


**A Review***Dr. Dipankar Pal**Associate Professor, Department of Prosthodontics, NBDC&H, Sushrutanagar, W.Bengal, India**E-mail: [drpdipankar@gmail.com](mailto:drpdipankar@gmail.com)***Abstract:**

Restoration of occlusion in patients with mutilated dentition is a challenging situation as every case is unique in itself. There is a great apprehension involved in reconstructing worn-out dentition due to widely divergent opinions regarding the choice of an appropriate occlusal scheme. An understanding of the factors controlling the pattern or contours of occluding tooth surfaces is desirable in planning for the maintenance of oral health and function. This is equally important whether we are maintaining the natural dentition or are supplying prosthesis for the partially or fully edentulous patients. The objective of full mouth rehabilitation is not only the reconstruction and restoration of the worn out dentition, but also maintenance of the health of the entire stomatognathic system. Full mouth rehabilitation should re-establish a state of functional as well as biological efficiency where teeth and their periodontal structures, the muscles of mastication, and the temporo mandibular joint (TMJ) mechanisms all function together in synchronous harmony. The aim of this article is to review briefly the various occlusal concepts in reconstructing worn out dentition by different clinicians and researchers to help overcome various difficulties occurring during full mouth rehabilitation.

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**Introduction:**

The objective of full mouth rehabilitation is not only the reconstruction and restoration of the worn out dentition, but also maintenance of the health of the entire stomatognathic system. Full mouth rehabilitation should re-establish a state of functional as well as biological efficiency where teeth and their periodontal structures, the muscles of mastication, and the temporomandibular joint (TMJ) mechanisms all function together in synchronous harmony. Proper evaluation followed by definitive diagnosis is mandatory as the aetiology of severe occlusal tooth wear is multifactorial and variable. Careful assessment of the patient's diet, eating habits and/or gastric disorders, along with the present state of occlusion is essential for appropriate treatment planning. Various classifications have been proposed to classify patients requiring full mouth rehabilitation, however, the classification most widely adopted is the one given by Turner and Missirlian.

According to them, patients with occlusal wear can be broadly classified as follows:

- **Category-1: Excessive wear with loss of vertical dimension of occlusion (VDO)**  
The patient closest speaking space is more than 1 mm and the interocclusal space is more than 4 mm and has some loss of facial contour and drooping of the corners of the mouth. All teeth of one arch must be prepared in a single sitting once the final decision is made. This makes the increase in VDO less abrupt and allows better control of esthetics.
- **Category-2: Excessive wear without loss of VDO but with space available**  
Patients typically have a long history of gradual wear caused by bruxism, oral habits, or environmental factors but the occlusal vertical dimension (OVD) is maintained by continuous eruption. It might be difficult to achieve retention and resistance form because of shorter crown length and gingivoplasty may be needed. Enameloplasty of opposing posterior teeth may provide some space for the restorative material.
- **Category-3: Excessive wear without loss of VDO but with limited space**  
There is excessive wear of anterior teeth over a long period, and there is minimal wear of the posterior teeth. Centric relation and centric occlusion are coincidental with a closest speaking space of 1 mm and an interocclusal distance of 2–3 mm. In such cases vertical space must be obtained for restorative materials. This can be accomplished by orthodontic movement, restorative repositioning, surgical repositioning of segments, and programmed OVD modification.  
After evaluating and classifying the patient's existing clinical situation but before beginning the reconstruction procedure, the clinician must decide upon the occlusal approach and choose an appropriate occlusal scheme.

**Occlusal Approach:**

Occlusal approach for restorative therapy can be either conformative approach (often advisable) or a reorganised approach.

In conformative approach, occlusion is reconstructed according to the patient's existing intercuspal position. It is adopted when small amount of restorative treatment is undertaken.

It includes two situations:

1. Occlusion is untouched prior to tooth preparation although small changes can be made on restorations such as elimination of the non-working contacts.
2. Occlusion is modified by localized occlusal adjustments before tooth preparation that is shortening of an opposing cusp, elimination of non-working side interferences and removal of a deflective contact on tooth to be restored.

In reorganised approach, new occlusal scheme is established around a suitable condylar position which is the centric relation position. The patient's occlusion may be reorganised if the existing intercuspal position is unacceptable and needs to be changed or when extensive treatment is to be undertaken to optimize patient's occlusion.

Indications for reorganised approach are loss of vertical dimension, repeated fracture/failure of teeth or restorations, severe bruxism, lack of interocclusal space for restorations, trauma from occlusion, unacceptable function and esthetics, presence of temporomandibular disorders or developmental anomalies.

#### **Occlusal concepts in Full Mouth Rehabilitation:**

There are two important basic steps which must be recognised in any technique. These are; a) preliminary equilibration of occlusion and b) establishment of incisal guidance. The basic principles of occlusion must be understood and observed, and definite objectives must be visualized and achieved wherever possible. The objectives of the preliminary occlusal equilibration are: (1) to correlate centric occlusion with the unstrained centric relation, (2) to obtain the maximum distribution of occlusal stress in centric relation, (3) to retain the vertical dimension of occlusion, (4) to equalize the steepness of similar tooth inclines in order to distribute eccentric occlusal stresses evenly, (5) to establish smooth guiding tooth inclines, (6) to reduce the steepness of inclines of guiding tooth surfaces so that occlusal stresses may be more favourably applied to the supporting tissues, (7) to retain the sharpness of cutting cusps, (8) to increase the number and size of food exits, and (9) to decrease the size of the occlusal contact surfaces. One of the most destructive forms of malocclusion is the premature (deflective occlusal) contacts of balancing or non functioning tooth inclines. These contacts contribute not only to the premature loss of teeth involved, but also to temporomandibular joint injury. Balancing cusp incline contact are objectionable only on natural teeth.

#### **Gnathological concept:**

B.B. McCollum graduated from dental school in 1907 and his interest to create the better denture led him to expand the quest to include natural dentitions. With Dr. Harvey Stallard he coined the word "Gnathology" in 1926 defining it as the science that relates to the anatomy, histology, physiology, and pathology of the stomatognathic system and that includes treatment of this system on the basis of

examination, diagnosis, and treatment planning. Gnathological Society was formed in 1926 by McCollum and, he along with Harlan, led to the discovery of the first positive method of locating the transverse horizontal axis and transferring the recording to an articulator using components from a Snow Facebow to describe the study and treatment of entire mouth as a functioning unit. Their observations led to the development of the principles of mandibular movements, transverse horizontal axis, maxilla-mandibular relationships, and an arcon articulator that was designed to accept the transfer of these records. The goal was to record maxillomandibular relationships that accurately reproduced border jaw movements and which would prescribe the better occlusal interface. With McCollum's guidance a gnathological concept was developed that clearly stated the significance of occlusion for patients who are completely or partially edentulous as well as for the completely dentulous patient.

The Gnathological Society developed parameters that must be recognized, captured, and understood. These parameters are dictated by several factors present in every patient, some variable are alterable by the restorative dentist, some fixed and constant for each individual and unalterable in oral rehabilitation. Variable factors that can be influenced by the needs of restorative dentistry and esthetics include tooth shape and position(which incorporates compensating curves), vertical interarch dimension, anterior guidance, and the occlusal scheme. The constant factors that must be accounted for are: the intercondylar distance, the hinge axis position, the condylar path as it moves in the glenoid fossa, and the relationship of the maxilla to the mandible. These represent individual characteristics that must be considered as they occur in the patient when planning an oral rehabilitation and completing treatment.

The goal of gnathology is to establish an occlusion that is interference free and necessitates the concept of an organic occlusion which encompasses occlusion, uniform centric contact, forces directed in line with the long axes of the teeth, tripodism, twin centric contact for cross tooth stability, narrow occlusal table, maximum cusp height, and fossae depth with supplemental anatomy.

#### **Simplified occlusal design by Wilskott and Belser:**

According to this concept the force vectors that are active on teeth are not directed along the longitudinal axes of the roots only, and thus occlusal contact locations will not determine the direction of functional forces. The stability of the teeth on the arch depends primarily on the forces of eruption from the periodontium and the balance between the resting pressures of the muscles of the cheeks and the tongue. The variability of the guiding surfaces inherent to the temporomandibular joints should be incorporated into an occlusal design. Occlusal contacts that do not fulfill a justifiable purpose may be eliminated, and the number of contacts may be reduced to one per tooth. Based on this, they proposed a simplified occlusal scheme in which; one occlusal contact per tooth usually a cusp-fossa relation is sufficient instead of a tripod contact, all interproximal contacts should be proper and tight as they stabilize the tooth mesio-distally, anterior disclusion mechanics should be applied so that posteriors do not experience any interference on lateral excursive movements, antero-posterior freedom of

movement should be provided which is achieved by [12]having concave internal slopes on the cusps of posterior teeth.

**Freedom in centric by Schuyler:**

Schuyler first introduced the Concept Of 'Freedom in Centric' and supported the theory that centric relation was rather a biological area of the TMJ than a point. Centric occlusion has been commonly recognized as occurring at a static point of occlusal contact of opposing teeth in harmony with the accepted maxillo mandibular relation (a single precise position). Perhaps it might be more favorably recognized as occurring at a limited area of the occlusal surfaces upon which occluding tooth surfaces rest. Thus the teeth would have a degree of eccentric freedom of movement before their relationship would be influenced by the inclined tooth surfaces. The desirability of a slight freedom of lateral and anteroposterior movement in centric occlusion rather than a locked intercuspation in the most retruded maxillo mandibular relation has been recognized. This freedom of movement in centric occlusion promotes patient comfort and reduces the tendency to bruxism and other traumatogenic influences on the structures supporting the dentition.

Establishment of the freedom of movement in centric occlusion has been recognized as an essential factor in the functionally generated path technique. It is first established in the incisal guide component of the upper anterior teeth. The contact of the lower anterior teeth is made upon a horizontal surface on the incisal guidance (the lingual surfaces of the upper anterior teeth) permitting slight eccentric mobility before the influences of inclined planes of these surfaces become effective. This may be a slight departure from the incisal guide pattern normally found in natural dentitions. This area of horizontal freedom in the incisal guidance mechanism will assure the desired freedom in posterior occlusal contours, whether the functionally generated path technique or the articulating instrument itself is used in the final construction procedures.

**Pankey, Mann and Schuyler philosophy:**

Arvin Mann and L.D. Pankey soon realized that the fabrication of a static model of the dynamic movement of mandibular function resulted a matrix that could be used for designing any occlusion in fixed prosthodontics as well as removable. They developed the Pankey-Mann Technique of oral rehabilitation. Their philosophy was pertinently based on the spherical theory of occlusion, the "wax chew-in" technique described by Meyer and Brenner, and on the importance of cuspid teeth as discussed by D'Amico. The canine teeth serve to guide the mandible during the eccentric movements when the opposing teeth come into functional contact. Lateral and protrusive movements of mandible are determined when upper canine teeth, is in functional contact with the lower canines and first premolars. When their opponents come in contact during attempted eccentric movements of the mandible, they transmit in greater degree than any other teeth the desirable periodontal proprioceptor impulses to the muscles of mastication, reducing muscular tension and thereby reducing the magnitude of the applied force.

The planning and finalization of the oral rehabilitation with the Pankey- Mann-Schuyler technique involves a segmental approach. Lower anterior, upper anterior, lower posterior, and upper posterior teeth are evaluated, planned out with a wax-up, and restored in sequence. Optimal occlusal plane is selected as dictated by the curve of Monson and mandibular posterior teeth are restored in harmony with the anterior guidance such that they will not interfere with the condylar guidance. The definitive restorations are equilibrated into a centric relation position with mandibular buccal cusps onto flattened fossae–marginal ridge contact, with "long centric" incisal guidance and group function in working excursion. Acrylic provisionals are employed in the Pankey-Mann-Schuyler technique, are adjusted intraorally. The lower arch reconstruction is completed first before initiating work on the upper teeth. There is minimisation of discomfort as only one arch is restored at a time. There are lesser chances of developing errors in this technique.

### **Twin –Table technique of Hobo:**

This was given by Dr. Sumiya Hobo, which is followed in rehabilitation of dentate patients. In twin-tables technique, the working condylar path is set on the articulator to move directly outward along the transverse horizontal axis to produce a neutral line. A semi adjustable arcon-type articulator with a box-shaped fossa element mimics such a working condylar path. After setting condylar guidance mount the maxillary study cast with a removable anterior segment. Remove the maxillary anterior segment and move the articulator through eccentric movements to get rid of interferences that prevent an even, gliding motion. This procedure results in a cusp-shape factor that harmonizes with the condylar path. In Twin table concept, anterior guidance is predetermined, so as to create harmonious disocclusion with the condylar path. The technique utilizes 2 different customized incisal guide tables. The first incisal table is referred to as incisal table without disocclusion. It is achieved by fabricating die systems with removable anterior and posterior segments, which helps us achieve uniform contacts in the posterior restorations during eccentric movements. Placing 3 mm plastic separators behind the condylar elements so that the articulator can simulate border movements makes the other incisal table. This is termed the incisal guidance with disclusion. The first incisal guide table helps in fabrication of restoration for posterior teeth. The second guide table is required to achieve incisal guidance with disocclusion. The final prosthesis by use of the twin-tables technique results in a restoration with a predictable posterior disclusion and anterior guidance in harmony with the condylar path.

### **Twin Stage technique by Hobo and Takayama:**

Twin stage procedure was developed as the advanced version of the Twin Table technique. As per literature, condylar guidance and anterior guidance are considered as primary determinants of occlusal rehabilitations. This technique, which was used in rehabilitation of a severely worn dentition proposed by HOB0 and TAKAYAMA, describes the method of reorganizing an occlusion by using cuspal angle as the primary determinant. Condylar path has always been considered as a key determinant of occlusion. However, according to Hobo and Takayama, condylar path has shown to have a deviation

and results in minor influence on disocclusion. However, it was found that with every degree of rise in the horizontal condylar guidance, the amount of disocclusion was increased by only 0.020 mm during protrusion, by 0.015 mm on nonworking side and by -0.002 mm on the working side. Thus, the cusp angle and the anterior guidance are more important determinants for achieving a disocclusion and with use of these average angulations of the horizontal condylar guidance can be successfully used to achieve a mutually protected occlusion. Though independent of condylar path as well as incisal path, a standard value for cusp angle was determined such that it may compensate for wear of natural dentition due to caries, abrasion and restorative works. By using the standard cusp angle, it was possible to establish the standard amount of disocclusion.

#### **Nyman and Lindhe scheme for severely advanced Periodontitis:**

The occlusion was designed so that there was an even and simultaneous contact all over the dentition when the patient occluded in the intercuspal position (IP). This means that the forces exerted by the masticatory muscles retained the bridge in a balanced, stable position. On lateral excursions of the mandible, the occlusion was also designed as to obtain intermaxillary contact simultaneously over the various areas of the bridge. This in turn means that all precautionary measures were taken to prevent tendencies toward tilting of the bridge. The same balanced occlusal pattern was designed also for the movements between RP (retruded contact position) and IP, and between IP and protruded contact position.

#### **Youdelis scheme:**

Youdelis in 1971 proposed an occlusal scheme for advanced periodontitis cases. The aim was to achieve simultaneous interocclusal contact of posterior teeth in centric relation position (usually coincident with intercuspal position) with forces directed axially. Anterior disclusion is provided for protrusive excursions and canine disclusion for lateral excursions. Cuspal anatomy is so arranged that if the canine disclusion is lost through wear or tooth movement, the posterior teeth drop into group function. Both fully and semi adjustable articulators can be used.

#### **Discussion:**

Rehabilitation of occlusal form and function is the primary goal of full-mouth rehabilitation. Thorough examination, diagnosis, and choice of appropriate occlusal scheme are the key to successful prosthodontic rehabilitation. Initially bilateral balanced occlusal scheme, which is mainly used for complete denture, was used by McCollum, Schuyler, and others. Schuyler supported balanced occlusion during his early clinical years but later began to observe clinical failures. Similar failures were observed by Stuart due to unequal wear of the buccal and lingual cusps causing deflective occlusal contacts with a loss of centric-related closure, causing patients to bite their cheeks and tongue. The PMS system is a very flexible concept. According to Dawson, the most impressive advantage of PMS philosophy is the latitude it permits. The advantages of this concept include

incorporation of freedom from centric, no need for preparing or rebuilding all the teeth at a time, a well-organized procedure, all posterior occlusal contours are programmed in harmony with both condylar border movements and a perfected anterior guidance, and there is no need for any specific instrument unlike Hobo technique. The limitations of this technique include use of FGP technique which utilizes wax, so there is great potential to cause errors. This technique cannot be used in periodontally weak dentition as FGP cannot be accurately recorded. The incorporation of posterior disocclusion that avoids harmful lateral forces was suggested by Hobo technique. In the twin-stage procedure, as cusp angle was the main determinant of occlusion, the need to record condylar path was not necessary. Therefore, complicated instruments, such as the pantograph and fully adjustable articulators are not required. This procedure is much simpler than the standard gnathological procedure, yet it follows gnathological principles. However, if the sagittal condylar path of the patient is steeper than the articulator adjustment values ( $40^\circ$ ), disocclusion increases. If the path is less than  $40^\circ$ , then the amount of disocclusion decreases. If the patient has less than  $16^\circ$  (only about an 8% occurrence rate), cuspal interferences will occur. If the incisal path is more than  $5^\circ$  steeper than the condylar path, patients complain of discomfort. After reviewing the various occlusal concepts, it may be stated that it is best to achieve posterior disocclusion in full mouth rehabilitation to avoid harmful lateral forces as was suggested by Hobo. Although the concept of gnathology provides stable long term results due to mutually protected occlusion and tripod contacts, in some patients freedom in occlusion may be required and therefore the PMS concept cannot be outrightly dismissed.

**Conclusion:**

Occlusal rehabilitation is a radical procedure and should be carried out in accordance with the dentist's choice of treatment based on his knowledge of various philosophies followed and clinical skills. 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. This requires accurate diagnosis regarding the etiology of the deranged condition, intra-oral changes and other adverse effects on jaw relations. Further scientific research and systematic reviews are needed to validate occlusal treatment theories. Ultimately, the clinician must evaluate and assess the literature along with individual clinical experiences. Both function and health can be restored to badly deteriorated, diseased mouths by utilizing modern techniques of oral rehabilitation. In times past, some of these "dental cripples" were condemned to full-mouth extraction and complete dentures because the success of rehabilitation procedures was dubious. Recent advances in dental technology, materials, and equipment, however, have simplified the task of rebuilding, restoring, and rehabilitating diseased mouths. This has enabled dentists to preserve many teeth, which would have otherwise been sacrificed.



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