OCCLUSION IN DENTAL IMPLANTS

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I. INTRODUCTION

The introduction of osseointegrated implants in the early 1980s revolutionized the approach to treating partially and fully edentulous patients with prosthetics. Successful implant prosthesis planning relies heavily on the restorative expertise of the dentist in prosthetic dentistry. While implant placement depends on the patient's oral anatomy and bone structure, the ultimate prosthesis design is influenced by the dentist's implant dentistry knowledge and past clinical experience. Achieving predictability and long-term success hinges on several factors, including selecting the right patient, performing aseptic and gentle surgical procedures, allowing for a sufficient no-load healing period, ensuring correct prosthodontic reconstruction, and providing proper follow-up care.

A Swedish government evaluation highlighted that the prosthodontic phase is the most critical aspect for the long-term success of implants. Implant Prosthodontics not only involves the technical aspects of crafting supported prostheses but also demands the proper application of occlusal principles for implant selection and placement, as well as for the prosthetic phase of treatment. The development of a suitable occlusion is pivotal for the success of both the implant and the prosthesis attached to it.

Occlusion is vital for implant longevity because osseointegrated implants lack periodontal ligaments like natural teeth, which can absorb stress and allow for tooth movement. In the case of implants, occlusal stress is borne entirely by the implant-bone interface. If the occlusal force exceeds the interface's capacity to absorb stress, implant failure can occur.

To prevent implant failure, occlusal forces must be directed along the implant's long axis to avoid destructive lateral forces. The prosthesis must be precisely fabricated to ensure long-term success, and it should be securely connected to the fixtures to transmit any occlusal stresses directly to the surrounding base.

Harmony with the rest of the stomatognathic system is crucial when developing occlusal concepts. As English suggests, "Accurate occlusion is essential for the long-term success of implant treatment. Implants cannot compensate for faulty occlusion."

II. SIGNIFICANCE OF OCCLUSION ON OSSEOINTEGRATED IMPLANTS

In natural teeth, periodontal ligament receptors protect against excessive occlusal forces, preventing trauma to supporting bone. However, osseointegrated implants lack these defense mechanisms, making a well-restored occlusion critical for their longevity. Success rates for osseointegrated implants depend on sound prosthodontic principles, not just meticulous surgical procedures.

Parafunctional habits like bruxism, which generates six times the bite strength of natural dentition, or long-term changes in vertical dimension, can have adverse effects on the muscles supporting the craniomandibular structures and contribute to bone resorption.

Osseointegrated implants are firmly connected to supporting fixtures, transmitting occlusal stresses directly to surrounding bone. Therefore, careful consideration of potential occlusal stresses during prosthesis fabrication is essential for long-term success.

Studies have shown that osseointegrated implant-supported overdentures provide better masticatory efficiency and speed compared to conventional complete dentures. Occlusal forces in patients with osseointegrated implant-supported prostheses are controlled by neuromuscular mechanisms via masticatory muscles.

1. **Impact Forces:** Osseointegrated implants lack a cushioning mechanism, so occlusal forces are directly transmitted to the supporting bone. Aggressive occlusal forces can harm the surrounding bone, and potential impact forces, such as premature occlusal interferences, should be eliminated during prosthesis fabrication.

   Impact forces, occurring when the mandible closes with high velocity and power, can damage the prosthesis, implant components, and supporting bone. Contacting teeth simultaneously in maximum intercuspation can help mitigate these forces, as natural teeth effectively function from this position. Significant differences in forces were observed between patients with fully bone-anchored prostheses, natural dentition, and complete dentures, based on calculations of theoretical stress-bearing capabilities.

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2. **Optimum Occlusion for Osseointegrated Implants:** There is limited research available concerning the optimal occlusion for osseointegrated implants. Lekholm, in 1983, noted that poor occlusion can lead to uneven distribution of loads and stresses, resulting in bone resorption and fixture mobility. To distribute these loads and stresses more evenly, a balanced occlusion has been applied in osseointegration prostheses. However, it's important to recognize that while a balanced occlusion shares loads effectively from an occlusion perspective, the lateral loads it generates can be detrimental to the fixtures and surrounding bone. In a balanced occlusion, occlusal contacts are spread across posterior teeth during all eccentric movements, including working and nonworking contacts, which generate lateral loads on posterior teeth. These lateral forces can impact the rigid components of the implant system, particularly the fixture-bone interface. Therefore, a balanced occlusion is not recommended as the preferred occlusal scheme for fully bone-anchored prostheses.

   Conversely, occlusal forces during maximum intercuspation are directed vertically, transmitting forces uniformly to all fixtures. The fixtures integrated into bone are within a specific mesiodistal region, and the prosthesis is designed with cantilever extensions that can resist fulcrum forces through a lever effect. Calculations indicate that loads on the cantilever are absorbed vertically within normal limits and transmitted to the fixtures. Consequently, the occlusal forces transmitted are not detrimental, even when transmitted through the cantilever regions during maximum intercuspation.

   During eccentric movements, occlusal forces tend to create horizontal loads, with increasing forces toward the distal sections. To prevent destructive lateral forces, the occlusal forces should be shared by anterior teeth. For instance, the occlusal force on a canine is approximately one-eighth less than the force on a second molar, as noted by Guichet in 1970. Even with applied horizontal loads, the stress generated on fixtures in the anterior region is less. Therefore, the occlusion for an osseointegrated prosthesis should closely resemble optimum occlusion in natural dentition.

3. **Gnathological Principles:** The gnathological approach to clinical treatment emphasizes recording mandibular movement using devices like a pantograph and underscores the importance of harmony among the temporomandibular joint, teeth, and muscles. In edentulous patients, fixing clutches for pantographs has been challenging. However, in osseointegrated implant treatment, fixtures can be used to anchor the clutches, enhancing measurement accuracy.

The Gnathological Procedures Encompass

- Measuring vertical dimension and centric jaw relation records.
- Locating the transverse horizontal axis.
- Recording a facebow.

- Mounting casts in the articulator (first set).
- Fabricating clutches.
- Inserting intraoral clutches.
- Measuring eccentric movements with a computer pantograph.
- Adjusting the adjustable articulator.
- Mounting master casts in the articulator (second set).
- Determining anterior guidance.
- Adjusting the incisal table in the articulator.
- Prosthesis fabrication.
- Remount procedures.
- Delivery.
- Functional occlusal examination of the prosthesis.

In summary, understanding implant-supported prosthetic occlusion relies on fundamental principles derived from natural and prosthetic occlusion knowledge:

- Occlusal forces on natural teeth are controlled by patients through proprioception, but implants lack this protective mechanism. Consequently, occlusal forces on implant-supported prostheses must be carefully designed and executed.
- There's no one-size-fits-all occlusal scheme; it must align with the purpose and location of the restoration, whether it replaces a single tooth or involves a complete denture.
- Understanding whether the implant-supported prosthesis will occlude with natural dentition or tissue-supported prostheses is critical, as each exerts different forces during functional and resting movements.
- Consideration must be given not only to interarch space but also the plane of occlusion when determining abutment height and position, as a disrupted or incorrectly oriented plane of occlusion can compromise optimal occlusion.
- Establishing stable jaw relationships with bilateral identical maximum intercuspal contacts is essential.
- Achieving "freedom in centric" within the overall occlusal scheme.
- Eliminating interference between maximum intercuspal and retruded contact positions.
- Providing harmonious mandibular movement with light tooth contact during lateral and protrusive contacts.

In all phases of prosthodontic rehabilitation, the occlusal scheme must be tailored to the specific oral situation. For instance, when replacing a single tooth with an implant-supported prosthesis in an otherwise intact dental arch, the occlusion should mimic that of a tooth-supported single restoration. However, it's essential to consider canine occlusion if the natural canine is present and periodontally sound, especially when the implant-supported prosthesis occludes with natural teeth or other implants supported by natural teeth. This helps prevent overloading a single supporting fixture during disclusion. Group function occlusion, which provides centric occlusal contacts and complete disclusion in balancing positions, is another option.

III. BIOMECHANICAL CONSIDERATIONS ON OSSEOINTEGRATED IMPLANTS

As the bone is strongest under compressive forces, lower strong to tensile forces and significantly weak to shear forces, the occlusal design should aim at reducing the tensile stresses and barring shear forces whenever possible.

An axial cargo over the long axis of an implant distributes further compressive stresses compared with tensile or shear forces. The lesser the angle of the cargo, applied to the implant long axis, the lesser is the compressive, tensile and shear stresses. therefore, along with the quantum of stress adding with an angled cargo, the type of stress converts to further tensile and shear factors. As bone is stronger in contraction, the negative goods of angled loads is enhanced. Because vertical or side loads beget an increase in the quantum of pressure or shear forces at the crest of the crest, these loads must be reduced within the occlusal scheme, especially in mechanical systems which increases in force, as cantilevers or crowns with lesser crown implant rates. Lighter occlusal connections are placed on cantilevers as a primary compressive force on a unilateral stake portion of aF.P.D. also applies considerable shear and tensile stresses to the most distant abutment.

The angle of the force to the bone affects the physiologic limit of compressive and tensile strength of bone. An angled cargo, i.e., force applied at a 300 angle increases the quantum of stresses around the implant body, transforms a lesser chance of the force to the tensile and shear force, and reduces bone strength in contraction and pressure. The girding implant body stress is least, and the strength of the bone the topmost under axial cargo to the implant body. Axial lading of the implant is especially important when the intensity and duration of force increases i.e., in parafunction. Occlusal designs should thus include axial loads to implant bodies, and when not possible should incorporate mechanisms to drop the negative goods of side loads.

1. **Splinted Implants:** Factors considered important to drop the goods of vertical loads which beget pressure and shear stresses on the crest of the crest include implant periphery, the number of implants supporting the prostheses and distributing the cargo. It's important to have an acceptable face area support. Whenever, the side force factors increase in quantities direction or duration of operation, the number of implants splinted in the region should also increase. As side loads constantly increase in the anterior region of the mouth during mandibular excursion more splinted implants are thus placed then to dissipate the performing crestal stresses.

   Wider implants have a lesser area of bone contact at the crest than narrow implants, performing in lower compressive and tensile forces. Narrow root form implants have lower face and beget lesser stresses at the crest of the crest. Therefore when narrow implants are used in regions which admit lesser forces, fresh splinted implants are indicated to compensate for their narrow design and help drop and distribute the cargo over a broader region. When forces are increased in intensity, duration or both as in parafunction, crest addition may be needed to place wider implants to compensate for the increased cargo. The prostheses can be modified to reduce occlusal loads from a fixed restoration to removable prostheses. This is especially important when nightly parafunction is present, and the restoration may be removed to exclude the condition.

Some stress relieving element may be included in the removable restoration, to allow the soft towel to help dissipate the loads.

2. **Reduced Occlusal Table Conception:** The wider the occlusal table, the more constantly neutralize connections do during mastication or parafunction. Wider root fountain implants offer a broader area for axial connections and transmit lower forces at the transosteal spots under neutralize loads than narrow plate form or root form implanted. The narrower the implant body, the lesser the significance of occlusal table range and axial lading the implant body. Therefore, faciolingual confines of the occlusal table on which connections are placed is directly related to the range of the implant body.

3. **Occlusal Forces:** Natural teeth have a lesser stress relieving element than implants, particularly under side forces. However, the occlusal scheme uses those teeth to distribute the vertical loads during mandibular excursions healthy.

   Thus, whenever fixed partial dentures are seated upon dental implants, it's generally possible to achieve hindrance occlusal connections with either canine guidance or group function. It has been demonstrated that muscle exertion is reduced with canine guidance, also appertained to as cuspid defended occlusion. still, this situation isn't generally observed, except in youthful cases. Group function is more frequently observed in senior cases. With this type of occlusion, it's also possible to achieve a harmonious balance of all involved structures including the musculature, the TMJ, the teeth and their occlusal deconstruction.

   In implant retained, mucosa brone overdentures in the nib and/ or beak, stabilisation of the prostheses during neutral function in the posterior parts demands a completely equalized occlusal scheme (bilaterally balanced occlusion).

4. **Natural Teeth and Implants:** The success of a rigid fixated implant splinted to natural teeth is governed by the factual capability of the implicit natural abutments. In the implant- tooth fixed prosthesis, the implant, tooth, bone or the prostheses may contribute movement to the system.

   When the occlusal adaptation is completed in centric relation occlusion, the side and intrusive movements may be estimated. When opposing a fixed dentition, no posterior implants or teeth should communicate in any digressive mandibular movement. The vertical movement of natural anterior teeth ranges from 64 to 108. An implant has a side movement range of 12(thick bone) to 140(in veritably soft bone). When a combination of non splinted anterior teeth and implants are present in the anterior region of the beak or nib, the forces produced during mandibular side excursions should be distributed originally and primarily to the natural teeth. However, two or further splinted implants should distribute the side force, If no anterior teeth are present in the direction of the excursion.

5. **Bone Resorption:** In an edentulous crest with abundant height and range and little resorption, the implant may be placed in an ideal position for occlusion and esthetics. A cement retained restoration permits situating the implant body directly under the primary block contact. An implant is stylish deposited in the middle of the remaining range of bone or slightly towards the further thick bone of the lingual plate. As a result, the

implant is placed under the central fossa region of the natural tooth. To load the implant body in an axial direction, the primary occlusal contact should be in the central fossa region, which permits posterior mandibular natural teeth opposing the maxillary implant to have the Mandibular buccal cusp as the primary contact. Mandibular implants opposing maxillary natural teeth must use the maxillary lingual cusp as the primary contact. xillary lingual cusp as the primary contact.

In conditions where the bone continues to resorb from the facial aspect to further decrease the bone width, the implant is often placed under the lingual cusp portion relative to the natural tooth in the mandible or the maxilla. The implant body is ideally placed perpendicular to the occlusal plane. In the mandible, the buccal cusp is reduced in height to correspond to the central fossa, and the occlusal table is reduced from the facial aspect to permit axial loading of the implant body. In the maxilla, the implant crown should retain the offset buccal cusps for aesthetics. However, the mandibular occlusal table is modified to permit axial loading of the maxillary implant body and the maxillary occlusal table may be reduced lingually.

Thus, the implant body is placed in the middle of the edentulous crest of the bone, which is in the central fossa region or even more lingual. Due to this, the natural teeth occlusal concepts have to be modified, so that the primary occlusal contact is axial to the implant body, not the buccal cusp of the mandibular natural tooth.

6. **Occlusal Stresses and Biomechanical Considerations:** One of the principal objective in implant prosthodontics is reduction of occlusal loads and accordingly reduction of transmitted stresses to the supporting osseous structures. Utilising the three – dimensional finite element stress analysis method several endosseous implants were investigated for stress distribution and transmission within the implant and their osseous supporting structures. A representative blade shaped implant and four root shaped implants (TPS implant core –vent implant, Nobelpharma implant and ISIS implant) were investigated using a loading condition of 5 pounds vertical load and 8 pounds lateral load (a combination of 5 pounds vertical and 3 pounds horizontal loads). Principal stresses compressive and tensile were analysed both vertically and horizontally for all five implants.

Based on these Studies the Following Conclusions are drawn

- Root: shaped implants because of their cylindrical shape minimise transmission of stresses to supporting bone better than blade shaped implants.
- Implant neck or prosthetic post diameter should be enlarged to implant fixture diameter whenever possible. Implant with narrow (or constricted) necks or posts should be avoided.
- Blade shaped implant should be redesigned to increase the neck diameter and central portion of the blade to minimise the transmission of stresses to supporting bone.
- Alveolar crestal bone loss (saucerization). Which occurs around implant fixtures, appears to be directly related to transmission to the osseous tissues in this region of stresses that exceed the tolerance of bone?

Based on these findings and those of other researchers guidelines should be established for selecting the appropriate type of implant for a given patient. The physical and psychological state of the patient and his or her prosthodontic requirements may be very important in determining certain aspects of the loading condition and biting forces. Since these factors are not easy to determine the biomechanical aspects of implant design and how the individual implant transmits stresses to its supporting bone must be considered when selecting an endosseous implant when placing the endosseous implant and when designing occlusion during the prosthetic phase of the implant treatment.

7. **Occlusal Considerations:** The precusor signs of occlusal trauma on natural teeth are usually reversible and include sensitivity, hyperemia or and increase in mobility. The presence of the periodontal membrane on natural teeth significantly reduces the amount of stress to the bone, especially in the crestal region.

   However 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 the greatest magnitude of force localized around the implant is not reversible without the surgical intervention. And results in decreased implant support and increased sulcus pocket depth. This leads to implant loss unless the density of the bone increases or the amount or duration of the force decreases.

8. **Axial Implant Loading:** The direction of load to the implant body is a very critical factor the primary force of occlusion should be directed to the long axis of the implant body and not the abutment post as this leads to less distribution of force to the surrounding crestal bone. To achieve this goal during the planning phases the localixation and axis orientation of the implant should be determined according tot this principle and carried out during the surgical phase with the help of guiding stents. The following principle may be applied depending on whether the axis orientation of the implants is more to the buccal or to the lingual aspect:

   - The centric stop should be located in the central fossa of the crown that is affixed tot he implants or the implant abutment should be located directly beneath the cusp (Graber, 1985).
   - The implant should be positioned such that it represents an extension of the force vector of its antagonist.
   - The width of the occlusal surface should be considerably reduced compared to natural teeth and for bio mechanical reasons, occlusal contacts should be localized with in the diameter profile of the underlying implant.

9. **Angled Abutments:** Are mainly used to meliorate the path of insertion of the prostheses. A 30º angled abutment loaded in the abutment long axis will transmit lower compressive and tensile stresses to the crest of the bone around the implant body compared to the same implant with and angled abutment loaded in the direction of the long axis of the implant body. The lower the angle between the primary force and the implant body, the lower is the amount of crestal compressive and tensile stresses with a rigid fixed implant. The side loads to the implant crestal region further increase when crown height increases or when present on the cantilevered portion of the prostheses.

   Thus, whenever possible, the implant bodies should be primarily vanquished to the vertical element of the occlusal weight. Vertical or side forces magnify the amount of compressive or tensile stresses at the transosteal implant spots, and so should be reduced or barred, especially when the rate of the crown height to implant length is lower than 1 or present on cantilevered prostheses.

10. **Premature Connections:** Premature occlusal connections results in localized loading of the opposing reaching crowns. A premature contact provides minimal area to distribute the loads, and the stress is greatly increased. All the occlusal forces is applied to one region rather than being shared by several abutments or teeth. The premature contact may be on an inclined airplane, giving a lower perpendicular force to the weight and adding compressive and tensile crestal stresses. Therefore elimination of premature connections is especially important with habitual parafunction as the amount, duration and direction of force or the weight increase.

11. **Offset Loads:** These are generally facial or lingual occlusal connections, and not along the long axis of the implant body. Occlusal connections are rarely placed over an occlusal access hole for a managing screw, because acrylic swiftly wears out and results with no contact. Thus neutralize loads are generally used when occlusal screws are used in the prostheses.

    For aesthetic factors, in a screw retained prostheses, the implant body is placed more lingual than for a cemented prostheses. The neutralize occlusal weight is applied slightly facial to the implant body and parallel to its long axis. A cement retained restoration may place the implant directly under the primary occlusal contact. The crown may load the implant body in an axial direction, due to which lower neutralize loads are present on cement retained prostheses than in screw retained restorations. When neutralize connections have an angled force, the distance of the neutralize connections acts as a moment arm and magnifies the effect of the side force.

    When two or further implants are placed to support a screw retained prostheses, the intermediate frame ridges and pontics may have further medium primary occlusal connections, constantly in the central fossa region rather of the usual mandible buccal cusp contact. This eliminates the neutralize weight between the implants, and the occlusal loads between the implant bodies are in a farther axial direction.

In Detail, the Principles Followed Are

- Axial loads to the implant body produce lower compressive and tensile stresses.
- Vertical loads produce an increase in both compressive and tensile stresses.
- Premative connections affect in lower stresses, constantly on side inclines of cusps.
- Screw retained prostheses constantly have implant bodies more lingual compared with cement retained prostheses, and results with lower neutralize loads.

IV. IDEAL OCCLUSION

Ideal occlusion can be defined as an occlusion compatible with the stomatognathic system, furnishing effective mastication and good aesthetics without creating physio- sense abnormalities as stated by Hobo in 1978. Guichet34 in 1970 described morals for ideal occlusion as the following

- **Criteria 1:** Incorporate in the occlusion those factors which have to do with the reduction of vertical stress.
- **Criteria 2:** give for maximum intercuspation of the teeth with the condyles in centric relation.
- **Criteria 3:** give for perpendicular movement of the beak from the centric related intercuspal position, until those teeth most suitable of bearing the perpendicular weight come into function.

There is no bone ideal occlusal pattern for all individualities but an applicable pattern can be set up predicated on the below criteria. Accepted ideal occlusal schemes include balanced occlusion, mutually defended occlusion, and group function occlusion.

1. **Balanced Occlusion:** Balanced occlusion has all teeth contact in maximum intercuspation and during eccentric mandibular movements. It has been appertained to as a fully balanced or bilateral balanced occlusion and said to be ideal for restoration with complete dentures. This occlusion is used constantly in osseointegration prosthetic treatment.

Lucia in 1961 Described the Failures of a Balanced Occlusion as Follows

- The cusp- to- fossa connections exists only in part of the molar connections. The bicuspid cusps function in the opposing alcoves, making wedging and tooth drifting possible.
- There are large areas of tooth contact and broad occlusal shells.
- In such a “tight” occlusion, slight changes produce a readily visible distinction.
- Crimes in full – mouth balance are crimes of commission, not elision.
- When a restoration is completely balanced, gash is constantly delicate.
- In order to produce a full balance, it may be necessary to increases the perpendicular dimension to a dangerous degree.

Occlusal face wear and tear due to redundant contact area was allowed to be the crucial cause of failure. Granger in 1962 described that occlusal face wear and tear doesn't do when the occlusal shells are acclimated barring cuspal interferences during eccentric movements. Still wear and tear was ineluctable when the teeth remained in contact during movements.

2. **Mutually Defended Occlusion:** In 1961 Stallard and Stuart supported a balanced occlusion as the optimum occlusion for oral recuperation. After numerous cases' treatments failed, they misdoubted balanced occlusion should be the ideal occlusion. They observed that the molars didn't communicate during eccentric movements but in maximum intercuspation, they communicated while the anterior teeth had no connections. The molars were said to be responsible for bearing the perpendicular occlusal loads. Stallard set up anterior teeth cover posterior teeth and posterior teeth cover anterior teeth. The conception of a mutually defended occlusion was grounded on this observation.

A mutually defended occlusion occurs where the posterior teeth cover the anterior teeth in centric position. The centric stops on the posterior teeth also help help redundant lading transferred to the temporomandibular common structures. The incisors cover the canine and posterior teeth during intrusive movement and the doggies cover the incisors and posterior teeth during side movements. This is felt to be the ideal occlusion for natural dentition and perpendicular dimension is maintained by posterior teeth. Lucia described advantages of a mutually defended occlusion as the following " minimal quantum of tooth contact is involved and this makes penetration of the food more. A cusp- to- fossa relationship produces an interlocking of the upper and lower factors, thereby giving maximum support in centric relation in all directions. The force is easily near to the long axis of each tooth. The arrangement of the borderline, transverse, and oblique crests so that they've a shearing action, which makes for a much more effective chewing outfit. "

In 1974, Dawson stated when doggies cannot be used, side movements have posted disclusion guided by anterior teeth on the working side, rather of the doggies alone; he called this the anterior group function.

Another disadvantage of a mutually defended occlusion is arbitrary quantities of posterior disclusion. Thomas in 1967 stated that when each cusp is waxed using cusp-fossa waxing, a cusp- to- cusp relation during side movement has 1 mm posterior disclusion. In 1961 Stuart and Stallard stated by avoiding cuspal interferences during eccentric movements, this created a minimal quantum of disclusion to ameliorate masticatory function.

The term mutually defended occlusion was changed to organic occlusion by Stallard and Stuart in 1961, also described by Thomas in 1967. In organic occlusion, centric relation position and maximum intercuspation are coincident. The posterior teeth are in a cusp- fossa relation, one- tooth to one- tooth contact. Each functional cusp connections the occlusal fossa at three points while the anterior teeth disclude by 25 microns. In intrusive movement, the maxillary four incisors guide the beak and disclude the posterior teeth. In side movements, the lingual face of the maxillary canine attendants along the distal grade of the mandibular canine and also mesial crest of the first premolar facial cusp

3. **Group Function Occlusion:** In 1929, Schuyler introduced the fundamentals of group function occlusion. This type of occlusion occurs when all facial ridges of working side teeth contact the opposing dentition while the nonworking side teeth do not contact. In 1954 Beyron listed characteristics of this type of occlusion :

- Teeth should receive stress along the tooth long axis.
- Total stress should be distributed among the tooth segment in lateral movement.
- No interferences occur from closure into intercuspal position.
- Keep proper interocclusal concurrence.
- Teeth contact in side movement without interferences. He felt that no bone occlusion could serve as a general base for every individualities

Characteristics of group function occlusion include 1) the proposition of long centric, 2) the conception of all working side teeth participating side pressures during side movements, and 3) the conception of nonworking side teeth free from connections during side movements. Long centric is a0.5-0.75 mm free space between maximum intercuspation and centric relation position without changing perpendicular dimension of occlusion.

In group function occlusion; there are no tooth connections on the non-working side. Schuyler observed masticatory movement and set up that when the beak is closed, the mandibular buccal cusps communicate the facial crests of maxillary lingual cusps and the cusps aren't held in a stable position. Group function occlusion doesn't have the dangerous goods as seen with a balanced occlusion and isn't as delicate to fabricate as a mutually defended occlusion. Group function occlusion was felt to be a thing for occlusal adaptations and has easy operation in short- span prostheses

In 1974, Dawson Described Five Generalities Important for an Ideal Occlusion:

- Stable stops on all teeth when the condyles are in their most superior posterior position (centric relation).
- An anterior guidance that's in harmony with the border movements of the envelope of function.
- Disclusion of all posterior teeth in intrusive movements.
- Disclusion of all posterior teeth on the balancing side.
- Noninterference of all posterior teeth on the working side with either the side anterior guidance or the border movements of the condyles.

4. **Occlusion for Osseointegrated Prostheses:** Since there's no bumper effect between institutions and bone, occlusal forces are transmitted directly to bone through the osseointegrated prosthesis. These forces aren't limited to masticatory forces but also include impact forces.

Cusp height can help ameliorate masticatory effectiveness, but exaggerated inclinations may beget cuspal interferences as stated by Belser and Hannam in 1985. Since masticatory movement is generally a perpendicular movement, the cusp shapes and inclinations impact the movement. With steep cuspal inclinations, there's an increase in the Vertical element of mastication. With low cuspal inclinations, there's an increase in the side rudiments of masticators movements.

Balanced occlusion can serve well in complete dentures since the dentures are supported by portable towel that has a bumper effect for occlusal forces. Denture wear and tear with 0 to 30 degree cusp inclines show lower disclusion compared to natural dentition. In osseointegrated prostheses, institutions bear perpendicular forces better than vertical forces so it's preferable to direct forces vertically. A single institution can bear occlusal forces original to a single confirmed natural tooth. Generally there are no institutions available in the posterior region to support vertical loads. For this reason, disclusion is preferred in prosthetic restoration of posterior osseointegrated implants. Since further vertical loads are generated in the anterior region, longer institutions are used and restored with attachments to natural teeth.

5. **General Occlusal Scheme:** The conception of occlusion suitable for osseointegrated prostheses is principally the same as the gnathologic occlusion. In centric, all of the posterior teeth should have connections, and anterior teeth should have a concurrence of about 30m.However, it'll be easier to establish such an occlusion, if the entire bends are restored with osseointegrated prostheses similar as a completely bone- anchored ground. In the mixed dentition, which is composed of natural teeth and osseointegrated bridgework, it becomes more complicated to gain a good occlusion. The natural tooth sinks roughly 30 m during is function. An osseointegrated ground, which is supported only by the bone, doesn't sink. Thus, it's necessary to acclimate the centric connections of the osseointegrated fixed ground slightly more open than the natural teeth. Consequently, in centric, the osseointegrated ground shouldn't communicate with opposing teeth under the soft bite pressure. Under strong bite pressure, the ground should communicate after the natural tooth intrudes roughly 30 m. The osseointegrated ground begins to communicate after the contact of all the natural posterior teeth. However, all the occlusal cargo will be borne only by the ground and will load the bone structure, If the osseointegrated ground is acclimated to communicate at soft bite pressure under the hard bite pressure. In order to avoid the overloading of the occlusal face he osseointegrated prosthesis shouldn't have aeroplane - to- fossa tripodal contact, is preferred. During eccentric movement, in order to minimize vertical lading the conception of disclusion is generally recommended. Canine- guided occlusion isn't recommended for the osseointegrated prosthesis because it generates inordinate occlusal forces into the single implant institution, which is placed in the canine area. In order to distribute the stress over the entire institution, anterior group function is recommended.

Therefore, anterior group function and posterior non-segregation are recommended for osseointegration prostheses. The degree of intervertebral disc observed when the condyle is 3 mm off-center at the mesiobuccal apex of the mandibular first molar is as follows.

- The average interposition of the protrusions is 1.1 = 0.6 mm.
- The disc inclusion amount on the non-machined side is 1.0 = 0.6mm.
- The amount of wear on the working side is 0.5=0.3mm. These numbers can be used to determine the amount of disc required for osseointegrated prosthesis.

Classification of osseointegration prostheses

Osseointegration prostheses can be classified as:

- The bridge is fully anchored to the bone
- Overdenture
- Independent bridge
  a. Kennedy Class I
  b. Kennedy Class II
  c. C Kennedy Class III
  d. Kennedy Class IV
- Bridges connected to natural teeth
- Single tooth replacement

6. **Occlusion for Fully Bone Anchored Bridge:** In the case of edentulous jaws, bridges that are fully anchored to the bone are used. It is highly effective against the mandibular arch as there are no anatomical restrictions on placement of the device between the left and right mental foramen. Four to seven devices are typically placed in this area to which the prosthesis is attached. The bridge can be extended backwards up to 15-20mm.

   Due to the anatomical limitations of the nasal and sinus floors, it is not easy to fabricate a fully bone-fixed bridge to the maxilla. In addition, the bone structure of the maxilla is also deteriorated. If maxilla is present, typically 6-7 appliances can be placed mesial to the first premolar and the full bony bridge screwed into the appliance. It can be extended backwards up to 10mm.

   Mutual protective occlusion is recommended for occlusion of fully bone-fixed bridges. In the central area, a distance of 30 mm is required between the anterior tooth area and the central stop of the lateral teeth. Disc closure should be used to remove harmful horizontal tension. To avoid load localization, it is necessary to exploit the function of the front group. The anterior guidance should be made slightly flatter than the natural teeth to avoid overstressing the appliance. This reduces the degree of disc clotting.

7. **Occlusion for Overdentures:** Overdentures are often used in edentulous upper jaws. Even if the patient has poor bone structure in the upper canine region, there is often bone available for instrumentation. It is usually possible to place an appliance in this area, and the two appliances can be joined together to create an overdenture. Due to its overdenture feature, this prosthesis is suitable for the maxillary arch as it provides excellent voice function, facial support and aesthetics. A mandibular overdenture is typically used for patients who cannot afford many braces. The recommended occlusion for overdentures is a perfect balance occlusion with tongue occlusion. For edentulous maxillary overdentures and mandibular bridges fully anchored to the bone, it is recommended that the posterior teeth are in contact while the central spacing of the anterior teeth is small.

8. **Occlusion for Freestanding Bridges**

   - **Kennedy Class I – Bilateral Case:** For the Kennedy class I situation, both sides of the arch are restored by osseointegrated bridges, and they maintain the vertical height. As mentioned earlier, the osseointegrated prosthesis does not sink during function. The clearance of anterior teeth should be smaller than the one given to natural teeth. The amount of disclusion required for this case is the same as in the natural dentition because anterior guidance is provided by the natural dentition.

   - **Kennedy Class II – Unilateral Case:** The Kennedy class II situation is ideal for the osseointegrated freestanding bridge because the contralateral side of the arch will maintain the vertical height, while the other side is restored by the Osseointegrated Bridge. In centric, the posterior osseointegrated bridge should have 30 μm open contacts, while anterior teeth also have 30 μm openings, and it begins to contact under strong bite pressure. In the Kennedy class II situation, because the anterior teeth are natural teeth, they can bear the occlusal load safely. The amount of disclusion suggested for this case is the same as for a natural dentition.

- **Kennedy Class III:** The Kennedy class III situation is also ideal for osseointegrated implants because vertical height is maintained by natural teeth. In centric, the osseointegrated bridge only contacts under strong bite pressure. Eccentric movement is guided by the natural dentition. The amount of disclusion suggested for this case is the same as for a natural dentition.

- **Kennedy Class IV:** Kennedy Class IV cases require an anterior free-standing bridge and are another indication for an osseointegrated bridge. An 8-unit fixed front bridge allows him to be supported by 4 fixtures without creating a pivot point.

  In Kennedy Class IV cases, the posterior disc is controlled by an osseointegrated bridge. Group function occlusion is preferred to minimize horizontal stress on the implantation site. Lateral movement allows the rear teeth on the working side to support horizontal loads while protecting the non-working side. During forward movement, the Osseointegrated Bridge guides the mandible to form the posterior disc. The anterior guidance should be flatter than the natural dentition to minimize stress on the appliance during protrusion movements. The recommended amount of disc closure in this case is 0.8 mm overhang. Non-working side 0.4 mm. Actuation side 0.0mm.

  Fixed anterior bridges do not sink like natural teeth, so the distance between the anterior teeth should be greater than that of the natural anterior teeth (> 30 μm).

9. **Connection for Natural Teeth:** When restoring a bridge using a single appliance, the mesial end of the bridge should be attached to the natural tooth to prevent loosening of the screws due to rotation of the bridge. As mentioned above, natural teeth cave in during their function, but osseointegrated implants do not. Implants are most stressed and overloaded under occlusal loading when osseointegrated implant prostheses and natural teeth are tightly connected. To avoid this, non-rigid connectors are often used. A matrix (keyway) is placed at the distal end of the retainer and is supported by the natural teeth. A key connected to the Osseointegration Bridge fits into the keyway. Natural teeth can therefore be lowered freely without affecting the Osseointegrative Bridge.

10. **Occlusion for Single Tooth Replacement:** In most cases, replacement of one tooth is required in the upper anterior region. This is contraindicated in the posterior region as the screws often loosen when the restoration is heavily loaded. There should be a distance of 30 μm in the central region of the anterior teeth. For premolars, contact should only be made under heavy load.

    During eccentric movement, the anterior restoration must contact the opposing tooth to form the anterior group feature. This eccentric contact is important to prevent protrusion of the opposing tooth. For premolars, the restoration should slide during eccentric movements and avoid lateral loading.

Hobo introduced his two methods of achieving correct termination of the prosthesis. There are computer-assisted and manual methods. In the first step, a specially programmed computer (Anteroputer, J Morita, Inc.) is used to calculate the adjustment values for the incisal table from the condylar trajectory output data obtained from the computer pantograph. The second method, also called the twin-table technique, uses two incisal tables to create molar talks. This is a relatively straightforward technique and does not require special equipment. The following steps briefly describe this technique.

- Measure the condylar path using pantographs or interocclusal recordings. Adjust condyle settings. The path of the working condyle on the articulator should be adjusted so that the working condyle moves straight along the hinge axis. This ensures harmony between anterior guidance and condylar guidance.

- Build an upper study model with a detachable front. Attach the study model to the articulator. Resection of the anterior part of the upper jaw. The articulator is then eccentrically moved to eliminate interference that prevents smooth sliding motion (perfectly balanced occlusion). If the tooth structure is poor, add wax to improve contact. As a result, the cusp form factor matches the condylar path.

- A flat incisal table is used and the incisal pin is eccentrically moved to mold the chemically cured resin. These are referred to without exception as incisal tables.

- Use the study model as an intraoral guide to remove interference and complete the preparation. After taking an impression and creating a working model, a maxillary model with a detachable front part is made. Attach the working cast to the articulator, remove the anterior segment from the maxillary working cast, and wax the posterior occlusal segment with an eccentric motion using the 'incisor table without discussion'. This forms a cusp form factor that causes the inclination of the molar cusp parallel to the condylar tract.

- Once posterior wax removal is complete, place a 3 mm spacer behind the articulator condyle to simulate a lateral position. Place a spacer of specified disc thickness (1 mm in natural dentition) on the non-acting side of the mesiobuccal apex of the mandibular first molar and another spacer (0.5 mm in natural dentition) on the operative side. Masu. This simulates lateral motion with disc crusion. Close the articulator. Make a resin cone between the stump pole and the stump table. This establishes the angle of rotation of the hinge to achieve the specified degree of blockage during lateral movement. Repeat this process on the other side.

- Next, place 3 mm spacers behind the left and right condyles of the articulator to simulate a protruding position. Use spacers of the correct thickness (1.1 mm for natural dentition) on the mesiobuccal apex of the left and right mandibular first molars to simulate anterior movement with the intervertebral disc. Make a resin cone between the stump pole and the stump table. This creates a hinge rotation angle for a given amount of rejection during the thrust motion. We have previously described the amount of intervertebral disc recommended for different types of osseointegration prostheses.

- Join the three cones with additional resin to form the walls. Add more resin and eccentrically move the articulator to complete the three-dimensional incisal table. This completes the "incisal table with disc closure".

- Reposition the anterior segment onto the maxillary model using the discotomy table. Complete the anterior wax-up by moving the articulator in an eccentric motion. This sets the angle of rotation of the hinge, and the posterior restoration creates the desired degree of disc formation.

The final prosthesis manufactured using two methods yields a restoration with a predictable amount of posterior disc and anterior guidance that matches the condylar trajectory.

11. **Occlusal Restorative Materials:** The materials used to restore the occlusal surface of the osseointegration prosthesis are resin, porcelain and gold. Osseointegration implants have no periodontal tissue. Therefore, resin is recommended for occlusal restorative materials to absorb impact forces. Resin has high elasticity and is the best material for absorbing occlusal stress. Resin teeth can be used to construct fully bone-fixed bridges and overdentures. Plastic teeth are strong enough to give good results. However, if the occlusal surface of the bone-fixed bridge is covered with composites, it breaks easily and he collapses within a year. The strength of composite resin veneers is insufficient to withstand the stressors caused by the use of osseointegration implants.

12. **Occlusal Design and Material**

- Cusp design and crown orientation should be such that stresses are directed along the long axis of the implant. Lateral stress should be avoided or at least minimized.

- The width of the occlusal surface of the implant crown should be minimal. If possible, the occlusal table should not be wider than the root width of the implant.

- The cusp height should be minimized to reduce lateral loading on the implant. The occlusion table should be relatively flat and provide only centric functionality. Alignment of the crown and implant root is a key prosthetic requirement so that the occlusal load is directed along the longitudinal axis of the implant. Studies of stress in various implants and their supporting tissues point to the negative effects of lateral loading on implant mounting. The loads transferred to the supporting bone in these studies were excessive compared to those generated by vertical loading. Lateral loading can lead to high stresses in the crestal bone structure that exceed the tolerance of the bone and cause bone resorption in the peri-implant neck region.

There are several references in the literature to the use of resins as the occlusal material of choice in implant prostheses. The authors suggested the use of plastic because it absorbs shock, thereby reducing stress on the implant mount and the bone structure supporting it. Skalak explained: “In the superstructure, a rigid prosthesis is preferable to a flexible prosthesis, which can be supported by osseointegrated implants and distribute the load on the abutment more effectively. The use of shock-absorbing materials such as acrylic resins in the can provide sufficient impact protection for a strong and tight connection between the osseointegration implant and the supporting bone.

V. ANTERIOR GUIDANCE

The trajectory of the incisal tip during eccentric movement of the mandible is called anterior guidance. The length is 2.0-5.0mm. The trajectory of the incisal point during protrusion movement is called the incisal protrusion path and reflects the lingual concavity of the upper incisors. The lingual surfaces of the maxillary incisors exhibit both concave and convex surfaces, the latter clinically referred to as the cingulum. The incisal edge of the mandible should contact the lingual surface of the maxilla when transitioning from concave to convex in a centrocentric position. The recess represents a uniform shape. The trajectory of lateral movement from side to side is called the lateral incisor trajectory, also known as the canine lead.

1. **Condylar Path and Anterior Guidance Relation:** Anterior guidance is determined by the vertical and horizontal overlap of the anterior teeth to guide mandibular movement. The mandible resembles an inverted tripod, with two hind legs representing the left and right condyles and a third leg representing the anterior teeth (shown by Guichet 1970). These three elements control her three-dimensional position of the lower jaw. As Boderson pointed out in 1978, anterior guidance is primarily determined by the lingual surfaces of the maxillary anterior teeth, which control the posterior intervertebral disc during eccentric movements. Various methods have been described to establish forward guidance, but they are all qualitative in nature and few quantitative studies have been published by Weinberg, Schuyler and Lee. As a result, Dawson's 1974 front lead was determined by a clinical trial-and-error procedure.

2. **Determination of Amounts of Disclusion- Amount of disclusion for osseointegrated implant:** Individual anterior guide tables are used only for anterior tooth restorations. If the anterior teeth are not restored, the teeth themselves act as a guide for the front edge of the articulator when the posterior teeth are restored.

   If both anterior and posterior teeth are fully fabricated on a fully adjustable articulator, all condylar guides should be adjusted prior to fabricating the custom guide table. With such a correctly programmed articulator, the movement of the mandible can be reliably reproduced on the model. Rather than recording the condyle motion and interpolating the tooth motion from the condyle trajectory, the feature generation path technique can be used to plot the condyle trajectory three-dimensionally at the site of the tooth itself. When creating the back teeth using a later adjustable articulator, individual anterior guide tables can be created in any desired condylar path. An adjustment of 20° horizontally and 15° laterally ensures rear blockage even with flat front guides. Arbitrary adjustment results in posterior non-separation, as healthy joints are found to be stationary most of the time unless there is severe remodeling of the condyles or flattening of the condylar tract.

   Before fabricating the custom anterior guide table, the impression must be mounted in an articulator with a face bow and the condyle tracks must be established.

3. **Customized Anterior Guide Table:** Individual anterior guide tables are used only for anterior tooth restorations. If the anterior teeth are not restored, the teeth themselves act as a guide for the front edge of the articulator when the posterior teeth are restored.

If both anterior and posterior teeth are fully fabricated on a fully adjustable articulator, all condylar guides should be adjusted prior to fabricating the custom guide table. With such a correctly programmed articulator, the movement of the mandible can be reliably reproduced on the model. Rather than recording the condyle motion and interpolating the tooth motion from the condyle trajectory, the feature generation path technique can be used to plot the condyle trajectory three-dimensionally at the site of the tooth itself. When creating the back teeth using a later adjustable articulator, individual anterior guide tables can be created in any desired condylar path. An adjustment of 20° horizontally and 15° laterally ensures rear blockage even with flat front guides. Arbitrary adjustment results in posterior non-separation, as healthy joints are found to be stationary most of the time unless there is severe remodeling of the condyles or flattening of the condylar tract.

VI. REMOUNT PROCEDURES

Remount procedure is a term that describes the final procedure -needed to refine the occlusion on prosthesis. Use a remount record to reposition the prosthesis on an articulator and complete occlusal adjustments to enhance the accuracy of occlusion. In complete denture treatment, remount procedures help reduce soreness and restore the proper occlusal contacts since the occlusal pattern influences mandibular movement.

1. **Remount Procedure for Fully Bone Anchored Prostheses:** Remount procedures for fully bone anchored prostheses are similar to freestanding fixed partial dentures. A remount impression is not necessary since the fully bone anchored prosthesis is a single unit. Connect abutment replicas to the fully bone anchored prosthesis and secure with gold screws. Use a base-former and submerge the retentive tips of the abutment replicas into a smooth mix of stone. Make a facebow record to mount the maxillary remount cast and a remount interocclusal record to mount the mandibular cast. Follow all procedures for gig aqua—in the laboratory and clinic.

2. **Intraoral Examination: Occlusal Examination**

After completing the reassembly procedure, connect the fully bone-fixed prosthesis intraorally to the abutment using gold screws. Check the patient for centration and eccentricity disturbances following the same procedure as for the articulator. Slowly manipulate the mandible as follows

Eccentric movements are adjusted in a similar way to articulators. Adjust the cusp interference in the lateral position as follows:

- Ask the patient to open their mouth slightly. Move the lower jaw laterally so that the tips of the canine teeth are directly opposite each other.
- Instruct the patient to make light contact and then fully close to maximum insertion.
- Identify side position clashes.

- **Adjust Cusp Interference in Protrusion Motion**
  - Instruct the patient to protrude the lower jaw and guide them into the end-to-end position.
  - Instruct the patient to make light end-to-end contact and then slide to maximum occlusion.
  - Identify disturbances caused by protrusion motions. The final step is to check the simultaneous contact from rest position to center relationship. A prerequisite for an ideal occlusion is to ensure a normal occlusion without interference, especially when the occlusion is applied to osseointegrated prosthesis.

VII. SUMMARY AND CONCLUSION

That there are inherent differences between natural and artificial occlusion should be clear. Force exerted on one tooth or on a series of teeth on the teeth on the denture have a direct effect on the entire prosthesis. Natural teeth are well-suited to withstand forces of; occlusion because of the unique configuration of the periodontal ligament. Non vertical forces applied to natural teeth may not be detrimental to the supporting apparatus.

The principles Of Occlusion for Osseointegrated Prostheses Include the Following:

- Vertical dimensions of occlusion must be established by accepted techniques
- Anterior guide.
- Centric relation, myocentric occlusion maxillary intercuspation, multiple simultaneous bilateral contact s for stability.
- Contacting movements canine or group function on working side.

The design of occlusal surface may vary with the design of the oral rehabilitation. If a mandibular tissue integrated prosthesis opposes a maxillary complete denture the occlusion is more likely to be balanced bilaterally. Where two tissue integrated prostheses oppose one another canine protected or group function would be accepted. The loading of and osseointergrated implant is determined by the type of dentition and occlusal scheme of the opposing arch. A tissue borne removable prosthesis delivers much less strain to opposing fixed partial dentures than does a full complement of natural teeth Thus a tissue integrated prosthesis opposing natural teeth or a fixed restoration must be protected by using material s and a design that damp the occlusal load. The fabrication of conventional tooth-to- bone fixed and removable bridges follow principles of occlusion traditionally related to periodontal ligament support: how ever because osseointegrated implants rely on direct contact with bone with no intervening connective tissue the traditional concepts may not apply. It of therefore important to keep an open mind as more is learned about the principles of osseointegration.

Implants are alloplastic devices that transmit occlusal stress. Candidates for implantation require a routine occlusal evaluation The opposing arch is checked for the curve of Spee and Wilson and for the presence of supraerupted or tipped teeth. The patient is checked for sufficient intermaxillary space; adequate vertical height is needed for proper retention of an implant supported prostheses. To improve the prognosis lateral forces on the implant must be minimized, for example by establishing anterior guides or group function occlusion with posterior implants. If implants are to oppose a complete denture bilaterally balanced occlusion is usually desirable. The dentist should select rigid materials to restore full arch maxillary implants. O rings used most commonly in over denture application can absorb some of the occlusal shock.

Optimal occlusion should insure a stable myocentric functional pattern of the masticatory system that avoids undue strain or injury to any structures. It should be self-perpetuating inevitable change in occlusion with function and age should be favorable to occlusal development.

Davis said that the issue of maintenance and follow up care are critical, “Only with frequent post reconstruction occlusal referrals can the operator be sure of eliminating all stressful occlusal disharmonies”.

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