Chapter III

Occlusal Consideration in Implant Supported Prosthesis

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Introduction

In addressing the subject of oral implantology our must consider not only the surgical phase of placing the implant but also the prosthodontic rehabilitative, procedures.

The choice of an occlusal schema for implant-supported prosthesis is broad and controversial. Whether the selected implant is endosseous, subperiosteal or transosseous, proper understanding and application of sound prosthodontic principles in the selection, placement and restorative phases are prerequisite to successful implant therapy. Thus long-term success depend on several factors like proper selection of patient and implant, aseptic and a traumatic surgical procedures, adequate no load healing period, correct prosthodontic reconstruction and proper follow up care.

Implant prosthetics deals not only with the technical aspects of fabricating an implant supported prosthesis but also with proper application of occlusal principles for implant selection and placement and also for prosthetic phase of the treatment. So accurate occlusion is essential to the long-term success of implant treatment, thus.

"Implants cannot bail out our faulty occlusion"

Occlusion must be considered in three major areas, it
1. Occlusal determinants
2. Occlusal forces and their transmission to supporting tissues
3. Occlusal design and materials

1. Occlusal determinants

Occlusion must be viewed as a dynamic function of the stomatognathic system rather than as a static intercuspal position.
- Gradual reduction in face height (WO),
- Changes in the maxillomandibular relation,
- The presence of temperomandibular dysfunction are important occlusal deviations seen in implant candidates. There problems must be properly diagnosed and addressed in the treatment and laying phase.

The occlusal determinants may be classified as denture occlusion, TMJ's and the neuromuscular mechanism.

Temperomandibular Joints Established dental occlusion Neuromuscular mechanism

In order to provide physiologic occlusion for implant patients, the dentist should perform occlusal assessment and diagnosis prior to the restorative phase of treatment, and even prior to implant selection and placement.

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2. Occlusal forces and their transmission to supporting tissues
Transmission and distribution of stresses to implant supporting structures depend on the magnitude, direction and duration of the applied occlusal loads.

One of the principle objectives in implant prosthodontics is reduction of occlusal loads and accordingly reduction of transmitted stresses to the supporting osseous structure. The initial reversible signs and symptoms of trauma on natural teeth do not occur with endosteal implants.

An absence of soft tissue interface between the implant body and bone results with greatest magnitude of force localized around the implant bone region, leading to loss of crestal bone around the implant which results in loss of support to implant increased sulcus pocket depth.

So unless the density of bone increases or the amount or duration of force decreases, the condition will progress and even accelerate until implant less occurs. Thus elements to decreased crestal bone forces are implemented in occlusal design of the prosthesis.

The primary forces of occlusion should be directed to the long axis of the implant body, not the abutment post. Wherever possible implant bodies should be primarily submitted to the vertical component of the occlusal load. Horizontal or lateral forces magnify the amount of compressive and tensile stress at the implant crestal site and should be reduced or eliminated.

a. Offset load: OFF set usually are facial or lingual occlusal contacts not those in the long axis of the implant body. In screw-retained restoration, occlusal contact rarely is placed over an access hole. Therefore offset loads are common when occlusal screws are used. But when cement refined prosthesis is used, the occlusal load in directly placed over the long axis of the implant body.

In case of anterior implants, the screw retained prosthetis is placed lingual to the incisal edge on the access hole in the cingulum region, compared to cement retained prosthesis.

In order to decrease the offset load in screw-retained prosthesis during lateral excursion, natural truth when present the greatest load.

A representative blade shaped implant and four root shaped implants (TPS, core vent, Nobelpharma and ISIS implant) were investigated using a loading condition of 5 pounds vertical and 8 pounds lateral.

In summary, the general principles regarding direction of load to the implant body are.

a. Axial loads to the implant body produce less compressive and tensile stress
b. Horizontal loads produce an increase in both compressive and tensile stress
c. Screw retained prosthesis often have implant bodies more lingual compared to cement retained restoration

3. Occlusal design and materials
A proper occlusal scheme in a primary requisite for long term survival especially when para function or a marginal foundation is present.

a. Occlusal design: The occlusal plan that is unique and specially designed for the restoration of endosteal implants, providing an environment for improved clinical longevity of both implant and prosthesis is known as “Implant protective occlusion” or “medial positioned linguolised occlusion”.

a. Div A bone: A maxillary implant opposing a natural mandibular molar may have the lower buccal cusp or primary contact with the central fossa of the maxillary implant crown. The maxillary posterior implant most often is positioned under the central fossa of the natural tooth in Div A bone.

b. Div B bone: In div B bone, maxillary and mandibular implants are positioned under the lingual cusp relative to natural tooth. A mandibular implant opposing a natural maxillary posterior tooth may have the lingual cusp of maxillary teeth as primary contact

A maxillary implant opposes the mandibular natural tooth. The buccal cusp is completely out of occlusion in centric relation and all mandibular excursion. But the buccal cusp of the opposing natural tooth is reduced to eliminate any offset load on the maxillary implant. The primary contact here is the maxillary palatal cusp over the implant body and the central fossa region of the mandibular natural tooth.

Certain rules were recommended in the “Dentist desk reference” (DDR) to establish proper occlusal design in implant prosthodontics.

a. Cusp design of crown alignment should be made so that stresses are directed along the long axis of the implant.
b. Lateral stresses should be avoided or atleast minimized.
c. Width of the occlusal table of implant crown should be minimized.
d. Cusp height should be minimized to decrease lateral stresses, providing only centric function.

b. Materials:
The materials on the occlusal aspect of the prosthesis affect the transmission of force and the maintenance of occlusal schemes. Porcelain occlusal as a hardness of 2.5 times more then natural teeth, enamel has a 350 kg/mm² hardness, composite has hardness of 85% of enamel, Acrylic resin has a hardness of 17 kg/mm².

Therefore this shows impact loads are reduced with acrylic and increases with composite enamel and porcelain.

a. Acrylic: Acrylic is used in progressive bone loading as a transitional prosthesis. So in patients with parafunction acrylic transitional prosthesis used for extended periods to improve the bone-implant interface during progressive loading period.

Acrylic resin wears 7 to 30 times faster when opposing gold, resin enamel or polished porcelain. Acrylic fracture is a much more common complication in fixed restoration than removable prosthesis. Mechanical retention must be incorporated in metal superstructure.

b. Metal: For full arch implant supported prosthesis metal occlusal surface are used to minimize wear and prolong the accuracy of occlusal schemes. Metal occlusal surface is also used in posterior restoration in non-esthetic region and parafunction or marginal interact space present.

c. Porcelain: Porcelain fracture is the third most common condition requiring the replacement of fixed prosthesis supported by natural teeth. The ideal thickness of porcelain to prevent
breakage is approximately 2 mm.

Porcelain is used in full arch implant supported prosthesis in esthetic regions and in bruxism opposing with metal or acrylic.

4. Biomechanics
Several feature help decrease the effects of horizontal loads responsible for tension and shear on the crest of the ridge. This include mainly
a. Implant diameter and
b. Number of implants supporting prosthesis and distributing load
  ⊳ Wider implants should be used than narrow diameter implants
  ⊳ When narrow diameter implants are used in region of greater forces, additional splinted implants are indicated.
  ⊳ Narrow occlusal tables are recommended in non-esthetic regions of the mouth, where the occlusal table is reduced from buccal aspect.
  ⊳ In esthetic region, when occlusal table cannot be reduced in width e.g., in maxillary implant, the buccal cusp of the opposing natural teeth is reduced.

5. Weakest component theory:
Consideration like:
a. Identifying the weakest like in the overall restoration.
b. Establishing occlusal and prosthetic scheme to protect that component of structure.
- In maxillary denture opposing mandibular implant supported restoration, the maxillary denture is the weakest link. So bilateral occlusal scheme, raming of posterior occlusal plane, implant protective occlusion and elimination of anterior contacts with mandibular teeth in centric occlusal relation, is given.
- In the case of cantilevers, Reduced occlusal forces with an absence of lateral contacts in excursion are recommended on posterior cantilevers or anterior offset pontics. This decreases the forces and load on the abutment.
- When the cantilever polices on both the arches, In maxillary posterior implant cantilever anterior teeth, and mandibular anterior implants cantilever posterior teeth, the occlusal scheme cannot minimize forces on both. Then it is better for mandibular cantilever pontics to oppose maxilla implants.

6. Full arch fixed prosthesis:
In this case implant restoration should follow mutually protected occlusal schemes whenever possible. In protrusion there should be total absence of posterior contacts especially for cantilevered posterior units.
  ❖ In mandible the effects of mandibular movement is limited to the posterior to the mental foramen. So sufficient number of anterior implants of acceptable length and anteroposterior distance may often replace the mandibular teeth with a one-piece rigid bilateral posterior cantilever.
  ❖ But when implants are used in both mandibular posterior regions, they should be independent from the implants placed in the contralateral region. As a result instead of cantilever, two to four implants support an independent prosthesis on at least one side.
  ❖ In edentulous maxilla flexure of bone is not a concern, so a full arch prosthesis may be fabricated in one section.

7. Types of occlusion in implant supported prosthesis:
❖ In fixed or removable restoration with opposing fixed or removable implant supported prosthesis.

Organic occlusion is given:
❖ In fixed or removable implant – supported restoration with opposing removable full denture without implants bilaterally balanced occlusion is given.
❖ In partial prosthesis occlusion is in cases of cantilevers, the resiliency of the neighboring natural dentition and of the TMJ is taken.
❖ In single-implant occlusion, implant should be there of any occlusal overload and function.

8. Developing occlusal contact:
When developing occlusion in a restoration, the anterior guide must be created; once it is perfectly incorporated, we move to adjust the occlusion in posterior.

a. Anterior disocclusion guide: The anterior guide should be as flat as possible allowing for posterior disocclusion.
   As a general rule, a condylar side shift of 3mm should have a 1.5 mm separation in the opposing teeth on the non working side and a 1 mm separation on the working side.

b. Posterior occlusal anatomy: To achieve proper occlusion and efficient masticatory function, the active cusps must have their corresponding fossae.
   ❖ The first step will be to relate the cusp within the fossa. This is done by cusp contacting the fossa inclines and not in the fossa’s bottom.
   ❖ Three contacts per cusp is considered, making sure they are ‘really contact points and not surface contacts’.
   ❖ The next step is, the grooves that will allow the cusps exit from their fossa during working, non-working and protrusive movements are designed.

The fossa exit paths are completely opposite in the upper and lower teeth.

a. Upper arch :
   Working Groove : Transverse toward buccal.
   Non working Groove : Oblique towards mesial and lingual.
   Protective Groove : Towards mesial.

b. Lower arch :
   Working Groove : Transverse toward Lingual.
   Non working Groove : Oblique towards distal and buccal.
   Protective Groove : Towards distal.

In lateral excursion, this will only allow anterior tooth contact, while the posterior teeth remain completely free. However in closure, only the posterior teeth will be in contact.

9. Prematurities:
Prematurities represent any tooth contact during mandibular closure with the condyles in the centric relation that occurs before maximum intercuspatation.

10. Interferences:
These are non physiological contact that appear in the anterior and posterior teeth in lateral and protrusive excursion.

a. The non-working interferences are very important because the mandible pivot to avoid them, which in turn produces.
   - A compressive component on the working condyle, predisposing to arthrosis and discal pathology.
   - A Tensional component in the non-working condyle, which predisposes to hyperlaxitudes and meniscal displacement.
   - If anterior guidance cannot be accomplished, group function should be used.
   - If anterior guidance can be accomplished than posterior contacts during working movement should be eliminated.

c. Protrusive interferences: Create a tensional component in both condyles and implant overloading. Thus prematurities and interferences will be more or less pathological depending on whether para functions are present.

10. Bruxism
Bruxism is a form of eliminating internal tension and is often a cause of tooth loss. Bruxism is not a contraindication for implant, but we should be extremely careful during prosthesis fabrication. Frequent occlusal follow up are mandatory, eliminating prematurities and interferences as well as verifying good guidance in the anterior teeth.

11. Splinting:
In the implant tooth fixed prosthesis four important components may contribute movement to the system, i.e., the implant, bow, tooth and prosthesis.
   - There has been controversy regarding whether a rigid fixed implant may remain successful when splinted to natural teeth.
   - The tooth movement range from 8 to 28 m in a vertical direction and that of implant 3 to 5 m. Because of this difference in vertical movement the initial occlusal contact should account for the difference.
   - Using key ways in fixed bridgework also proves stress relief, and reduction of occlusal load to the implant.

12. Complication from overloading implants:
   a. Crestal bone loss
   b. Screw loosening
   c. Screw fracture
   d. Material fracture.

13. Minimizing overloading of implants:
   a. Narrow occlusal table
   b. Splinting
   c. Cantilevers
   d. Proximal contacts.
   e. Cement retained restoration.

Conclusion

Conclusion has been an important variable in the success of failure of most prosthodontic reconstruction with natural teeth, a certain degree of flexibility permits compensation for occlusal irregularity. Implant dentistry is not as forgiving. The occlusion must be more rigorously evaluated with implant supported prosthesis.