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Removable partial denture occlusion

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When treating a patient with a removable partial denture, the natural and artificial teeth, both functionally and esthetically, must coexist in a harmonious relationship. To achieve this result, the clinician must have a thorough understanding of the basic physiologic factors that affect the patient's occlusion. In reviewing the dental literature, it becomes readily apparent that this area of dentistry has been discussed frequently and in great detail, but confusion still exists.

Many differing occlusal schemes, morphologies, and materials have become popular during the last few decades. Clinicians have become strong advocates of a particular occlusal scheme, material, or articulator to the point that they consider any other point of view heretical. Fox [1] perhaps put it best when he stated, ''The thinking of the dentist is frequently limited and distorted by such things as the articulator he used, the scheme of occlusion to which he subscribed, and the clinical experience that may not have been properly evaluated. He has a tendency to get so deeply involved in the detail of his work that he fails to maintain the perspective of the general scene.''

Clinicians must remember that there are multiple ways, both successful and unsuccessful, to complete the restoration of a patient's occlusion. The goal is to meet the physiologic, functional, and esthetic needs of the individual patient while applying knowledge, accurate diagnosis, experience, sound clinical judgment, and meticulous attention to detail [2,3].

Because several terms are used throughout this article, their definition is necessary [4]. *Balanced articulation* exists when there is bilateral, simultaneous, anterior, and posterior occlusal contact of teeth in centric and eccentric positions. *Canine-protected articulation* is a form of mutually protected articulation in which the vertical and horizontal overlap of the canine teeth disengage the posterior teeth in the excursive movements of the

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mandible. *Mutually protected articulation* is an occlusal scheme in which the posterior teeth prevent excessive contact of the anterior teeth in maximum intercuspation, and the anterior teeth disengage the posterior teeth in all mandibular excursive movements. *Group function* exists when there are multiple contact relations between the maxillary and mandibular teeth in lateral movements on the working side whereby simultaneous contact of several teeth acts as a group to distribute occlusal forces. *Lingualized occlusion* is a form of denture occlusion that articulates the maxillary lingual cusps with the mandibular occlusal surfaces in centric, working, and nonworking mandibular positions. Monoplane articulation is the arrangement by which teeth are positioned in a single plane.

Diagnosis and treatment planning

There are many steps between the initiation of treatment and completion of a physiologic occlusion for a patient. Decisions concerning many treatment options must be made using best clinical judgment. Unless the clinician begins the treatment with a properly completed diagnosis and treatment plan, however, all the best decisions, materials, and techniques do not assure satisfactory results. Information and material required to perfect a diagnosis and treatment plan include a review of the patient's medical and dental history, a full-mouth series of radiographs, a complete clinical examination, and well-made diagnostic casts that ideally have been affixed to a programmed semiadjustable articulator using a facebow and proper interocclusal records.

If the patient exhibits the signs of an ongoing occlusal dysfunction, preprosthetic treatment is required. Symptoms of occlusal trauma may include temporomandibular joint dysfunction, pain in the head and neck area or shoulders, pulpitis, fractured cusps, premature wear or bruxofacets, mobile teeth, abfraction, or fremulus [5,6,7]. Treatment options may include medications, physical therapy, occlusal stents, stress reduction or habit elimination, restorative dentistry, endodontic therapy, periodontal surgery, extractions, orthodontics, or orthognathic surgery [8].

Additionally, the plane of occlusion must be analyzed and altered as necessary. Teeth may be rotated, infraerupted, or tipped. These teeth may require selective occlusal adjustment to correct occlusal prematurities, a fixed partial denture, intentional devitalization, clinical crown lengthening using periodontal surgery, orthodontic movement, orthognathic surgery, or extractions.

A preconceived prejudice toward one particular type of occlusion is not a valid reason for altering an existing occlusal scheme. An anterior slide of less than 2 mm from the most retruded contact position to the maximum intercuspal position is not necessarily a sign of a pathologic condition; both group function and mutually protected articulations are commonly found in

natural physiologic dentitions and do not necessarily indicate a pathologic condition in the partially edentulous patient [7,9]. The alteration of any physiologic state may create a nonphysiologic or traumatic occlusion.

Because a classification of the edentulous arches is needed in any discussion of removable partial dentures, Kennedy's classifications are used in this article [10]. A Kennedy class I patient has bilateral edentulous spaces posterior to the remaining natural teeth; a class II patient exhibits a unilateral edentulous space posterior to the natural teeth; a class III patient has a unilateral edentulous space with remaining natural teeth both anterior to and posterior to the space; and a class IV patient exhibits a single edentulous space that crosses the midline and has remaining natural teeth posterior to the space bilaterally. Other edentulous areas are classified as modification spaces.

Articulator selection

The clinician must choose an appropriate instrument to perform the pretreatment analysis and treatment planning as well as the actual treatment phase for each patient. The selection depends on the clinician's level of experience with the instrument, the complexity of the treatment to be performed, and the requirements dictated by the patient's current condition [11]. During the diagnostic phase, the articulator provides the information required for occlusal analysis, aids in correct formulation of diagnostic wax-ups and other aids, and assists in the final determination of a reasonable treatment plan. As treatment commences, it permits the fabrication of physiologic cusp and fossa morphology, correct artificial tooth placement, and proper positioning, which help assure that the restoration will function within the range of the patient's dynamic movements.

The articulator may be used to relate casts in static positions to the condyles and to simulate paths of mandibular movement in eccentric positions. The accuracy of the methods used to record static positions or actual mandibular movements within the envelope of motion dictates the accuracy of the instrument in simulating mandibular movement. Although the advantages and disadvantages of articulators and their uses have been widely discussed [7], it is necessary to discuss briefly the use of these instruments in removable partial denture occlusion. In this article the authors use Celenza's [11] classification of articulators as classes I, II, III, and IV.

Simple articulator—class I and class II

Class I and class II instruments use a basic hinge opening with fixed condylar pathways. This instrument may or may not be constructed with average values to simulate a typical patient. This articulator is used for limited restorations that will be constructed to follow the patient's existing

occlusal pattern. They also are used for monoplane occlusal schemes that do not require eccentric positions. These simple instruments also are used when generating an occlusal scheme by the functionally generated path technique, in which the opposing template has been developed by an actual surface recording of the patient's functional movements.

Semiadjustable articulator—class III

Class III instruments are based on average size values and have adjustable horizontal condylar guides that are set by using a protrusive interocclusal record. The lateral condylar inclinations are set according to average value formulas or lateral interocclusal records. These recordings are positional and do not include information obtained from the patient about the actual mandibular movement. Therefore more intraoral adjustments may be expected because of the limited information provided by the positional recordings. Restorations that may be fabricated using the semiadjustable articulator include class I, class II, or class III/IV removable partial dentures for patients whose remaining natural teeth dictate the occlusal movement (group function or a canine protected articulation). This instrument also can be used for restorations using monoplane articulation.

Fully adjustable articulator—class IV

This instrument is managed by multiple widely adjustable or customized components to simulate accurately the actual movements of the mandible. It can be programmed by tracings or records that capture movements rather than static positions. It can be used with any theory of occlusion or occlusal scheme, including balanced, group function, or mutually protected articulations. The proper cusp/fossa/groove morphology can be established on this instrument to function efficiently and harmoniously with the patient's true mandibular movements. The fully adjustable articulator allows the fabrication of the most complex occlusal patterns needed to create a physiologically acceptable occlusion with the minimum intraoral adjustments.

Interocclusal records

Following attachment of the maxillary cast to the articulator using a facebow recording, an interocclusal record or occlusal registration is usually necessary to orient the maxillary and mandibular diagnostic or master casts to each other properly.

Three widely separated tripod points of occlusal contact are necessary to relate the two casts accurately. These contact points may be tooth-to-tooth or tooth-to-interocclusal recording material. A stable orientation of the opposing casts may exist if sufficient teeth remain, and in these patients no interocclusal relation recording is necessary. It is suggested, however, that

orientation lines be drawn on the casts to guarantee proper cast alignment in the future. An interocclusal recording will be necessary if insufficient teeth remain to allow a stable cast-to-cast relationship.

It often is desirable to make the interocclusal relation record before the fabrication of the removable partial denture framework. Doing so will allow the laboratory technicians to fabricate and adjust the framework properly before returning it to the clinician. This process should minimize clinical adjustments to the framework and in many patients allow complete fabrication of the removable partial denture without the intermediate trial insertion appointment.

When a recording is necessary, a record base, occlusion rim, and occlusal recording material are needed to make the recording accurately. It has been suggested that the record base be fabricated using autopolymerizing acrylic resin [12,13], although they often are fabricated of light polymerized resin. Because a record base is not transferable from one cast to another, the record base must be made on the cast to be attached to the articulator. The occlusion rims most often are made using hard baseplate wax.

An interocclusal relation record must (1) be made in either the centric occlusion position or the maximum intercuspation position, as desired by the clinician; (2) be made at the correct vertical dimension of occlusion, whenever possible; (3) allow the accurate and positive alignment of the casts; (4) be dimensionally stable; (5) be made with a "dead soft" material to minimize the displacement of displaceable tissues; and (6) be easily used by both the clinician and the technician [13].

Excellent occlusal recording materials include zinc oxide eugenol impression material, plaster impression material, modeling compound, polyether, and polyvinyl siloxane. Wax records made in edentulous areas with or without the support of record bases may not be sufficiently stable to be acceptable.

The interocclusal recording is most often made after fabrication of the removable partial denture framework. Following the fitting of the framework and the making of a corrected cast impression (if indicated), the record base is fabricated on the edentulous areas of the framework/master cast. Occlusion rims are added, and an occlusal recording material is used to make the record. The cast is oriented to the opposing cast with the recording, and desired denture teeth are selected. This fabrication is followed by a trial insertion appointment.

Selection of denture teeth

Choice of materials

Occlusal surfaces have been made of wood, ivory, porcelain, acrylic resins, and gold [14,15]. In more recent years glass ceramics [16] and composite materials [17] have been recommended.

The factors that influence the choice of materials for occlusal surfaces for removable partial dentures have been discussed in many articles [18–20]. Modern acrylic denture teeth, hardened by cross-linking agents, are resilient, wear-resistant, natural-sounding in function, and possess excellent esthetic properties. They are easy to adjust, can be recontoured when necessary, and polish simply with little effort. Acrylic resin teeth can easily be recontoured for limited space applications or when metal components of the removable partial denture framework need to be closely approached. The acrylic resin teeth bond chemically to the denture base resin; the bonding prevents staining and leakage around that junction. Acrylic resin has a low abrasion resistance, however, and can wear rapidly in some patients. It is preferred that acrylic resin denture teeth oppose other acrylic resin teeth; occlusal wear should be monitored more closely when they function against natural teeth or restorations using porcelain or metal occlusal surfaces. Proper function of the occlusal relationships must be checked more frequently when acrylic resin teeth are used.

Porcelain denture teeth have a high abrasion resistance and exhibit minimal wear. They are esthetic and match the porcelains used for fixed restorations. They may sound unnatural to the patient; are brittle; may chip or crack, and are difficult to adjust, recontour, and polish. Porcelain teeth do not bond chemically with the denture base resin but are mechanically retained with diatoric holes or pins. They may stain dramatically at the tooth-to-base interface. They are not suited for patients with minimal interocclusal space or those in whom extensive adjustment is needed to approximate a minor connector or precision attachment. Porcelain may cause severe wear of opposing natural teeth if the glaze is broken during adjustment of the occlusal surface. To maintain a stable occlusion, it is extremely important to smooth and polish highly any surface on which the glaze has been broken [21].

Cast metal (eg, type III gold, type IV gold) is another material choice for the occlusal surface of artificial posterior teeth. Although there are certain disadvantages, such as additional technical procedures required for fabrication, unacceptable esthetics for some patients, and the cost of the alloy, there are some advantages. Because the technician waxes the occlusal surfaces, they can be custom made to fit any occlusal scheme. Highly polished metal surfaces cause minimal wear to opposing surfaces of natural teeth, other metals, acrylic resins, or porcelain. Polished metal has high abrasion resistance and can be used when the clinician might be concerned about future loss of vertical dimension. They can be used in removable partial dentures made for patients with reduced interocclusal space. Cast surfaces also are easily adjusted and polished. In addition, patients state that the cast surfaces feel and sound natural during function.

Another option similar to cast metal occlusal surfaces is using cast ceramic surfaces to improve the esthetic results of the occlusal restorations. The denture occlusal surfaces are reduced and prepared to accept an onlay

type restoration as with a metal occlusal surface. The wax patterns generated are cast in ceramic material instead of metal. They are adjusted and cemented to the acrylic resin denture teeth using a dual-curing composite resin cement. This surface treatment may be useful when there are opposing surfaces of existing ceramic materials [16].

Choice of occlusal schemes and morphologies

Occlusal schemes include balanced articulations [22], a neutrocentric occlusion [23], a unilateral balanced articulation [24], a mutually protected articulation [25], a canine-protected articulation [26], an occlusion in which centric occlusion coincides with centric relation [25], or an occlusion with a long centric [27]. Multiple occlusal morphologies that range from mimicking the natural unworn dentitions to using metallic blades for improved efficiency have also been advocated [28,29]. The occlusal morphology of the artificial teeth must be capable of creating the type of occlusal scheme desired.

Posterior denture teeth may be obtained with occlusal morphologies varying from a monoplane form (0°), to a semianatomic form (10°–30°), to a completely anatomic form (30°–45°) [30]. Depending on the occlusal morphology of the tooth selected, differing occlusal articulations have been advocated ranging from multiple functional excursive contacts (balanced) to minimal excursive contacts (monoplane). The form of articulation termed lingualized occlusion has also been advocated [31] and is growing in popularity.

DeVan [23] initially described a monoplane articulation that he termed neutrocentric. With this type articulation, some recommend that all teeth be set on a flat plane [23,32], whereas others recommend a stabilizing curve or distal ramps to obtain some degree of balanced articulation [30,33,34]. Monoplane articulation consists of monoplane teeth set on a flat plane. It offers less chance of prematurities during function and unrestricted freedom of movement from the retruded contact position to the maximum intercuspation position. Monoplane teeth are less esthetic than anatomic teeth and do not permit balanced or group function. When there are no cuspal inclines to contact during functional movements, some believe that lateral destructive forces are decreased [23,32]. Others, however, argue that there is an increased lateral component of jaw movement during function by patients with monoplane teeth [35]. Nonanatomic teeth are seldom indicated for use in removable partial dentures unless they oppose a complete denture or removable partial dentures with monoplane articulation or if a monoplane type lingualized occlusion is being developed.

Anatomic teeth can be placed to create a balanced, group function or a mutually protected articulation. The cuspal angulation, fossae, and working and idling grooves can be modified to permit any desired occlusal scheme. These teeth are claimed to be more efficient in mastication [36], although this claim has not been proved despite of numerous investigations

[37,38]. Anatomic teeth are indicated for partially edentulous patients for whom esthetics is an important consideration, when a balanced or group function articulation is desired, when anterior guidance from natural teeth is present, or when artificial teeth must harmonize with existing natural cuspal inclinations.

Semianatomic denture teeth are fabricated with numerous cuspal morphologies. These teeth lie between monoplane and anatomic teeth as far as advantages, disadvantages, indications, and contraindications are concerned.

Lingualized occlusion is named because the functional elements of the maxillary posterior teeth are the lingual cusps. Even in a balanced articulation the buccal cusps of the maxillary teeth do not contact the mandibular teeth. Generally anatomic or semianatomic maxillary and mandibular posterior denture teeth are used to develop this occlusion. If a monoplane-type lingualized occlusion is desired, monoplane mandibular teeth are used, and anatomic maxillary teeth are used for esthetic and functional purposes. Lingualized occlusion enjoys many of the advantages and few of the disadvantages of both the balanced and neutrocentric articulations [5].

Position of natural teeth

Within reason it is desirable to place artificial denture teeth in close proximity to the original position of the natural teeth. Therefore it is helpful to know the average location of the natural dentition.

Landmarks for the anterior teeth

The incisive papilla is an important landmark for the maxillary anterior teeth. With few exceptions the incisive papilla bisects the midline of the natural dentition. In the authors' experience, almost without exception, if the incisive papilla does not coincide with the midline of the face, it also does not indicate the midline of the natural dentition. Another potentially important anatomic feature of the incisive papilla is the distance between the most anterior border of the incisive papilla and the labial surface of the central incisors. This distance varies from 5 to 7 mm.

Also the average distance from the depth of the labial vestibule, immediately lateral to the labial frenulum to the incisal edge of the maxillary central incisor is 22 mm. In extremely small individuals it may be as small as 18 mm [39].

Landmarks for the occlusal plane

Guides in reestablishing the occlusal plane have included the retromolar pad, the parotid papilla, and the commissures of the lips. The occlusal plane

(as established by projecting a line from the tip of the mandibular canine through the tip to the distolingual cusp of the most distal mandibular molar) almost always aligns with the middle to upper one third of the retromolar pad. The occlusal plane also falls approximately 4 mm inferior to the parotid papilla. The papilla also lies between the distobuccal cusp of the maxillary first molar and the mesiobuccal cusp of the maxillary second molar. The occlusal plane is located within 4 mm, either superiorly or inferiorly, of the commissure of the lips when viewed frontally [40].

Landmarks for the posterior teeth

The maxillary tuberosity and retromolar pads are important landmarks for the natural dentition in the posterior teeth. Roraff [39] demonstrated that the maxillary tuberosity lies immediately posterior to the lingual cusp of the maxillary second molar. This landmark is generally useful but becomes less reliable as atrophy increases. The retromolar pad is the anatomic landmark used most frequently as a guide for reestablishing maxillary posterior tooth position. Pound [41] found that the triangle established by lines drawn from the cusp tips of the mandibular canines to the lingual and buccal aspects of the retromolar pad includes the lingual cusps of the mandibular molars in the natural dentition.

Positioning the artificial teeth

Ideally the artificial teeth would occupy the same anatomic position as the natural dentition. Because of phonetic and esthetic requirements, changes in occlusal demands, altered alveolar ridge anatomy and relationships, and decreased ability to withstand occlusal forces, such placement is often not possible. Compromises, such as decreased vertical overlap of the anterior teeth, bilateral reverse articulations, and decreased numbers of artificial teeth, are often necessary. Natural tooth contacts that are present without the removable partial denture inserted must be present with the removable partial denture inserted. These contacts may be evaluated with articulating paper or shim stock.

Anterior teeth

The position of the maxillary anterior teeth is dictated by the esthetic and phonetic requirements of the patient but must function in harmony with the remaining dentition. Many authors have offered guides for creating outstanding esthetic results [42,43]. It has been recommended that 1 to 3 mm of the incisal edge of the maxillary central incisors be visible when the patient's lips are in a relaxed position. During the "f" and "v" sounds the incisal edge should contact the junction between the transitional epithelium

and the oral mucosa of the lower lip (wet/dry line). The incisal edges should be positioned to support the lips and give the patient a natural profile.

Pound's /S/ position is an excellent guide in positioning the mandibular anterior teeth [44]. He details a technique that, using phonetics, relates the mandibular teeth to the maxillary anterior teeth. He explains that "the /S/ sound is a subtle whistle which is created when air is forced through a 1 to 1.5 mm space between the incisal edges of the lower central incisors and the coronal surfaces of the upper central incisors. It is the most forward, most closed position of the mandible during speech."

Difficulty often is encountered when a tooth must be set between two remaining natural teeth. The width of the edentulous space may be too narrow for the denture tooth selected because of natural tooth migration, requiring that the mesial and distal surfaces of the denture tooth be narrowed by grinding and that the proximal surfaces of the natural teeth be reduced slightly to increase the width of the embrasure.

Plane of occlusion

For patients with removable partial dentures, the plane of occlusion is frequently established by the remaining natural dentition, especially in Kennedy class III and class IV patients. For Kennedy class I and class II patients, however, the plane must often be reestablished. When an occlusal plane must be reestablished, a line may be drawn from the incisal edge of the cusp tips of the most distal natural teeth to the middle to upper one third of the retromolar pads. To provide acceptable room for positioning the posterior artificial teeth or to favor the weaker arch, it may be necessary to alter the position of the occlusal plane by either raising or lowering the posterior determinates. Ideally, the plane of occlusion equally divides the available interarch space.

Posterior teeth

For esthetic, phonetic, and functional reasons, the posterior teeth on a removable partial denture should be positioned to harmonize with any remaining natural dentition. Not every natural tooth that is lost must be replaced with an artificial tooth. Only teeth required for esthetic, phonetic, and functional purposes should be used. For class I and class II removable partial dentures, any remaining opposing natural teeth dictate the placement of the artificial teeth. The established plane of occlusion should be used to position the artificial teeth vertically for patients with no remaining natural posterior teeth [45]. To direct forces of occlusion in a favorable vertical direction, the denture teeth should be centered over the residual ridge in a medial lateral direction. The lingual cusps of the mandibular teeth are positioned within the confines of a triangle established by drawing lines from the buccal and lingual borders of the retromolar pads to the cusp tip of

the canines. Because of severe changes in the relationship of the ridges caused by resorption, it is not always possible to obtain an acceptable occlusion and still position the center of both the maxillary and mandibular teeth over the residual ridges. The mandibular ridge should be favored when a compromise becomes necessary.

Because of a limited choice of differing tooth morphologies and the desire for custom occlusal contacts to maximize function, it is often necessary to position the teeth initially at an excessive vertical dimension of occlusion (approximately 0.5 to 1 mm) and then to equilibrate the denture teeth until the correct vertical dimension of occlusion is regained. This process creates what often is referred to as a tight centric occlusion.

Another common problem encountered when positioning artificial teeth for a removable partial denture is the need to position the tooth adjacent to a clasp assembly. In these situations it is often necessary to custom grind the tooth to encompass the clasp assembly partially. As much crown length and facial surface as possible should be retained for esthetic reasons.

Functionally generated path

The functionally generated path is a method of developing occlusal relationships on simple instrumentation without using a semi- or fully adjustable articulator that has been programmed to match the patient's mandibular movements [46,47]. Using the removable partial denture framework as a base, a dynamic recording of the occlusal patterns is generated in the patient's mouth under normal functional conditions. The patient's own functional jaw movements are used to form a three-dimensional opposing cast or template. Although this record looks somewhat bizarre, it represents the dynamics of mandibular movement and eliminates the need for an articulator capable of eccentric movements. Using this type of opposing cast allows the creation of any occlusal scheme and minimizes intraoral adjustments. Caution must be exercised when using this technique to ensure that centric occlusal contacts are not lost when denture teeth are adjusted or cast surfaces are created to conform to the opposing template [48]. When both arches are being restored, one arch must be completed before the opposing arch can be started.

To use this technique the removable partial denture framework is adjusted, and an accurate and stable denture base is attached to the framework. This work is completed using the master cast. After the denture base is adjusted intraorally, an occlusal rim is added to support the recording material that will be used to capture the occlusal patterns. The occlusal surface is adjusted intraorally so that there is occlusal contact in the centric occlusal position and during all excursive movements. The patient wears the removable partial denture base, and functional recordings are made over a 24-hour period with the exception of meals. The completed functionally recorded surface will be shiny or burnished and somewhat

wider than the normal occlusal table. The final recording is reseated on the master cast with the removable partial denture framework and secured in the proper position. The record area is boxed, using clay or wax, to include areas of the master cast that will serve as vertical stops. This step guarantees maintenance of the vertical dimension of occlusion. Die stone is poured into the boxed record to create an opposing template. The resulting working template and master cast is attached to any type of articulator before the newly poured template is separated from the master cast/framework record. The record is removed, and the occlusal surface of the prosthesis is fabricated on the denture base and adjusted to this template.

Cast gold occlusal surfaces

Although cast gold occlusal surfaces offer many advantages, they are seldom used because of their cost, technical complexity, and esthetic results. The authors have included this technique because they believe that it has value. Because little has change in the last 20 years the following excerpt is taken directly from a previous article by one of the authors [49].

> It is possible to establish cast gold occlusal in various ways, including the following [50–54]:
>
> 1. The surfaces may be purchased prefabricated and incorporated into the occlusal portion of the denture teeth during fabrication of the removable partial denture.
> 2. The occlusal surface of acrylic resin denture teeth can be replicated in gold and incorporated into the partial denture either during initial processing or after an adjustment period during which the patient wears the removable partial denture for two to four weeks.
> 3. The surfaces can be custom fabricated, opposing a template by the functionally generated path technique.
> 4. The surfaces can be custom fabricated by use of an opposing anatomical cast and a fully adjustable articulator.
>
> Although cast gold occlusal surfaces may be fabricated before delivery of the removable partial denture, the following technique offers a more stable occlusion. The partial denture is fabricated using acrylic resin artificial teeth, delivered, and adjusted as necessary for several weeks. The partial denture is then returned to the previously programmed articulator using remount casts, and a new jaw relation record is made as closely to the vertical dimension of occlusion as possible. The acrylic resin posterior teeth are reduced 1.5 to 2 mm, and the individual occlusal surfaces are carved in wax or created via the fluid or drop wax technique. Mechanical retention is created. The occlusal surface is invested, cast, finished, and polished. The gold occlusal surface is then attached to the reduced acrylic resin teeth with autopolymerizing acrylic resin, assuring that the established occlusal relationships are retained. The cast surfaces are refined on the articulator, and any necessary intraoral adjustments are made to ensure the desired physiologic results.

With this technique, the occlusal table can be created to any desired width. Occlusal morphology can have any desired cuspal angulation, cuspal height or position, and groove placement. Occlusion can be created or restored to any desired scheme.

Preliminary objectives for establishing an occlusal scheme

The following seven objectives should be met when establishing an occlusal scheme:

1. If a physiologic state exists, maintain the patient's maximum intercuspal position. Maximum intercuspation also is an acceptable position for treatment if the patient has no symptoms of dysfunction, and the clinician is not in complete control of the occlusal position, as with complete dentures or full-mouth rehabilitation. If centric occlusion must be reestablished, it must be coincidental with centric relation.
2. Bilateral simultaneous contacts of the opposing anterior and posterior teeth should be established in restored occlusion. Anterior points of contact should be passive and should not assume any of the occlusal load. Multiple points of posterior occlusal contact improve chewing efficiency and decrease the potential for wear. If a complete denture is part of the final restoration, anterior occlusion must be controlled by the complete denture occlusion scheme used by the clinician.
3. Do not alter a patient's existing occlusal scheme in lateral movement unless such alterations are needed to correct a nonphysiologic condition. Both canine-protected and group function articulations are commonly found in natural physiologic dentitions.
4. If the restoration must reestablish lateral guidance, canine-protected articulation is preferable when the remaining natural canines are present and not periodontally compromised or if implant replacement of the canines is part of the restoration. Canine guidance reduces horizontal forces on posterior teeth and promotes a more vertical chewing cycle. This articulation scheme results in greatly diminished lateral stresses on the posterior teeth and ridges and reduced occlusal wear. With no posterior contacts in lateral movement, any posterior occlusal morphology can be used, and the selection of the articulator is less critical.
5. Establish group function or a unilateral balanced articulation for patients with missing canines being replaced by a removable prosthesis or periodontally compromised canines that will be maintained. Use either a fully adjustable articulator programmed with a pantographic tracing or with a simple articulator using the functionally generated path technique to establish the occlusal scheme for these patients.
6. Do not establish nonworking contacts on remaining natural teeth unless these teeth are opposed by a complete denture for which bilateral balanced articulation is desirable.

7. When there are healthy remaining natural anterior teeth, posterior tooth contact during the protrusive movement is not desirable. For patients with an opposing complete denture, protrusive contacts may be necessary to achieve a balanced articulation.

Determining the occlusal scheme

The number and positions of the remaining natural teeth in both the arch in which a removable partial denture is being fabricated and the opposing arch determine the necessary occlusal scheme. The following occlusal schemes are recommended [20]:

1. Class III removable partial denture
    a. The occlusal morphology of the artificial teeth is selected to match that of the opposing teeth or surfaces.
    b. If the existing occlusion is physiologically healthy, the patient is restored to the existing occlusal scheme, which may be group function or mutually protected.
    c. A group function articulation is recommended if the patient's natural canine is missing or periodontally compromised.
    d. A balanced articulation is recommended if the restoration is to oppose a complete denture. Some clinicians believe that balanced articulation is not desirable or clinically obtainable and select a monoplane or lingualized occlusion.
2. Class II removable partial denture. The recommendations given for class III are appropriate, with the following exceptions:
    a. Group function articulation should be avoided when there are no remaining premolars. A canine-protected articulation reduces the destructive lateral forces that are generated on the distal extension during function.
    b. Except when opposing a complete denture, a balanced articulation should be avoided to prevent nonworking contacts on natural teeth.
3. Class I removable partial denture. The recommendations given for classes II and III are appropriate with the following exception:
    a. Balanced articulation is recommended for patients for whom canine-protected articulation is not possible to provide bilateral occlusal contacts for increased denture stability.
4. Class IV removable partial denture
    a. During excursive movements the anterior artificial teeth should either disocclude or have passive occlusal contact.

b. A balanced articulation is recommended if the restoration is to oppose a complete denture. Some clinicians believe that balanced articulation is not desirable or clinically obtainable and select a monoplane or lingualized articulation with no anterior tooth contact in function.

Summary

No single occlusal morphology, scheme, or material will successfully treat all patients. Many patients have been treated, both successfully and unsuccessfully, using widely varying theories of occlusion, choices of posterior tooth form, and restorative materials. Therefore, experience has demonstrated that there is no one right way to restore the occlusion of all patients.

Partially edentulous patients have many and varied needs. Clinicians must understand the healthy physiologic gnathostomatic system and properly diagnose what is or may become pathologic. Henderson [3] stated that the occlusion of the successfully treated patient allows the masticating mechanism to carry out its physiologic functions while the temporomandibular joints, the neuromuscular mechanism, the teeth, and their supporting structures remain in a good state of health.

Skills in diagnosis and treatment planning are of utmost importance in treating these patients, for whom the clinician's goals are not only an esthetic and functional restoration but also a lasting harmonious state. Perhaps this was best stated by DeVan [55] more than 60 years ago in his often-quoted objective, "The patient's fundamental need is the continued preservation of what remains of his chewing apparatus rather than the meticulous restoration of what is missing, since what is lost is in a sense irretrievably lost."

Because it is clear that there is no one method, no one occlusal scheme, or one material that guarantees success for all patients, recommendations for consideration when establishing or reestablishing occlusal schemes have been presented. These recommendations must be used in conjunction with other diagnostic and technical skills.

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