Occlusal considerations and principles in Dental Implant: A Review of Literature

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Abstract

In today’s world dental implant have been used widely. Occlusion plays a central role in clinical dentistry and is essential for normal physiologic function. Occlusion in implantology is a very important factor to be considered during treatment planning. This paper summarizes current knowledge on how implant protected occlusion is a very important criteria to obtain an improved longevity of both the dental implant and prosthesis.

Introduction

Dental Implantatology have become an integral part of reconstructive dentistry. Implant treatment has become the treatment of choice and the most desirable treatment option for replacing missing teeth in partially as well as completely edentulous patients. Dental implants have different biological and biomechanical characteristics compared to natural teeth. Occlusion in implant is one of the most important criteria.\(^1\)

\textit{Dr Carl E.Mich} proposed the concept of implant protected occlusion.\(^2\)Occlusion overload is often considered as the main cause of peri-implant bone loss and implant prosthesis failure as it cause crestal bone loss, thus increasing the anaerobic sulcus depth and peri-implant disease states. Besides that, crestal bone acts as a fulcrum when there is occlusal overload which again leads to biological and mechanical complications. It can be rightly said that occlusion is a determining factor for implant success in the long run.\(^3\)

An Ideal Occlusion

Occlusion is defined as any contact between the incising or masticating surface of maxillary and mandibular teeth (According to Glossary of Prosthodontic Terminology 9)

In 1974 Dawson described the five important concept of ideal occlusion. They are:-
1. Centric relation:

Definition of centric relation (GPT): The maxillomandibular relationship in which the condyles articulate with the thinnest avascular portion of their respected disks with the complex in the anterior posterior position against the shape of the articular eminencies. The position is independent of tooth contact. This position is clinically discernible when the mandible is directed superior and anteriorly. It is restricted to a purely rotary movement about the transverse horizontal axis.

2. Anterior guidance must be in harmony with the border movements of the envelope of function.

3. Disocclusion of all the posterior teeth in protrusive movements.

4. Disocclusion of all the posterior teeth on the balancing side.

5. Noninterference of all posterior teeth on the working side with either the lateral anterior guidance or the border movements of the condyles.

Overloading factors of Implant Occlusion

- On immediate loading of implant dentures, there can be a negative effects biologically, technically as well as mechanically such as loosening of screws or fracture of the prosthesis as stated by Yuan, 2013.\(^4,5\)
- Due to implant overloads there can be loss of osseointegration and marginal bone loss around implants.\(^4,5\)
- A cantilever of an implant prosthesis can leads to overloading.
- Parafunctional habits.
- Implant arch position and location.
- Poor bone density
- Steep cuspal inclination
- Horizontal offset position
- Vertical Offset position

Management of complications by targeting occlusal overload factors:

- Kim 2005; Degidi 2009; stated that Occlusal overload can be significantly reduced by increasing the bone support surface and harmonizing the distribution of occlusal contacts.\(^4,5\)
- According to Misch\(^6,4\) bone achieves adaptability to loading and also there is availability of time for development of load bearing bone at bone-to-implant interface by progressive bone loading.
- This progressive loading of the bone can be obtained by increasing the occlusal load over a time period of six months.
- Appleton\(^7,4\) proposed that amount of crestal bone loss and bone dentisity can be increased by progressively loading implants. It suggested that careful monitoring of loaded implant and healing time is extended in poor quality bone.
- In case of parafunctional habits, Yuan 2013 strongly indicated the use of noctual occlusal splint. \(^4,5\)
• In parafunctional habits, premature contacts has to be eliminated because when such habits are present both the duration and magnitude of the occlusal force are magnified.
• An occlusal force should be directed along the long axis of the implant.\(^8\)
• Stress is defined as the magnitude force divided by the cross-sectional area in which force is applied. This means that when force is applied, if area is greater less stress is produced. For this reason, wider implant will produce less stress at the crest. And also in cases where narrow diameter implants are used, additional implants are indicated.\(^8\)

**Implant Protective Occlusion**

The implant protective occlusion should be followed and the guidelines for that are as follows:-

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**Premature occlusal contacts:**

Depending on the many factors such as shape of the tooth, position, geometry of roots, and time elapsed since last load application, initial tooth movement ranges 8 \(\mu\) to 28 \(\mu\) in a vertical direction under a 3 lb-5 lb load.\(^9, 10\) The secondary tooth movement is similar to the movement seen in implants (3 \(\mu\)-5 \(\mu\)) \(^10\) and is reflective of the property of the surrounding bone. When teeth come in contact, the combined intrusive movement is about 56 \(\mu\) (28 \(\mu\) +28 \(\mu\)) but when an implant opposes a natural tooth, only 28 \(\mu\) of movement occurs, hence though the occlusal design may be ideal, premature occlusal contacts on the implant may still occur due to the difference in the vertical movement of the teeth and the implants in the same arch. The implant prosthesis should just barely contact and the surrounding teeth in the arch should exhibit greater initial contacts.\(^1\) Hence, in cases of implants restorations opposed by natural teeth, the dentist should use a heavy bite force followed by a light bite force to differentiate between the occlusal contacts. Heavy bite forces causes depression of the natural teeth and positions them closer to the implant and thus permits equal sharing of the load.\(^11\) So in implant supported prosthesis during maximum intercuspation and centric occlusion no occlusal contacts should be premature.\(^4\)

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**Relation of surface area to stress distribution:**

When the load is transmitted to the prosthesis, sufficient surface area is required.
Same in case of implant prosthesis if surface area is decreased, there will be increase load in magnitude, direction or duration, the stress and strain in the interfacial tissue will increase.\(^2\) Bidez et al have reported a study in which force distributed over 3 abutments produces less stress on the crestal bone when compared to 2 abutments.\(^12\)

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**Cantilever:**

Cantilever should not exceed more than 20mm and its kept at best less than 15mm.\(^16\) Cantilever with unfavourable crown or implant ratio, will increase the stress or load to the implant which will lead to peri- implant bone loss and prosthesis failure.\(^17, 18\)

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**Implant crown contour:**

The most ideal occlusal concept advocated for implant supported restorations is that of mutually protected articulation. The posterior and anterior groups of teeth mutually protect each other. In protrusion, only the anterior teeth are controlled by the incisal guidance \([20]\) and there is uniform disocclusion seen in the posterior region whereas in centric occlusion there is intercuspation of the posterior teeth and the anterior teeth are free of any contact.
In cases where a healthy canine is present, only the canine disoccludes the rest of the posterior teeth in lateral excursions.\textsuperscript{21-23} in implant prosthodontics, the incisal guidance should be as shallow as possible, Weinberg and Kruger\textsuperscript{24} noted that for every 10-degree change in the angle of disocclusion, there was a 30% difference in the load. Hence all lateral excursions opposing fixed prostheses or natural teeth must disocclude all posterior Components. The greater the crown height, the greater the resulting crestal moment with any lateral component of force including those forces that develop because of an angled load.\textsuperscript{24} The central fossa of an implant crown should be 2-3-mm wide in the posterior teeth and parallel to the occlusal plane. Secondary contacts should remain within 1 mm of the periphery of the implant to decrease the moment loads and marginal ridge contacts should be avoided. Splinted crowns also decrease occlusal forces to the crestal bone and reduce abutment screw loosening; hence adjacent implant crowns should be splinted. The center of the implant most often is placed in the center of the edentulous ridge, as the ridge shifts lingually with resorption, the implant body is most often not under the buccal cusp tips but rather near the central fossa or sometimes under the lingual cusp of the natural tooth. A buccal or lingual cantilever is called an offset load, which acts as a class 1 lever. Greater the offset, greater the compressive tensile and shear forces at the implant crest. Hence, reduction in buccolingual dimension of the crown helps minimize these loads.\textsuperscript{24}

**Multiple factors to be considered in Implant supported Clinical Scenario.\textsuperscript{13,14,15}**

<table>
<thead>
<tr>
<th>Clinical Scenario</th>
<th>Factors to be considered</th>
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<tbody>
<tr>
<td><strong>Single Implant</strong></td>
<td>• Cuspal inclination must be reduced</td>
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<td></td>
<td>• Anterior guidance and lateral movement must be excluded</td>
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<td></td>
<td>• Axial posterior inclination at right angle to the occlusal plane is still the optimal paradigm.</td>
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<td></td>
<td>• Minimal cantilever</td>
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<td>• Proximal contact should be increased which will help in improving the stability of the restoration.(Misch 1999)</td>
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<td>• Centrally positioned contact will reduce bending forces on the implant.</td>
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<td><strong>Full arch fixed Prosthesis</strong></td>
<td>• Cantilever extension should be infraoccluded (100 µm)</td>
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<td>• Maximum length of the cantilever 15mm in mandible and 10-12mm in maxilla</td>
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<td>• Avoid canine guidance if canine is one of the abutment.</td>
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<td>• 6-8 Implants in maxilla</td>
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<td>• 4-8 implants in mandible</td>
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Removable overdenture supported by Implants

- Heights of the attachments should be minimum to reduce any horizontal forces. (Gross 2008)
- Masticatory problems are associated with magnets
- 2-4 Implants
- Achieve 3 points balanced on lateral and protrusive movement

Conclusion

The osseointegrated implants lack mechanoreceptors and a shock absorbing function because they are ankylosed to the surrounding bone without the periodontal ligament.

One of the main causes for peri-implant bone loss and implant/implant prosthesis failure is occlusal overload. Many clinical complications such as screw loosening or fracture, prosthesis fracture, continuing marginal bone loss, implant fracture, and implant loss may be attributed to implant overload. By application of biomechanical principles such as reducing the cantilever length, passive fitting of prostheses, narrowing the buccolingual dimensions of the prosthesis, reducing cusp inclination, eliminating excursive contacts, and centering occlusal contacts, these complications can be prevented. Implant occlusion should be adjusted periodically and re-evaluated to prevent them from developing potential overloading clinical sequelae, thus providing implant longevity.

References:


