to implants it is important to develop an occlusion that places minimum stress on both the bone implant interface and prosthesis. The types and basic principles of implant occlusion have largely been
derived from occlusal principles in tooth restoration. These occlusal concepts (i.e. balanced, group-function, and mutually protected occlusion) have been successfully adopted with modifications for implant-supported prostheses. Furthermore, implant-protected occlusion has been proposed strictly for implant prostheses. This concept is designed to reduce occlusal force on implant prostheses and thus to protect implants.

Besides the principles of Dawson described earlier, other modifications from the conventional occlusal concepts that have been proposed in literature includes
- providing load sharing occlusal contacts,
- occlusal morphology guiding occlusal force to the apical direction with narrow occlusal table with flat area at the centre, decreased cuspal inclination and wider grooves and fossae,
- correction of load direction(axial loading)
- increasing of implant surface areas,
- and elimination or reduction of occlusal contacts in implants with unfavorable biomechanics.

Occlusal guidelines that need to be considered (in addition to the above guidelines) while restoring various clinical situations with implant supported prostheses are:-

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Edentulous classification</th>
<th>Type of prosthesis</th>
<th>Optimal Occlusal Scheme</th>
<th>Additional guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Edentulous</td>
<td>Implant supported fixed prosthesis</td>
<td>Group function(widely accepted)</td>
<td>Bilateral and anterior-posterior simultaneous contacts in centric relation and MIP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mutually protected with shallow anterior guidance(recommended)</td>
<td>For occlusal contacts, wide freedom (1-1.5mm) in centric relation and MIP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a) opposing natural dentition</td>
<td>Bilateral Balanced</td>
<td>Anteriorly placed working contacts to avoid posterior overloading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) opposing a complete denture</td>
<td></td>
<td>Infraocclusion (100 mm) on a cantilever unit to reduce fatigue and technical failure of the prosthesis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implant supported Over denture</td>
<td>Bilateral Balanced with lingualized occlusion</td>
<td>Canine guided occlusion increased a potential risk of screw joint failure at the canine site due to stress concentration on the area</td>
</tr>
<tr>
<td>2</td>
<td>Edentulous</td>
<td>a) for normal ridges</td>
<td>Bilateral Balanced</td>
<td>At least three point balance on lateral and protrusive excursion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>with lingualized occlusion</td>
<td>Increase vertical dimension and alter plane relation to allow for vertical space for attachment housings and metal framework space if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) severely resorbed ridges</td>
<td>Monoplane occlusion</td>
<td>Decrease vertical dimension if interarch distance is excessive and poses a biomechanical risk.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Keep attachment height minimal to avoid unfavorable torquing moments on implants.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implant supported Over denture</td>
<td></td>
<td>Horizontal axis of rotation of the denture base round anterior attachments is purported to reduce distal cantilever effect on loading of distal denture saddles. This and a lack of indirect retention causes distal denture displacement on anterior closure increasing need for protrusive balance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>With anterior and posterior implant supported attachments, enhanced retention and resistance reduces the need for balance to prevent distal base displacement.</td>
</tr>
</tbody>
</table>
### Occlusion And Occlusal Considerations

Shantanu Jambhekar, et al.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Edentulous classification</th>
<th>Type of prosthesis</th>
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<th>Additional guidelines</th>
</tr>
</thead>
</table>
| 3       | Class III or IV partially edentulous | Free standing FPD | Group function | • Anterior guidance in excursions and initial occlusal contact on natural dentition disclinging the posterior implant supported segment when possible.  
• Reduced inclination of cusps, centrally oriented contacts with a 1-1.5mm flat area, a narrowed occlusal table(by around 30%), and elimination of cantilevers  
• Additional implants in the maxilla could provide tripodium to reduce overloading and clinical complications.  
• Axial positioning and reduced distance between posterior implants (min of 3mm)  
• The utilization of cross-bite occlusion with palatally placed posterior maxillary implants can reduce the buccal cantilever and improve the axial loading  
• If the number, position, and axis of implants are questionable, natural tooth connection with a rigid attachment can be considered to provide additional support to implants.  
• Lone-standing self-supporting implant segment is preferable.  
• Infra-occlusion on cantilevered section with Mesial cantilever being biomechanically more favorable than a distal cantilever. |
| 4       | Class I or II partially edentulous (in posterior region) | Free standing FPD | Mutually protected Group function (when anterior teeth are periodontally compromised) | Also utilization of cross-bite occlusion and a reduced length of cantilever in bucco-lingual and mesio-distal dimension with a maximum of 15mm in mandible and 10-12mm in maxilla have been suggested as factors to consider when establishing implant occlusion.  
In cases with compromised quality of bone/ Grafted bone  
• Longer healing time.  
• Progressive loading by staging diet and occlusal contacts/materials  
• It is suggested that soft diet and reduction of the buccolingual, occlusal surface need to be considered in unfavorable loading conditions, such as immediate loading, initial healing phase, and/or poor bone quality. |

**Conclusion**

The objectives of implant occlusion are to minimize overload on the bone–implant interface and implant prosthesis, to maintain implant load within the physiological limits of individualized occlusion, and finally to provide long-term stability of implants and implant prostheses. To accomplish these objectives, increased support area, improved force direction, and reduced force magnification are indispensable factors in implant occlusion.

In addition, systematic, individualized treatment plans and precise surgical/prosthodontic procedures based on biomechanical principles are prerequisites for optimal implant occlusion. Implant occlusion should be re-evaluated and adjusted, if needed, in a regular basis to prevent from developing potential overloading on dental implants, thus providing implant longevity.

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8. A novel objective approach towards standardization of Epithelial dysplasia Index.
9. Quantitative and qualitative evaluation of AgNORs in Odontogenic cysts and tumors.

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4. Academic Advisor - College of Dentistry - Riyadh - 1982 - 85
5. Member Audiovisual & Stores Committee - College of Dentistry - Riyadh - 1982 - 85
6. Member Board of studies, Bangalore University - 1990 - 93
8. Dental Council of India - Inspector for MDS examinations
9. Member Board of Studies - MAHE