

Dent Clin N Am 48 (2004) 567-583

THE DENTAL CLINICS OF NORTH AMERICA

# Single maxillary complete denture Carl F. Driscoll, DMD\*, Radi M. Masri, BDS, MS

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Successful complete denture use by patients depends on many variables, but three factors stand out in terms of functional success: retention [1]. stability [2], and support [3]. The Glossary of Prosthodontic Terms, seventh edition, defines retention as the quality inherent in the prosthesis acting to resist the forces of dislodgment along the path of placement; stability as the quality of a prosthesis to be firm, steady, or constant, to resist displacement by functional horizontal or rotational stresses; and support as the foundation area on which a dental prosthesis rests [4]. Of the three, it generally is agreed that stability is the most important factor. Occlusion that is not balanced in excursive movements will create instability of the denture, loss of retention, and, eventually, frustration to the patient [5,6]. In addition, when a dentate arch opposes an edentulous arch, the edentulous arch is usually adversely affected because of the forces generated [6]. Koper [7] believes that occlusal problems and denture-base fractures seen in the single complete denture are the result of one or all of the following: (1) occlusal stress on the maxillary denture and the underlying edentulous tissue from teeth and musculature accustomed to opposing natural teeth, (2) the position of the mandibular teeth, which may not be properly aligned for the bilateral balance needed for stability, and (3) flexure of the denture base. The use of a metal base to help prevent denture-base fracture has been previously discussed [8,9].

Fabrication of complete dentures is adequately covered in many textbooks and is routinely taught in the dental school curriculum. The fabrication of a single complete denture, however, is often overlooked in educational courses and requires a complete understanding of the factors involved in obtaining bilateral balance. Theilemann simplified Hanau's Quint making it easier to understand how to obtain balance and therefore stability [10,11]. The five elements to be considered are condylar guidance (CG), incisal

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guidance (IG), compensating curve (CC), cusp height (CH), and occlusal plane (OP). The following simplified equation makes understanding this concept easier.

$$CG * IG = CC * CH * OP$$

Equilibrium or balance is achieved when the five elements are in harmony. A change in any of the five elements requires changes in at least one of the remaining four elements. For example, if the incisal guidance is increased, either a decrease in the condylar guidance or an increase in the compensating curve, cusp height, or occlusal plane must occur to maintain balance. Because the condylar guidance cannot change without surgical intervention, one or more of the three elements to the right of the equation must be adjusted. Conversely, if there is an increase in the cusp height, there must be either a decrease in the compensating curve or the occlusal plane or an increase in the incisal guidance.

When fabricating complete dentures for completely edentulous patients, the dentist has control of the steepness of the incisal guidance, compensating curve, cusp height, and occlusal plane. He can alter these factors to obtain balance. When the dentist is faced with fabricating only a single denture, however, control of these elements is limited and may adversely affect the attainment of bilateral balance. Situations in which the dentist may be fabricating only a single complete denture include an edentulous arch opposing a complete dentate arch, a partially edentulous arch, or a previously existing denture. In the last example, the dentist should modify the existing denture at the same time to allow greater control and flexibility in obtaining balance. The maxillary arch usually is the first arch to become edentulous.

The position of the remaining natural teeth in these examples may create interferences in excursive movements of the single complete denture and create instability that would not be a problem in a patient with natural dentition in both arches and with anterior guidance. Correcting these interferences may be as simple as an occlusal adjustment or as severe as extraction of the offending tooth. This article discusses various nonextractive or nonorthodontic treatment modalities that may be used with various patients to achieve a balanced occlusion and to improve the stability of the single denture opposing natural teeth.

## **Occlusal discrepancies**

The proposed changes to occlusal discrepancies are best planned ahead of time in the dental laboratory on properly articulated casts to prevent unnecessary and irreversible alterations to the dentition. Making adjustments to the dentures after fabrication is not advisable because changes to the arrangement of the denture teeth are no longer possible. Patients also may view these postdelivery adjustments as an attempt to make the natural teeth fit a poorly made denture [6].

The most common area of adjustment is the molar area where teeth have been extracted and the teeth distal to the site have drifted forward, creating a supraeruption of the distal cusps [12]. This repositioning of teeth will result in an unfavorable occlusal plane, teeth with excessively steep inclines, and often is accompanied by an enlarged buccolingual width of the natural teeth [13]. The steep inclines may result in dislodgement of the denture in excursive movements, myofacial pain, and loss of retention and stability [6]. Treatment of the tilted molars may include orthodontics, odontoplasty, endodontics, crowns, or, in severe cases, extraction. When extractions are necessry, a distal extension removable partial denture or implants may be an alternative treatment option.

# **Tooth selection**

Anatomic teeth usually are chosen in the single complete denture to enhance esthetics but also to allow for some tooth stock to adjust. The decision as to which cusped tooth to choose is based on evaluation of the condylar guidance and incisal guidance and therefore is selected after anterior tooth setup. In patients who present with a full dentition on the mandible, the condylar guidance, occlusal plane, and compensating curve are already pre-set, so the only variables that the dentist can easily control are the incisal guidance and the cusp height [14]. The incisal guidance can be evaluated with esthetics and phonetics [15]. The cusp height can be chosen by either of two methods: (1) cusp height is equal to the sum of condylar guidance and incisal guidance divided by two, or (2) Swenson's formula [16]. In patients with flat occlusal tables, teeth can be reshaped or non-anatomic teeth maybe chosen [17]. Plastic teeth are chosen over porcelain teeth because the amount of adjustment that is sometimes required may weaken the porcelain teeth and make them unable to withstand the occlusal forces from the natural teeth. In addition, the wear characteristics of plastic teeth are more similar than those of porcelain teeth to the wear patterns of natural teeth [6].

# Classification

The following proposed classification system can simplify the identification and treatment of these patients.

Class 1: patients for whom minor, or no, tooth reduction is all that is needed to obtain balance

- Class 2: patients for whom minor additions to the height of the teeth are needed to obtain balance
- Class 3: patients for whom both reductions and additions to teeth are required to obtain balance. The treatment of these patients usually involves a change in vertical dimension of occlusion
- Class 4: patients who present with occlusal discrepancies that require addition to the width of the occluding surface
- Class 5: patients who present with combination syndrome as described by Kelly [18].

Class 1 includes patients for whom occlusal adjustments are made to the existing dentition to achieve balance in all excursive movements. Two methods can be used in the laboratory to evaluate the changes that must be made to the teeth [6]. The first method is more accurate and time consuming but is better suited for the inexperienced practitioner. The second is not as precise and should be reserved for the experienced clinician. The first method, described by Swenson [16], is performed with casts articulated at the correct vertical dimension and with maxillary teeth set, one at a time, to an ideal setup. As interferences arise, the opposing teeth on the cast are adjusted to allow for the ideal maxillary tooth positioning. The adjustments are marked on the cast, and the same adjustments are made in the mouth at the time of delivery of the maxillary denture. In this manner, changes are more precise and less arbitrary, and proposed adjustments can be evaluated ahead of time rather than clinically, when it may be found that proposed changes are not feasible.

The second method, described by Yurkstas, involves the use of a curved U-shaped occlusal metal template that is positioned on the incisal edges and



Fig. 1. The occlusal template is placed on the incisal and occlusal surfaces to evaluate the plane of occlusion.

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cusp tips of the casts to identify potential interferences or areas that are below the occlusal plane and require buildup of some sort (Fig. 1) [6]. These areas are adjusted to conform to the curve of the template, and then the denture teeth are set against this plane. This method is quicker but more arbitrary and more prone to error. The correct occlusal template should be selected after the condylar guidance and incisal guidance are determined to allow for easier balance. Fig. 2A–C shows the interferences and potential for dislodgement and the balance attained after selected reduction of the mandibular teeth.



Fig. 2. (*A*) Preoperative right lateral view of protrusive movement. (*B*) Preoperative left lateral view of protrusive movement. (*C*) Postoperative frontal view of right laterotrusive movement showing balanced occlusion. (Courtesy of Dr. Flavio Rasetto, Baltimore, MD.)

Class 2 includes patients for whom minor additions to the height of the teeth are needed to obtain bilateral balance. This situation may occur when there has been loss of tooth structure because of trauma or decay or when there has been isolated supraeruption in areas without the loss of vertical dimension. An example is a patient who presented for a new maxillary denture and a new mandibular swing lock removable partial denture. The patient had an American College of Prosthodontics edentulous classification of class I on the maxillary arch and a partially edentulous classification of class IV on the mandible [19,20]. The patient was referred for treatment after the general dentist had placed crowns on teeth #21 and #22. Upon establishment of the occlusal wax rim to register the proper occlusal plane relative to incisal show and lip support, it became evident that there was a discrepancy in the height of the mandibular anterior teeth (Fig. 3). The patient refused to have the crowns remade to the proper dimensions. An anterior try-in was performed to confirm the correct esthetic and phonetic positioning. During the placement of the posterior teeth, additions to the natural mandibular teeth were required to maintain contact in the protrusive excursion. Wax was added to the articulated mandibular cast to allow correct setting of the posterior teeth with balance in all excursions. To transfer this correction to the patient, the mandibular cast, with the wax added, was duplicated, and a 0.020-inch vacuum-pressed sheet was fabricated. This sheet was used on the day of delivery to act as a template to the placement of composite resin to the natural teeth to create the balanced occlusion that was developed in the dental laboratory (Fig. 4A). Slits were placed through the vacuum-formed template interproximally to prevent bonding of the composite resin to the adjacent tooth and to allow the patient to floss normally. Fig. 4B shows the final result.



Fig. 3. Frontal view of occlusal wax rim showing incisal edge discrepancy. (Courtesy of Dr. Sarit Kaplan, Bethesda, MD.)



Fig. 4. (*A*) Vacuum-formed template in place before teeth buildup. (*B*) Anterior teeth built up in composite resin to permit balance in protrusion. (Courtesy of Dr. Sarit Kaplan, Bethesda, MD.)

Class 3 includes patients for whom both reductions and additions to teeth are required to obtain balance. These patients often require restoration of the vertical dimension of occlusion.

Fig. 5A–C shows a patient who was edentulous in the maxillary arch and dentate on the mandible. The patient had poor oral hygiene, caries, a history of fractured denture teeth, perforations of crowns, large restorations, loss of vertical dimension, supraeruption of the mandibular anterior teeth, inverse smile line, and poor self esteem. Instruction in oral hygiene was provided, and basic restorative needs were addressed accordingly. The maxillary arch was border molded, impressed, and mounted on an articulator by the use of a face bow. The wax occlusal rim was idealized with no input from the position of the mandibular teeth. The result is demonstrated in Fig. 6; the lack of a natural smile is evident. With the maxillary teeth in the ideal position, the vertical dimension of occlusion was increased 4 mm from the correct location determined by the physiologic rest position and 8 mm greater than at presentation. Using a second occlusal rim, an interocclusal record was made at the correct vertical dimension of occlusion, and the mandibular cast was articulated. Once articulated, the maxillary cast with the ideal setup was placed back on the articulator, and a 4-mm discrepancy was noted in the



Fig. 5. (A) Preoperative frontal view. (B) Cameo view of maxillary denture. (C) Occlusal view of mandible. (Courtesy of Dr. Youssef Obeid, Clarksville, MD.)

anterior because of the supraeruption of the mandibular anterior teeth. Before any adjustment of the mandibular anterior teeth, a 0.020-inch vacuum-formed template was fabricated over the mandibular cast. Adjustments to the mandibular cast were made and marked in red (Fig. 7). The patient was advised of the possible need for endodontic treatment of these teeth before any intraoral modifications. After the mandibular anterior teeth were adjusted to allow the correct vertical dimension to be established,



Fig. 6. Frontal view of proposed maxillary setup. (Courtesy of Dr. Youssef Obeid, Clarksville, MD.)



Fig. 7. Adjustments to mandibular cast marked in red. (Courtesy of Dr. Youssef Obeid, Clarksville, MD.)

there was no tooth contact in the posterior. A mandibular occlusal device was fabricated for delivery at the time of maxillary denture insertion and adjustment of the mandibular anterior teeth. The vacuum-formed template was trimmed with a scalpel to the level of the teeth modifications so that the amount of reduction of the mandibular teeth was clearly evident at the time of intraoral modifications [21].



Fig. 8. (*A*) Vacuum-formed template in place before adjustments. (*B*) Vacuum-formed template in place after adjustments. (Courtesy of Dr. Youssef Obeid, Clarksville, MD.)



Fig. 9. (*A*) After insertion of maxillary complete denture, reduction of the mandibular anterior teeth and insertion of occlusal device. (*B*) Occlusal view of occlusal device. (Courtesy of Dr. Youssef Obeid, Clarksville, MD.)

The maxillary denture was inserted, and the mandibular teeth were adjusted to the proper corrected vertical dimension using the modified vacuum-formed stent (Fig. 8A,B). A mandibular occlusal device that maintained posterior contact was also inserted (Fig. 9A,B). The patient was seen on follow-up to evaluate the changes in vertical dimension and the effect on esthetics and phonetics. The patient exhibited no adverse signs or



Fig. 10. Occlusal view of mandibular crowns. (Courtesy of Dr. Youssef Obeid, Clarksville, MD.)

symptoms from the changes, so treatment proceeded with the restoration of the mandibular posterior teeth. All posterior teeth were restored with gold occlusal surfaces (Fig. 10). The maxillary posterior denture teeth were then modified using the chew-in or functionally generated wax technique to obtain gold occlusal surfaces to register and maintain the balanced occlusion better in all excursive movements (Fig. 11A–C) [22,23]. The final photographs show a more natural smile and a far more esthetic result. The attention to detail in preserving the balance in excursive movements gives these restorations a good long-term prognosis (Fig. 12A,B).



Fig. 11. (A) Functionally generated wax pattern. (B) Occlusals in wax ready for sprueing. (C) Gold occlusals. (Courtesy of Dr. Youssef Obeid, Clarksville, MD.)



Fig. 12. (A) Completed prostheses, facial view. (B) Completed prostheses, frontal view. (Courtesy of Dr. Youssef Obeid, Clarksville, MD.)

Class 4 includes patients whose occlusal discrepancies require addition to the width of the occluding surface [24]. These patients typically have an Angle's class 2 malocclusion, and present with constricted arches resulting in a posterior crossbite or a with a Brodie bite in which the entire mandibular dentition is lingual to the palatal surfaces of the maxillary teeth [25]. Fig. 13A–C shows a patient who exhibited a Brodie bite and who needed an immediate maxillary denture and an immediate interim mandibular partial denture. The maxillary teeth were placed in the most pleasing esthetic position, with care taken not to divert from the neutral zone. The occlusal surfaces were widened with wax to obtain balanced contacts in all movements. An additional row of teeth is an alternative method of treatment but is more expensive than building up the contacts in wax and eventually in denture base material.

# Class 5

Kelly [18] described combination syndrome as a situation that exhibits bone loss in the maxillary anterior, overgrowth of the tuberosities, papillary hyperplasia, extrusion of the mandibular anterior teeth, and loss of bone in



Fig. 13. (A) Frontal view of waxup. (B) Occlusal view of maxillary waxup. (C) Occlusal view of mandibular waxup.

the mandibular posterior in patients who have a maxillary complete denture opposing mandibular anterior teeth. Saunders [26] added six additional factors to include periodontal changes, loss of vertical dimension, occlusal plane discrepancy, poor prosthesis adaptation, epulis fissuratum, and anterior repositioning of the mandible. Although the combination syndrome is not found in every patient who has a maxillary complete denture opposing a Kennedy class I removable partial denture, one should be aware of the importance of equally distributed occlusal contacts between the maxillary denture and the mandibular natural teeth and the removable partial denture.

Figs. 14–17 shows the treatment of a patient who was edentulous on the maxillary arch for more than 20 years. Although a mandibular removable partial denture was initially fabricated, the patient admits to not wearing it



Fig. 14. Articulated clear duplicate maxillary denture. (Courtesy of Dr. Pete Gronet, Augusta, GA.)

very long. A clear resin duplicate was made of the maxillary denture and was used to articulate the casts (Fig. 14). The articulated casts clearly show that there is not enough space to fabricate the correct occlusal plane for the denture (Fig. 15A,B). With the mandibular incisor teeth and the retromolar pads serving as guides, the cast was adjusted in the tuberosity region. Fortunately, the sinuses were superiorly placed and would not be exposed during the surgical reduction of the tuberosity (Fig. 16A,B). A clear surgical



Fig. 15. (A) Preoperative right lateral view of articulated casts. (B) Preoperative left lateral view of articulated casts. (Courtesy of Dr. Pete Gronet, Augusta, GA.)



Fig. 16. (A) Right lateral view of articulated casts after adjustment. (B) Left lateral view of articulated casts after adjustment. (Courtesy of Dr. Pete Gronet, Augusta, GA.)

stent was fabricated to assist the oral and maxillofacial surgeon in the amount of tuberosity reduction and delivery of the maxillary denture. An interim mandibular removable denture was delivered at the same visit to maintain maximum occlusal contacts and to provide balance in all excursive movements (Fig. 17). After an appropriate healing period, a new complete maxillary denture and a cast metal–resin removable partial denture were fabricated.



Fig. 17. Frontal view of completed prostheses. (Courtesy of Dr. Pete Gronet, Augusta, GA.)

#### Summary

The single maxillary denture is a complex prosthesis that requires a complete understanding of the basics of denture occlusion. Theilemann's formula must be applied to each individual patient, and appropriate treatment must be taken to assure complete balance in all excursive movements. The basic principles of retention, stability, and support should not to be taken for granted, and steps must be completed so that all components are working in harmony for success of the maxillary denture. Treatment of various patients has been illustrated to allow the reader to comprehend better the modalities that can be employed for preparing the oral environment before denture insertion thereby ensuring better success in treating these classes of patients.

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