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Review Article

Occlusion in Fixed partial dentures -A review

[1]Renu Gupta, [2]Sonali Sharma, [3]Divya Vashisht, [4]Alageswaran Vignesh, [5]Manisha Kumari

[1]Professor & Head, [2,4,5]Post Graduate Student, [3]Professor, Dept of Prosthodontics, HP Govt Dental College & Hospital, Shimla, Himachal Pradesh, India

ABSTRACT:
Dental occlusion is the result of the coordinated effort or the effects of several components: the teeth, the supporting elements of the periodontium, the temporomandibular joints, the associated neuromuscular mechanisms, and the controlling centres in the brain.When principles of occlusal harmony are understood, the entire approach to examination, treatment, and problem solving takes on a new perspective. It is a perspective that pays huge dividends of predictability and increased productivity, regardless of the type of practice.
Key words: Occlusion, Dentistry

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Corresponding author: Sonali Sharma, Post Graduate Student, Dept of Prosthodontics, HP Govt Dental College & Hospital, Shimla, Himachal Pradesh, India

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INTRODUCTION

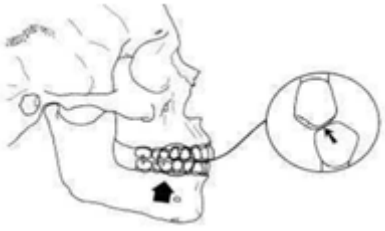
Occlusion is the static relationship of the teeth and is basic to all aspects of dentistry – jp. Dental occlusion is the result of the coordinated effort or the effects of several components: the teeth, the supporting elements of the periodontium, the temporomandibular joints, the associated neuromuscular mechanisms, and the controlling centres in the brain[1]

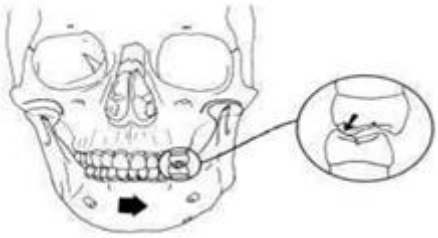
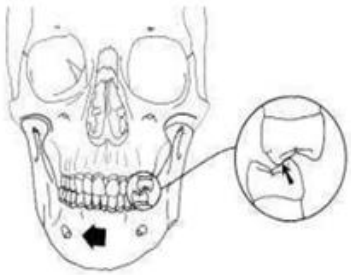
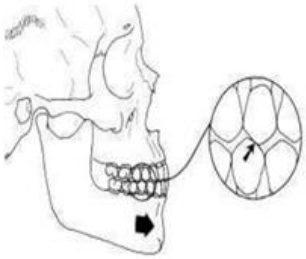
The occlusal forces applied to a fixed partial denture (FPD) are transmitted to the supporting structures through the pontic, connectors, and retainers. Variables that may influence the longevity of an FPD and its abutment include occlusion, span length, bone loss, and quality of periodontium. The excessive flexing of the long-span FPD, which varies with the cube of the length of span, can lead to material failure of prosthesis or to an unfavourable response. Biomechanical factors such as overload, leverage, torque, and flexing induce abnormal stress concentration in an FPD.[2]

When principles of occlusal harmony are understood, the entire approach to examination, treatment, and problem solving takes on a new perspective. It is a perspective that pays huge dividends of predictability and increased productivity, regardless of the type of practice[3]

OCCLUSAL INTERFERENCES

Interferences are undesirable occlusal contacts that may produce mandibular deviation during closure to maximum intercuspation or may hinder smooth passage to and from the intercuspal position. There are four types of occlusal interferences.[4]

Centric interference	A premature contact that occurs when the mandible closes with the condyles in their optimum position in the glenoid fossae. It will cause deflection of the mandible in a posterior, anterior, and/or lateral direction.[5]	 **Figure 35: Centric interference**

Working interference	When there is contact between the maxillary and mandibular posterior teeth on the same side of the arches as the direction in which the mandible has moved. If that contact is heavy enough to disoccluding anterior teeth, it is an interference[5]	 **Figure 36: Working interference**
Nonworking interference	Occlusal contact between maxillary and mandibular teeth on the side of the arches opposite the direction in which the mandible has moved in a lateral excursion The nonworking interference is of a particularly destructive nature.[4]	 **Figure 37: Non working interference**
Protrusive interference	Premature contact occurring between the mesial aspects of mandibular posterior teeth and the distal aspects of maxillary posterior teeth. The proximity of the teeth to the muscles and the oblique vector of the forces makes contacts between opposing posterior teeth during protrusion potentially destructive, as well as interfere with the patient's ability to incise properly [4]	 **Figure 38: Protrusive interference**

TYPES OF OCCLUSION

Bilateral Balanced Occlusion	This requires having a maximum number of teeth in contact in maximum intercuspation and all excursive positions. However, as the principles of bilateral balance were applied to the natural dentition and in fixed prosthodontics, it proved to be extremely difficult to accomplish, and high rates of failure resulted.	 **Figure 39: balanced occlusion**
Unilateral Balanced Occlusion	In a unilaterally balanced articulation, excursive contact occurs between all opposing posterior teeth on the laterotrusive (working) side only. On the mediotrusive (nonworking) side, no contact occurs until the mandible has reached centric relation	 **Figure 40: unilateral balanced occlusion**

Mutually Protected Occlusion	Advocated by Stuart and Stallard,based on earlier work by D'Amico. In this arrangement, centric relation coincides with the maximum intercuspation position. The six anterior maxillary teeth, together with the six anterior mandibular teeth, guide excursive movements of the mandible, and no posterior occlusal contacts occur during any lateral or protrusive excursions[6]	 **Figure 41: mutually protected occlusion**

LONG CENTRIC

As the concept of unilateral balance evolved, it was suggested that allowing some freedom of movement in an anteroposterior direction is advantageous. This concept is known as long centric. Schuyler was one of the first to advocate such an occlusal arrangement

Its length is arbitrary. At given vertical dimensions, long centric ranges from 0.5 to 1.5 mm in length. This theory presupposes that the condyles can translate horizontally in the fossae over a commensurate trajectory before beginning to move downward

It also necessitates a greater horizontal space between the maxillary and mandibular anterior teeth (deeper lingual concavity), allowing horizontal movement before posterior disocclusion (separation of opposing teeth during eccentric movements of the mandible)[6]

CONCEPT OF 138 POINTS OF OCCLUSAL CONTACT[7]

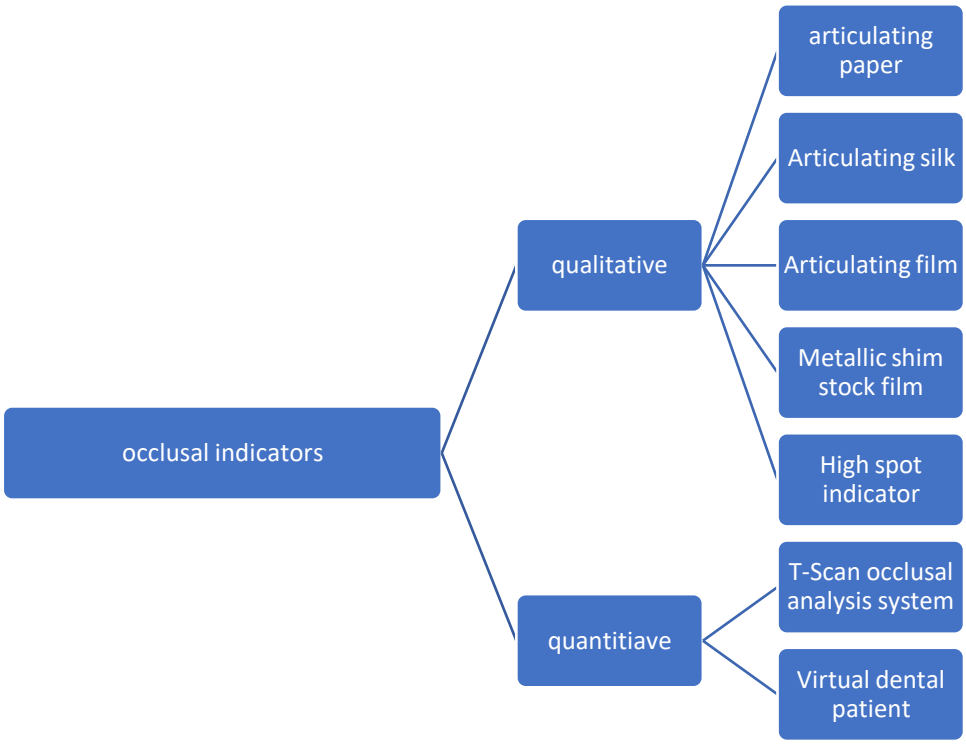
One scheme of occlusal contacts presented by Hellman included 138 points of possible occlusal contacts for 32 teeth. Later, with some modifications for application to complete occlusal restoration, most of the same contacts were made a part of the concept of occlusion in which supporting cusps and opposing stops (in centric relation) are tripoded and, with lateral/protrusive movements, immediate disocclusion of the posterior teeth takes place with canine (cuspid) guidance. The list of occlusal contacts (total 138) follows:

Figure 1: Idealised scheme for all contacts of supporting cusps with fossa and marginal ridge of opposongteeth.a- maxillary arch, b- mandibular arch

i) Lingual surfaces of maxillary incisors and canines,
ii) Labial surface of mandibular incisors and canines,
iii) Triangular ridges of maxillary buccal cusps of premolars and molars,
iv) Triangular ridges of lingual cusps of mandibular premolars and molars,
v) Buccal embrasure of mandibular premolars and molars,
vi) Lingual embrasures of maxillary premolars and molars (including the canine and first premolar embrasure accommodating the mandibular premolar),
vii) Lingual cusp points of maxillary premolars and molars
viii) Buccal cusp points of mandibular premolars and molars
ix) Distal fossae of premolars
x) Central fossae of the molars
xi) Mesial fossae of the mandibular molars
xii) Distal fossae of the maxillary molars,
xiii) Lingual grooves of the maxillary molars,
xiv) Buccal grooves of the mandibular molars [46]
xv) Occlusal assessments in fpd

Occlusal contacts occur when the maxillary and the mandibular dentition touch each other. Near contacts are those areas that range from a contact to a gap of 0.5 mm between the occluding surfaces, while noncontacts are those areas wherein there is a 0.5-2 mm separation of the teeth.[8]

An "**occlusal interference**" is any tooth contact that inhibits the remaining occluding surfaces from achieving stable and harmonious contacts. Any occlusal interference as small as 15 µ can trigger an untoward response and hence must be eliminated [9]



SELECTION OF INDICATOR [4]

Thickness	Plastic deformation	Tensile strength	Marking ability
The disadvantage of a thick occlusal registration strip, i.e., the one that the patient can perceive between the teeth is that it can indicate the tooth contact between the opposing teeth, even when no contact exists when the thickness of the registration strip is greater than the space between the teeth. Moreover, excessive thickness can induce a proprioceptive response that in turn can cause the jaw to be deflected.	Occlusal registration strips that have plastic deformation will stretch before they tear, thereby enabling the dentist to tug at the strip and to evaluate the occlusal contact	Thinner strips would tear before they served their purpose, but those having the property of plastic deformation will stretch prior to tearing.	On occlusal contact, the colouring agent should bond to the tooth. The occlusal registration strip should be thin, plastic and nonsmearing on the tooth surface. Articulating foils have the greatest marking sensitivity values, followed by the articulating paper. It has been found that the marking ability of all qualitative recording media is negatively affected by the presence of saliva, and hence, the teeth should be dried prior to the use of the registration strips

There are several types of occlusal form that can be used to restore posterior teeth. Whatever contour is selected should be chosen because it:

1. Directs the forces as near parallel as possible to the long axis of each tooth
2. Distributes the lateral stress to maximum advantage in varying situations of periodontal support
3. Provides maximum stability
4. Provides maximum wearability
5. Provides optimum function for gripping grinding, and crushing

Practicality of fabrication is a factor that should be considered when the type of occlusal form is being selected. If additional time, effort, and expense are required to produce the same clinical result that could be accomplished with greater case of the patients, the

dentist, and the technician, technique orientation has in all probability taken the place of goal orientation.[10]

TYPES OF CENTRIC CONTACT

Surface to surface contact	Tripod contact	Cusp tip to fosaa contact
•not recommended because it is stressful and produces lateral interferences	•tip of cusp never touches the opposong tooth .congtact is made on sides of cusps which are convexly shaped	•cusp tip is properly loacted in the most advantageous fossa. it offers good function and stability

AIMS AND OBJECTIVES OF SELECTING CORRECT OCCLUSAL SCHEME AND GIVING CORRECT OCCLUSAL MORPHOLOGY WHILE RESTORING PATIENTS' TEETH ARE

- ✓ To direct the occlusal forces properly by minimizing lateral forces during excursive movements of the mandible.
- ✓ To make the occlusion stable
- ✓ To increase the masticatory efficiency.
- ✓ To reduce the frictional wear [11]

OCCLUSAL CONSIDERATION IN IMPLANT SUPPORTED PROSTHESIS

- ✓ Determining an occlusal scheme for the restoration of implants requires careful consideration.
- ✓ This stems from the fact that after osseointegration, mechanical stresses beyond the physical limits of hard tissues have been suggested as the primary cause of initial and long-term bone loss around implants. [12]
- ✓ It can be rightly said that occlusion is a determining factor for implant success in the long run. [13]

Tooth	Implant
1. Periodontal membrane a. Shock absorber b. Longer force duration (decreased impulse of force) c. Distribution of force around tooth d. Tooth mobility can be related to force e. Mobility dissipates lateral force f. Fremitus related to force g. Radiographic changes related to force reversible	1. Direct bone–implant a. Higher impact force b. short force duration (increased force impulse) c. Force primarily to crest d. Implant is always rigid (mobility is failure) e. Lateral force increases strain to bone f. No fremitus g. Radiographic changes at crest (bone loss); not reversible c. Diameter related to existing bone
2. Biomechanical design a. Cross-section related to direction and amount of stress b. Elastic modulus similar to bone c. Diameter related to force magnitude	2. Implant design a. round cross-section and designed for surgery b. Elastic modulus five to10 times that of cortical bone
3. Sensory nerve complex in and around tooth a. Occlusal trauma induces hyperemia and leads to cold sensitivity b. Proprioception (reduced maximum bite force) c. Less functional bite force (higher maximum bite force functional)	3. No sensory nerves a. Occlusal trauma induces hyperemia and leads to cold sensitivity b. Occlusal awareness of two to five times less c. Functional bite force four times higher
4. Occlusal material: enamel a. Enamel wear, stress lines, abfraction, and pits	4. Occlusal material: porcelain (metal crown) a. No early signs of force
5. Surrounding bone is cortical a. Resistant to change [53]	5. Surrounding bone is trabecular (may be fine) a. Conducive to change [14]

implant protective occlusion

- no premature occlusal contacts or interferences
- mutually protected articulation
- implant body angle to occlusal load
- cusp angle of crowns(cuspal inclination)
- cantilever or offset loads
- crown height (vertical offset)
- implant crown contour
- occlusal contact positions
- timing of occlusal contacts
- protect the weakest component [15]

PROSTHETIC OPTIONS IN FIXED FULL-ARCH RESTORATIONS

Porcelain-metal restoration - The main problem encountered with this restoration is related to the added bulk of metal used in the substructure to keep porcelain to its ideal 2 mm thickness. This amount of metal acts as a heat sink during casting procedures which results in porosities and increases the risks of fracture after loading.[15]

Hybrid prosthesis an alternative option in such situations is the hybrid prosthesis. Because acrylic acts as an intermediary between the porcelain teeth and metal substructure, the impact force during dynamic occlusal loading also may be reduced. Hence, hybrid prostheses are indicated for implant restoration in large crown height spaces as a general rule

Occlusal guidelines that need to be considered (in addition to the above guidelines) while restoring various clinical situations with implant supported prostheses are: - [16]

Edentulous classification	Type of prosthesis	Optimal Occlusal Scheme	Additional guidelines
Edentulous	Implant supported fixed prosthesis a) opposing natural dentition b) opposing a complete denture	Group function (widely accepted) Mutually protected with shallow anterior guidance(recommended) Bilateral Balanced	• Bilateral and anterior-posterior simultaneous contacts in centric relation and MIP. • For occlusal contacts, wide freedom (1-1.5mm) in centric relation and MIP • Anteriorly placed working contacts to avoid posterior overloading • Infraocclusion (100 mm) on a cantilever unit- to reduce fatigue and technical failure of the prosthesis. • Canine guided occlusion increased a potential risk of screw joint failure at the canine site due to stress concentration on the area[16]
Edentulous	Implant supported Over denture a) for normal ridges b) severely resorbed ridges	Bilateral Balanced with lingualized occlusion Monoplane occlusion	• At least three-point balance on lateral and protrusive excursion. • Increase vertical dimension and alter plane relation to allow for vertical space for attachment housings and metal framework space if necessary. • Decrease vertical dimension if interarch distance is excessive and poses a biomechanical risk. • Keep attachment height minimal to avoid unfavourable torquing moments on implants. • 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. • With anterior and posterior implant supported attachments, enhanced retention and resistance reduces the need for balance to prevent distal base displacement [16]
Class III or IV partially edentulous	Free standing FPD	Group function	• Anterior guidance in excursions and initial occlusal contact on natural dentition disoccluding the posterior implant supported segment when possible. • Reduced inclination of cusps, centrally oriented contacts with a 1- 1.5mmflat area, a narrowed occlusal table (by around 30%), and elimination of cantilevers • Additional implants in the maxilla could provide tripodism to reduce overloading and clinical complications [16]
Class I or II partially edentulous (in posterior region)	Free standing FPD	Mutually protected Group function (when anterior teeth are periodontally compromised	• 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 favourable than a distal cantilever.[16]

CONCLUSION

Restoration of occlusion in patients with severely worn dentition is a challenging situation as every case is unique in itself. There is great apprehension involved in reconstructing debilitated dentition due to widely divergent views concerning the choice of an appropriate occlusal scheme [17]

The principles of treatment are universal, all the functional factors are interrelated, and all efforts should be made to construct an occlusal interface such that the periodontium of teeth, muscles of mastication, and TMJ's function in harmony with each other. Optimal occlusion according to the needs of the patient should be attained in rehabilitation procedures. Chewing efficiency can exist over a wide range of occlusal forms and types of occlusal schemes, so no set rule can be applied to all the patients[17]

Implants have become the treatment of choice in many, if not most, situations when missing teeth require replacement. Studies of the interaction between implant-supported restorations and the surrounding oral environment appear, fortuitously, to support the conclusion that the human host response to oral implants is favourable. With appropriate diagnosis and conscientious treatment planning, the use of endosseous oral implants enjoys good prognosis. [18]

To properly evaluate a patient's occlusion and to build up an artificial dynamic occlusal scheme, it is mandatory that the diagnostic casts and the final casts are placed in an articulator in approximately the same relationship to the temporomandibular joint as it exists in the patient. The ideal material-technique combination for making interocclusal records would allow the placement of indirectly fabricated prostheses in the patient's mouth with no occlusal adjustment and hence play a major role in the success of the rehabilitative procedures in terms of function and esthetics. [19]Many dentitions will have several materials (natural and artificial) forming occlusal contacts and different toughness, abrasion resistance, and erosion resistance will result in differential wear of these materials. Long-term monitoring of the teeth and supporting structures should include adjustments to re-establish the described contact patterns, thus maximizing biological, physiological, and mechanical stability [20]

Occlusion is a dynamic entity of human dentition and its influence upon the prosthesis design should never be undermined.[21]

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