Combining fixed and removable restorations with linear occlusion to treat combination syndrome: A clinical report

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Proper treatment sequencing is critical when a patient requires multiple fixed restorations in conjunction with a removable partial and complete denture. The vertical dimension, centric relation, and horizontal occlusal plane must be determined first, followed by a diagnostic wax-up that incorporates linear occlusal concepts to prevent anterior hyperfunction. A more predictable treatment outcome is possible when individual components are defined clearly.

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A 62-year-old woman required a maxillary complete denture and a mandibular removable partial denture (RPD). A treatment plan was developed providing a systematic, sequential approach that would result in an acceptable outcome. Essential elements of treatment were proper horizontal plane of occlusion at the correct vertical dimension and centric relation.

Available denture space and proper positioning of maxillary central incisors are critical to esthetics, phonetics, and horizontal plane of occlusion; they must be determined at the onset of treatment. Traditionally, labial surface placement of the maxillary central incisor is 7.0–8.0 mm from the middle of the incisive papilla but thickness and firmness of the upper lips differ between men and women; as a result, it is advisable to start with a measurement of 5.0–6.0 mm for men and 7.0–8.0 mm for women. The correct placement for each individual patient can be determined only by evaluating the cosmetic results after the maxillary anterior teeth have been positioned. All of this information is essential during treatment planning.

The potential consequences of combination syndrome are a prime concern when placing a mandibular RPD opposite a maxillary complete denture. Combination syndrome describes the characteristic features that result when an edentulous maxilla is opposed by natural mandibular anterior teeth. These features include loss of bone from the anterior portion of the maxillary ridge, overgrowth of the tuberosities, papillary hyperplasia of the hard palate’s mucosa, extrusion of the mandibular anterior teeth, and loss of alveolar bone and ridge height beneath the mandibular RPD bases (a condition known as anterior hyperfunction syndrome). When progressive loss occurs in the vertical dimension of occlusion, the mandible naturally moves upward and forward, resulting in anterior or occlusal overload and additional loss of residual ridge.

Prevalence of combination syndrome among patients with a mandibular bilateral distal-extension RPD opposing a maxillary complete denture is 25%. According to Saunders et al, there is no way to predict which individuals will develop and demonstrate the sequelae of combination syndrome. All patients should be treated in a manner designed to avoid anterior hyperfunction; that is, the anterior teeth of maxillary complete dentures should be used for only cosmetic and phonetic purposes.

Regarding posterior occlusal scheme, Saunders et al advocated developing balanced occlusion by using the proper cuspal angulation in conjunction with condylar and incisal guidance; however, Schmitt advocated balancing occlusion by utilizing a functionally generated path approach and casting gold occlusal surfaces on posterior teeth with acrylic resin maxillary anterior teeth. Both Saunders et al and Schmitt recommended that the anterior teeth of all maxillary complete dentures be used for only cosmetic and phonetic purposes, keeping excursive contact to a minimum.

For traditional procedures, centric relation is recorded at a reduced vertical dimension (2.0–3.0 mm closed from vertical dimension of rest) and the occlusal plane is positioned at the height of the mandibular canines; as a result, maxillary anterior teeth invariably vertically overlap mandibular anterior teeth in centric occlusion. When positioning maxillary anterior teeth, the amount of horizontal overlap depends on the pre-existing skeletal relationship and individual esthetic requirements. Potential anterior contact and the resulting occlusal overload will always exist due to the natural upward and forward movement of the mandible with interior arrangements that incorporate the vertical overlap of mandibular anterior teeth.

A different approach involves using the alternative tooth form and occlusal concepts of linear occlusion. Linear occlusion is defined as the occlusal arrangement of artificial teeth as viewed in the horizontal plane when the masticatory surfaces of the mandibular posterior artificial teeth have a straight, long, narrow occlusal form resembling a line; it usually articulates with opposing monoplane teeth. The potential for anterior overloading is avoided due to three unique facets inherent in this concept. With linear occlusion, the occlusal plane is established at vertical dimension of rest, eliminating anterior vertical overlap; there is a predetermined, built-in vertical clearance between the maxillary and mandibular anterior teeth; and a bilateral fulcrum of protrusive stability is incorporated.

By definition, the occlusal configuration has no cusp inclines or surface
depressions for blades to intercept or contact during the envelope of function. As a result, the blades are free to move and contact their antagonist without interference during lateral excursion. Centric relation is recorded at or very near the vertical dimension of rest. Interocclusal rest space is provided by postprocessing milling and occlusal refinement. Injection molding (Ivocap, Ivoclar Vivadent, Inc., Amherst, NY; 800.533.6825) is the processing procedure of choice because there is minimal postprocessing pin opening. Anterior vertical overlap is eliminated with no closure between the rest position and the recorded centric relation; initial anterior vertical clearance of 1.0 mm also is integrated into the technique.

To create anterior clearance, casts are mounted on the articulator at proper vertical and centric relation. The horizontal plane of occlusion can be established with a stainless steel setup template (Geneva Dental, Inc., Beverly Hills, CA; 800.436.3827) that is 1.0 mm thick and 3.0 inches in diameter. The template should touch the incisal edge of the maxillary central incisors and the top of the retromolar papillae. Mandibular anterior teeth are arranged contacting the underside of this template while all of the maxillary posterior monoplane teeth contact the opposite side. When the template is removed, the mandibular bladed posterior teeth are arranged in contact with the opposing maxillary monoplane teeth.

This occlusal concept also incorporates a bilateral fulcrum of protrusive stability. This fulcrum results from a ridge created when the mesial third of the first monoplane premolar's occlusal surface inclines on either side toward its proximal contact area with the canine (Fig. 1 and 2). Posterior occlusal surfaces usually separate during incising (a phase known as Christensen's phenomenon) as the mandible moves forward and upward. Premolar blades in the opposing arch contact this ridge on either side simultaneously (Fig. 3). Anterior space of 1.0 mm is provided by the setup template, preventing incising contact. Occluding forces are directed vertically behind the anterior residual ridge, eliminating rotational movement of the maxillary denture that results from contact with unyielding mandibular anterior teeth in front of the residual ridge. As a result, a major cause of combination syndrome is prevented.

The patient who sought treatment was wearing a maxillary interim complete denture without a mandibular RPD (Fig. 4). Her anterior and posterior teeth were made from acrylic resin and arranged and modified to achieve both anterior and posterior contact with anterior vertical overlap. Considerable wear was evident when the mouth opened to allow a sufficient view of the mandibular dentition (Fig. 5). The patient had a history of fracturing the maxillary complete denture repeatedly in the right canine and lateral areas. Excessive occlusal wear was evident in the base material lingual to the right first premolar. Both of these conditions resulted from bruxism due to an incorrect occlusal registration that also could have contributed to the patient's chronic headaches and neck muscle spasms. Using a metal base in the maxillary complete denture may have prevented the repeated fractures but would not improve the plane of occlusion or prevent bruxism.

The patient required a maxillary complete denture, fixed restorations for the remaining mandibular teeth (to re-establish the occlusal plane), and a precision RPD. To prevent anterior hyperfunction, linear occlusion was the recommended occlusal scheme.

**Treatment**

At the initial clinical appointment, a two-consistency type, irreversible hydrocolloid material (Accu-Dent System 1 and 2, Ivoclar Vivadent, Inc.) was used to make maxillary and mandibular impressions from which stone casts were produced. Almimeter and papillimeter measurements were made and recorded for use in the construction of the esthetic control base. The almimeter (Geneva Dental, Inc.) not only determines the ala-to-ala width but also suggests male and female molds based on the patient's personality or
physical characteristics (Geneva 2000 Premium Quality Mold Selection Guide, Geneva Dental, Inc.). Using the papillameter (Geneva Dental, Inc.), the unsupported lip length was recorded; this measurement was used in establishing the anterior length of the esthetic control base. Shade was selected according to skin tone and the patient was dismissed.

Two maxillary stable bases were fabricated with autopolymerizing methyl methacrylate material (C-Plast, Geneva Dental, Inc.); the first was used to construct the esthetic control base using the alameter and papillameter measurements, while the second was used for mounting the recording plate (Vertical and Centric Recorder, Geneva Dental, Inc.) for the intraoral needle point tracing. Using photocuring material (Paladisc LC, Heraeus Kulzer, Armonk, NY; 800.431.1785), a mandibular stable recording base was made that covered all saddle areas and teeth except for the anterior labial surface. A horizontal ledge of photocuring material was attached on the buccal; when the intraoral tracing was accomplished, the maxillary and mandibular bases were luted together with impression plaster (Plastogum, Harry J. Bosworth Co., Skokie, IL; 800.323.4352). Using hard setup wax on the lingual aspect of the base, a short, slotted bar with a rounded adjustable screw was attached below the occlusal surfaces (Fig. 6).

At the second clinical appointment, the patient stood as vertical dimension of rest was determined. It was verified that the mandibular slotted bar was parallel to the recording plate that paralleled the horizon. Desired mandibular movements were demonstrated and the tracing was executed without the dentist making physical contact. Using impression plaster, the bases were luted together with the adjustable screw tip at the arrow point apex. The united bases were placed on their respective casts (Fig. 7) so that they could be mounted onto a semiadjustable articulator. The six maxillary anterior teeth (900 Series porcelain anterior, Geneva Dental, Inc.) and both first premolars (AutoCentric posterior teeth, Geneva Dental, Inc.) were arranged on the esthetic control base (Fig. 8). When the lip support and the visibility of the central incisors were deemed appropriate for the patient's age and gender, she was dismissed.

The recording bases were removed after mounting and the posterior ridge relationship was evaluated; at that point, the mandibular arch was determined to be much narrower than the maxillary arch. In addition, both mandibular premolars on either side showed a definite lingual inclination. The esthetic control base with its anterior tooth arrangement was returned to the maxillary cast and the setup template was positioned to contact both the maxillary central incisors and the top of the retromolar papillae, establishing the horizontal plane of occlusion. Evaluating the relation of mandibular teeth to the template at the new vertical dimension of occlusion revealed that the cusp tips of the left premolars were approximately 0.25 mm out of contact with the template. The space increased progressively, with the right premolar cusp tips several millimeters short of contact (Fig. 9).

The occlusion would be rehabilitated by restoring the mandibular posterior teeth using porcelain-to-metal restorations with buccal cutting blades incorporated into their occlusal contour. Conservative Empress overlay veneers (Ivoclar Vivadent) would restore the height of the abraded mandibular anterior teeth; torquing forces would not be a problem on the veneers since the anterior teeth would not contact.

The ridgelap area of both maxillary first premolars was reduced to permit positioning as far as possible lingually to improve their occlusal relationship with the mandibular premolars (Fig. 10).
A line was drawn on the template from the buccal tip of each first premolar to a point 4.0 mm lateral to a line drawn down the crest of the mandibular residual ridge. Buccal cusp tips from the remaining maxillary posterior teeth were placed on the esthetic control base contacting this line. The mandibular anterior teeth were waxed to contact the undersurface of the setup template (Fig. 11). After removal of the template, the mandibular premolars were waxed with a blade to mimic the contour of manufactured bladed posterior teeth contacting the maxillary monoplane teeth (Fig. 12).

A decision had to be made regarding the type of temporaries that would be utilized when the mandibular teeth were prepared and impressed. One possible approach involved duplicating existing contours to oppose the existing maxillary denture. The selected approach was designed to duplicate the diagnostic work-up and included a new maxillary transitional complete denture that would possess the desired esthetics as well as the proper horizontal plane of occlusion and anterior separation necessary to prevent further combination syndrome sequelae. The interim restorations' occlusal anatomy would be identical to that of the proposed porcelain-to-metal restorations, allowing the patient to adjust to new speech patterns and chewing techniques prior to delivery of the finished restorations.

The patient was recalled and the trial denture esthetic composition was evaluated. The trial denture was approved and permission to proceed was requested and received. The maxillary trial denture was duplicated to fabricate an interim complete denture using resin block posterior (Jet acrylic resin, Lang Dental, Wheeling, IL; 800.222.5264) made from impressions of the mono-plane setup; at that point, the acrylic resin blocks and a duplicate set of the approved porcelain maxillary anterior teeth were placed in the tooth voids. Tissue undercut, buccal and labial extension, frenum attachment areas, and palatal surface were relieved sufficiently for the duplicate denture to be placed on the master cast in an occlusal relationship identical to that of the trial denture on the articulator. It was tacked into this position on the master cast (Fig. 13) and transferred to a rigid, two-post, reline instrument. Autopolymerizing methyl methacrylate acrylic resin was used to reline the palatal portion of the duplicate denture; tissue undercut and border areas were filled with tissue conditioning material (Lynal, Dentsply Caulk, Milford, DE; 800.532.2855) (Fig. 14).

Using silicone putty (Sil-Tech, Ivoclar North America), a stone cast was made from an irreversible hydrocolloid impression of the diagnostic wax-up to construct a lingual matrix; the matrix extended into the edentulous area on either side and onto the lingual surfaces of the anterior teeth. The stone teeth were covered with two thicknesses of baseplate wax and an autopolymerizing acrylic resin impression tray was fabricated. The area of relief was filled with polyvinyl siloxane impression material (Cinch Platinum, Parkell, Farmingdale, NY; 800.243.7446) and an impression was made (Fig. 15).

For the initial preparation of the mandibular teeth, routine, acceptable clinical procedures were followed. The final lingual, occlusal, and incisal reductions were performed to the extent required for the placing of the new restorations; at that point, an irreversible hydrocolloid impression was made and a cast was produced using quick-set stone. Photocast material was adapted to cover the edentulous areas, terminating above the muscle attachments and over the premolars to contact the tissue on the buccal and incisal surfaces of the anterior teeth. The short-slotted bar, with a short adjusting screw from the Vertical and Centric Kit (Geneva Dental, Inc.), was attached
Fig. 16. The stable mandibular recording base with short-slotted bar and short adjusting screw held in position by extra-hard baseplate wax.

Fig. 17. The interim restorations and provisional complete denture immediately after placement. Even with bilateral mandibular anesthesia, noninterceptive occlusion permits multiple nontripping occlusal contacts.

Fig. 18. The solid stone mandibular cast is mounted to the previously mounted maxillary cast.

Fig. 19. Finished Empress overlay veneers in position on their dies. Full contour wax-up of premolar abutments exhibit occlusal rests.

Fig. 20. The metal castings are fitted to their dies and the metal support for the porcelain blades is shaped properly.

Fig. 21. Permanently cemented Empress overlay veneers. The mandibular posterior interim restorations and maxillary provisional complete denture remain functional.

with extra-hard setup wax (Fig. 16).

After completing the preparations, a polyvinyl siloxane impression (Exaflex, GC America, Alsip, IL; 800.323.7063) was made. A new centric relation record was made using the new mandibular recording base in addition to the previously used maxillary base and recording plate; the bases were luted together with Plastogum, filled with a bisacryl composite provisional material (ProTemp II, 3M ESPE, St. Paul, MN; 888.364.3577), and seated on the preparations. Using the edentulous areas as tissue stops, the vertical height of the diagnostic wax-up was duplicated in the provisional restorations. The mandibular interim restorations were cemented with Nogenol (GC America). At that point, the transitional maxillary complete denture was inserted and the occlusion was evaluated (Fig. 17); protrusive anterior clearance was verified before the patient could be dismissed.

Two casts were produced from the polyvinyl siloxane impression. The first was silver-plated, with removable dies for waxing patterns; the second was a solid stone cast for fabricating and processing the RPD. Both were verified against the relationship record base for accuracy of fit and mounted in the articulator containing the maxillary master cast (Fig. 18).

The trial denture was processed by injection molding, returned on its master cast, and milled with 220 grit silicon carbide waterproof sandpaper on a 0.25-in. thick plate glass slab. The monoplane teeth were verified to be flat and contact ed in only one plane against the black Post Processing Occlusal Template (Geneva Dental, Inc.). The processed denture (on its cast) was returned to its articulator mounting. The setup template was attached to the maxillary denture and Empress crowns patterns were waxed into contact with the template's underside. Right and left premolar abutments, including blades, were waxed to full contour and the ERA matrix female attachment patterns (ERA RV Attachment, Sterngold, Attleboro, MA; 800.243.9942) were positioned and attached. An occlusal rest was placed in the mesio-occlusal area of the first premolars (for indirect retention) and the distolingual line angle of the occlusal of the second premolars (to act as a vertical stop for the RPD framework) (Fig. 19). The wax-ups were cut back to accommodate porcelain and the castings were completed; at that point, the metal was finished, retaining sufficient support for the porcelain blades (Fig. 20).

Guide planes were remilled and polished. The Empress crowns were delivered when the porcelain was stacked, fired, and finished (especially the contact areas on the mesial of the first premolars). The luting medium was a dual cure (photo and chemical) resin cement (Variolink, Ivoclar Vivadent) (Fig. 21). The absence of protrusive anterior contact was verified before the patient was dismissed.

Blades on the premolar abutment crowns were marked with articulating paper and reduced vertically with Silky stones (Geneva Dental, Inc.) until both sides achieved uniform contact; at that point, the blades were marked with the edge of a No. 2 pencil and the buccal and lingual markings were reduced until a thin, straight line was present. The ground porcelain was smoothed with silicone carbide-impregnated porcelain polishing wheels (Brasseler USA, Savannah, GA; 800.841.4522).

The abutment crowns were transferred to the solid second pour cast and a
4x magnification binocular scope (Mantis, Vision Engineering, New Milford, CT; 800.644.7264) was used to verify the marginal fit. The tilt of the cast was determined by placing the superior surface of each patrix (male) parallel to a broad blade waxing tool in the surveyor (Fig. 22). A gold RPD framework was fabricated with one major modification: the inclusion of an open metal chimney to attach the ERA patrix metal housing (Fig. 23). The metal housings were attached to the RPD framework with a clear autopolymerizing acrylic resin (Duralay, Reliance Dental, Worth, IL; 708.597.6694) prior to setup procedures and subsequent prosthesis processing.

After the metal housings were attached to the RPD framework, thin tin-foil was adapted to the cast edentulous areas. The crowns were placed on their dies, positioning the RPD framework, and the first molar ridge area over the ERA attachment was reduced and positioned in wax on the framework. The blade on each molar was reduced vertically until vertical dimension of occlusion was achieved; the blade's sharpness was accomplished after processing. The crowns were removed, the framework was reseated and sealed to the cast, and the wax-up was finalized (Fig. 24).

The mandibular prosthesis was processed by injection molding, recovered, and finished. The abutment crowns were seated in the finished prosthesis, which was seated on the removable dies; absence of contact was confirmed between the RPD saddles and stone ridge areas. The prosthesis was removed and silicone adhesive was applied to the stone ridge areas while putty was mixed and placed in each saddle area. The abutment crowns were reseated on the cast (Fig. 25). The blades on both abutments and the prosthesis were refined vertically to re-establish vertical dimension of occlusion and on the buccal and lingual aspects to establish a thin, straight, anterior-posterior line (Fig. 26). The porcelain blades' altered surfaces were smoothed and repolished and the processed maxillary complete denture was recovered and finished.

Flatness of the monoplane teeth was evaluated again at delivery. Uniform contact was restored by placing the denture on the plate glass slab and rubbing it in one direction against 220 grit water-proof sandpaper. The denture was fitted with pressure indicator paste to identify and eliminate potential tissue irritants. Abutment crowns were seated and margin integrity and contact with the canine Empress veneers were confirmed. The ERA retentive patrices were removed from their metal housings and the mandibular prosthesis was fitted with pressure indicator paste. The occlusion was evaluated only after the prosthesis was confirmed to be seated fully, with tissue contact, lingual plating, and rests to occlusal rests in intimate contact.

The simultaneous contact of porcelain mandibular and maxillary teeth produces a distinctive ringing sound; a dull, double-click sound is heard when occlusion is off. The patient was instructed to tap her posterior teeth together rapidly; this produced a dull contacting sound. The lips were parted and the patient was instructed to close her mouth slowly, stopping on the first contact of posterior teeth. The closure was observed and the location of first point of contact was noted; at that point, articulating paper was used to mark the occlusal contacts. The blades (never the flat surfaces) were
reduced vertically until uniform intensity was achieved and the buccal and lingual blades were reduced until a straight line was re-established. The patient was instructed to slide the mandible forward until the anterior teeth were in an edge-to-edge relationship. Both maxillary and mandibular teeth were reduced until contact in this position was eliminated (Fig. 27).

After the least retentive white ERA patrices were inserted, the ball portion was reduced in diameter with a 169L fissure bur (Brasseler USA) to reduce resistance against removal. The abutments were seated with Nogenol and the patient was instructed about insertion and removal of the prosthesis. Abutments were stabilized by placing a finger on the occlusal surfaces where vertical force was being applied to the saddle; once retention was lost on that side, the same procedure was performed on the other side. At that point, bilateral vertical force could be applied to the prosthesis without dislodging the crowns.

The patient returned 24 hours later for a postinsertion check of tissue and occlusion. Flatness of the monoplane teeth was evaluated using the black template; no discrepancies were discovered. Using 320 and 400 grit waterproof sandpaper on a plate glass slab, the flat porcelain surfaces received a smoother finish. Occlusion was evaluated by sound, visual appearance, and articulating paper and was found to occur with simultaneous contact.

After one month of retention using provisional cement, the abutment crowns were cemented permanently with glass ionomer cement (Ketac Cem, 3M ESPE). New white retentive patrices were inserted in the metal housings, allowing the application of simultaneous vertical force without dislodging the abutment crowns.

Summary
Before restorative procedures could begin, critical parameters of vertical dimension, centric relation position, and occlusal plane were delineated. Anterior hyperfunction was prevented by eliminating anterior vertical overlap, employing noninterceptive occlusion and integrating a bilateral fulcrum of protrusive stability into the occlusal configuration. To prevent incorporating habitual closure patterns into the centric relation recording, a non-manipulative bone- and muscle-dictated interoral needlepoint tracing was used to determine and register centric relation.

The value of a pretreatment diagnostic work-up cannot be overemphasized. For situations where fixed restorations oppose a maxillary complete denture—regardless of what occlusal philosophy is used—complete denture construction must be made through wax try-in before crown preparations can begin. Any changes necessary for correcting discrepancies in vertical dimension, centric relation, and esthetics become more difficult to accomplish if the fixed restorations are completed first. Without these changes, anterior hyperfunction often cannot be eliminated.

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The author has no commercial interest in any of the manufacturers listed in this article.

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References

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