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occlusion in full mouth rehabilitation

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ABSTRACT

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 aim of this article is to review briefly different techniques used in full mouth rehabilitation.

Article text

"Occlusion" is defined as the relationship between the occlusal surfaces of the maxillary and mandibular teeth when they are in contact. In occlusal rehabilitation, we attempt to develop an acceptable functional occlusion as our end result. [1] Occlusal rehabilitation deals with the restoration of functional integrity of dental arches by the use of inlays, crowns, FPDs and partial dentures. The primary objective of full mouth rehabilitation is preservation of health, restoring function and achieving aesthetics and patient comfort. [2] Complete rehabilitation of the mouth is a complex, integral part of prosthetic dentistry, requiring knowledge of physiology, anatomy, histology and physics, as well as a thorough understanding of, and ability to perform, the operative and restorative phases involved. The importance of an intelligent understanding and appreciation of these fundamentals cannot be overemphasized if the profession aims for continued progress in this direction.

The important broad field of complete rehabilitation of the mouth was comparatively unknown a few decades ago. At that time a few pioneers, Monson and others, foresaw the importance of opening or "raising" bites that were obviously close, strove to correct this condition by utilizing such measures as splints, pins, onlays and overlays and thus opened a new field in dentistry known as " bite raising." Gradually, it became the purpose of these men to correct bite anomalies in adults through prosthetic measures. Bite correction or bite revision, therefore, has been attacked constantly in the literature for its unscientific approach and background. However, with the growth of the field of bite raising from early endeavors, sound theoretic concepts concerning the mechanism of the human masticatory process were evolved, and well formulated fundamental technics were developed, so that today mouth rehabilitation can be effected on a scientific basis. [3]

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. [4]

This article reviews various philosophies of occlusion in full mouth rehabilitation by different clinicians and researchers who never stopped asking how they could provide a better service to patients.

OCCLUSAL CONCEPTS IN FULL MOUTH REHABILITATION

There are two important and basic steps, which must be recognized in any technique. These are: (1) a preliminary equilibration of the occlusion, and (2) the establishment of the 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 favorably 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 nonfunctioning tooth inclines. These contacts contribute not only to the premature loss of the teeth involved, but also to temporomandibular joint injury. Contacts on balancing cusp inclines are objectionable only on natural teeth. [1]

There has been a search for the ideal occlusal scheme in full mouth rehabilitation and 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 a prosthesis for the partially or fully edentulous mouth [5] hence this article overviews the various occlusal concepts given by different pioneers in field of prosthetics to help overcome various difficulties occurring during the restoration of health and function of stomatognathic system as a whole.

- **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 [6] 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 the entire mouth as a functioning unit. Stuart became associated with the Gnathological Society early and published the classic "Research Report" with McCollum in 1955. Their observations led to the development of the principles of mandibular movements, transverse horizontal axis, maxillomandibular 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. The registration of the horizontal and sagittal displacements of patients was believed to allow the maximum cusp height-fossae depth with proper placement of ridges and grooves as described in the anatomical illustrations of McHorris and Schillingburg. [7] 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. [8] The goal was to truly capture maxillomandibular relationships that accurately reproduced border jaw movements and which would prescribe the best occlusal interface. Mc- Collum believed in the concept of bilateral balanced occlusion in the restoration of the natural dentition. However, Stuart did not, as he observed failures due to the unequal wear of the buccal and lingual cusps causing deflective occlusal contacts or interferences with a loss of centric- related closure. Patients noted that their masticatory freedom was lost and it caused them to bite their cheeks and tongue. [7]

The goal of gnathology is to establish an occlusion that is interference free and necessitates the concept of an organic occlusion. Organic (organized) occlusion encompasses disocclusion, cusp to fossae relationship, centric (relation) 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. [7]

FREEDOM IN CENTRIC BY SCHUYLLER

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. [9] Centric occlusion has been commonly recognized as occurring at a static point of occlusal contact of opposing teeth in harmony with the accepted maxillomandibular 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. This is important because there are many factors, which influence the centric maxillomandibular relation. There is a difference between anatomic subconscious closures and a voluntarily retruded (conscious) closure on the horizontal hinge axis. These closures vary with muscle tone and neuropathic influences, with a forward, backward, or a lateral position of the head, and position of the body (sitting upright or reclining). The desirability of a slight freedom of lateral and anteroposterior movement in centric occlusion rather than a locked intercuspation in the most retruded maxillomandibular 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.

The establishment of this 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. [10] Dawson used the term 'long centric' for freedom in centric. Long centric accommodated changes in head position and postural closure. The measurable amount of long centric needed is the difference between centric-related closure and postural closure, which is rarely more than 0.5 mm. [11]

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 having concave internal slopes on the cusps of posterior teeth. [12]

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. Instrumental in the development of their technique (as well as the evolution of gnathology) was the occlusal concept of anterior guidance, which was published in a short article by Clyde Schuyler in the 1926 edition of the New York Dental journal. [13] Their philosophy was pertinently based on the spherical theory of occlusion, the ''wax chew-in'' technique described by Meyer [14] and Brenner, [15] and on the importance of cuspid teeth as discussed by D'Amico [16,17] D'Amico states, "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. The canine teeth also have a unique function. They are extremely sensitive organs. When their opponents come in contact during attempted eccentric movements of the mandible, they transmit in a 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. This is the all-important function we seek to reduce or prevent failure of restorations and the periodontium." [16]

Brecker' states, " . . . registrations on the patient and transfers from the patient to any type of articulator cannot be made without errors. The more steps required in establishing and transferring the records, the greater is the chance for errors. [18]

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. [19] 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. [14] 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. [20] Acrylic provisionals are employed in the Pankey-Mann-Schuyler technique, are adjusted intraorally. [19]

Many advantages of this technique result from completing the lower reconstruction before starting the work on the upper teeth. Discomfort is minimized because only one arch is operated on at a time. The instruments used in the technique are not complicated. Only the P-M instrument is needed in addition to the usual dental instruments. Extensive and complicated extraoral registrations of functional jaw movements are removed. Procedures are simplified, so there is less chance for developing errors. [21]

TWIN TABLE TECHNIQUE-HOBO

It 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 semiadjustable arcon-type articulator with a box-shaped fossa element mimics such a working condylar path. (When a fully adjustable articulator is used, the working condylar path is reset to zero both in the frontal and the horizontal planes so that the working condyle moves straight outward. 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. [22] The technique utilizes 2 different customized incisal guide tables. The first incisal table is reffered 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 fabricating restorations 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. [22]

TWIN STAGE PROCEDURE BY HOBO AND TAKAYAMA

The Twin-Stage Procedure was developed as the advanced version of the Twin-Table technique. [23] 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 HOBO 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. [24] 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. [23]

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. [25]

NYMAN AND LINDHE SCHEME FOR EXTREMELY ADVANCED PERIODONTITIS

The occlusion was designed so that here 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. [26]

CONCLUSION

Complete oral rehabilitation is one of the most complex services the dentist is called upon to render. [10] The objects of occlusal rehabilitation are optimum oral health, functional efficiency, speech and esthetics, and they can be achieved by various techniques described. [1] Optimum oral health should be the prime objective of all rehabilitation procedures, because the ultimate goal will always be to restore the mouth to health and preserve this status throughout the life of a patient [27]

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 heretofore would have been sacrificed. [27]

Many techniques have been discussed above to restore the occlusion to its acceptable functional form however Pankey Mann Schuyler and Twin stage technique by Hobo are the two techniques that are less complicated procedures for developing occlusal coordination. [10] These techniques work on the different segments and hence rehabilitation can be completed more quickly and easily and with much more comfort for the patient. With these techniques dentist eliminates much of the time-consuming, difficult, and uncomfortable (for the patient) removal and reseating of temporary fillings, the total chair and laboratory time for the rehabilitation is significantly reduced with these techniques and moreover the patients appreciate anything, which expedites having their work finished faster so that they can enjoy the oral health, comfort, functional efficiency, and esthetics which are the prime objectives of oral rehabilitation. [27]

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