

TOPICS OF INTEREST

Maximizing Mandibular Prosthesis Stability Utilizing Linear Occlusion, Occlusal Plane Selection, and Centric Recording

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The stability of mandibular complete dentures may be improved by reducing the transverse forces on the denture base through linear (noninterceptive) occlusion, selecting an occlusal plane that reduces horizontal vectors of force at occlusal contact, and utilizing a central bearing intraoral gothic arch tracing to record jaw relations. This article is intended to acquaint the reader with one technique for providing stable complete denture prostheses using the aforementioned materials, devices, and procedures.

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INDEX WORDS: flat plane teeth, bladed teeth, lineal occlusion, centric relation, gothic arch tracing

OBTAINING CONSISTENT mandibular denture stability has long been a challenge for dental professionals. The dynamic contact of teeth has an effect on the stability of denture bases, the forces transmitted to denture bearing tissues, and the comfort and function experienced by patients.¹ Literature has supported the use of linear (also known as lineal) occlusion to enhance the stability of complete denture prostheses.^{2,3} Noninterceptive occlusion (linear occlusion) requires that there should be no interference or interception with mandibular movement in protrusive or lateral excursions.

It has been reported that linear occlusion minimizes horizontal force vectors that act to dislodge

prostheses.^{2,3} It has been the experience of the authors that the use of linear occlusion, in conjunction with a steeper than conventional occlusal plane, assists in stabilizing mandibular denture bases. This is particularly helpful for patients exhibiting advanced mandibular residual ridge resorption. The additional use of intraoral central bearing gothic arch-tracing devices aids in producing repeatable centric relation measurements contributing to more stable mandibular denture bases.

Concept of Linear Occlusion

The Glossary of Prosthodontic Terms (January 1999, 7th edition) credits William H. Goddard, of Louisville, Kentucky with the founding of linear occlusion. In 1966 J.P. Frush described occlusion in geometric terms as one-dimensional (linear), two-dimensional (flat plane), and three-dimensional (cusped). This geometric classification of occlusion specifically classified the dimensional contact between occluding posterior teeth. Linear occlusion was promoted as an occlusal scheme that led to increased stability of denture bases by minimizing the lateral forces applied to those bases.²

Gronas and Stout explained how both anatomic and nonanatomic occlusal schemes transmit significant lateral forces to the denture bases, and they suggested that linear occlusion had the potential for creating the smallest lateral force

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Figure 1. Zero degree teeth on a monoplane maxillary plane of occlusion.



Figure 2. Bladed teeth set in a straight line for linear occlusion.

component.³ Massad refers to a similar concept to minimize the lateral interferences that contribute to denture base instability.⁴ Linear (noninterceptive) occlusion consists of the following basic parameters:

1. Zero degree (flat plane) teeth are opposed by bladed (line contact) teeth in which the blade is in a precisely straight line over the crest of the ridge (Figs 1–3).^{2,3}
2. Mandibular teeth are set to a flat (monoplane) occlusal plane (Fig 1).
3. There is no anterior tooth interference to protrusive or lateral movements (Fig 4).

Mandibular prosthesis stability may be analyzed by comparing the directional forces transmitted to associated denture bases by anatomic teeth, zero-degree teeth, and linear teeth. In the

maximum intercuspation position, surface contact between posterior anatomic teeth consists of multidirectional, but equalized, vectors (Fig 5). The directional forces change in eccentric positions, and there is a significant lateral force component exerted on the denture bases (Fig 6).⁵

Zero degree teeth may establish a monoplane (flat plane) occlusal scheme, as referred to by Lang¹ and Jones,⁶ in which the teeth are arranged in a single plane. Zero degree teeth set to a curve, in an attempt to achieve balance, result in additional planes. These inclined planes can cause skidding of the denture bases and induce excessive friction.⁷ A monoplane occlusal scheme with zero degree teeth reduces the horizontal force components because the direction of forces between zero degree teeth in centric and eccentric positions is essentially vertical (Fig 7).⁷ However,



Figure 3. Bladed teeth in a straight line over the crest of the mandibular edentulous ridge.



Figure 4. Linear occlusal scheme with no anterior tooth contact in protrusive or lateral excursions.

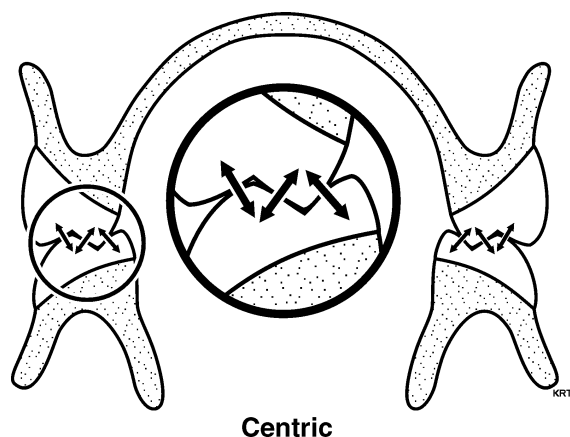


Figure 5. Anatomic occlusal scheme: Multidirectional force vectors to denture bases equalized in centric occlusion.

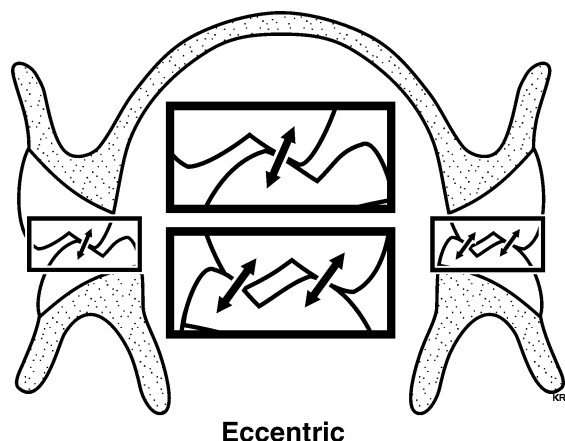


Figure 6. Anatomic occlusal scheme: Significant lateral force vectors on denture bases when in lateral eccentric positions.

in eccentric positions there is an inequity in the opposing surface area contact between working and nonworking sides and there is a shift in the location of the forces between the occluding teeth (Fig 8). The frictional resistance between the wide occlusal tables of zero degree teeth may contribute horizontal forces to the denture bases. The direction of force to the mandible changes location during movement from centric to eccentric positions in both anatomic and flat plane occlusions, thus contributing to instability of the denture base (Figs 5–8).^{2,3}

In linear occlusion, the size of the requiring the greatest stability may determine the arch receiving the bladed teeth. The mandible most

often requires greater stability, thus our example places the bladed teeth on the mandibular arch. The occluding forces between a zero degree and a bladed tooth are vertical in centric and eccentric positions (Figs 9 and 10). The location of force to the mandibular edentulous ridge does not vary regardless of the occluding position (Fig 10). There is minimal surface contact area between the flat plane and blade in linear occlusion, thus denture base movement due to frictional resistance is minimized. Noninterceptive occlusion provides a consistent vertical seating force in both centric and eccentric movement; hence, transverse force vectors are essentially eliminated.^{2,3} The zero degree teeth are flattened against fine-grit

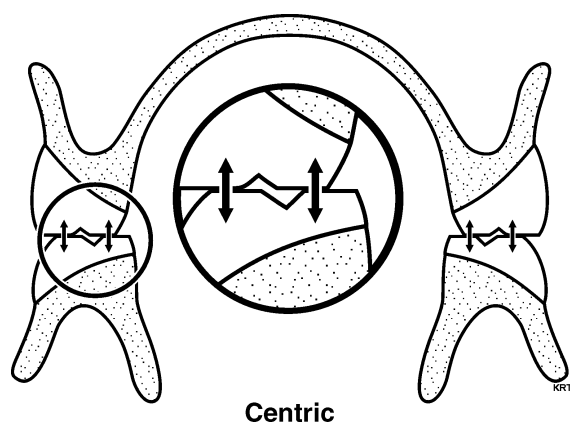


Figure 7. Zero degree occlusal scheme: Force vectors are vertical and equalized in centric occlusion.

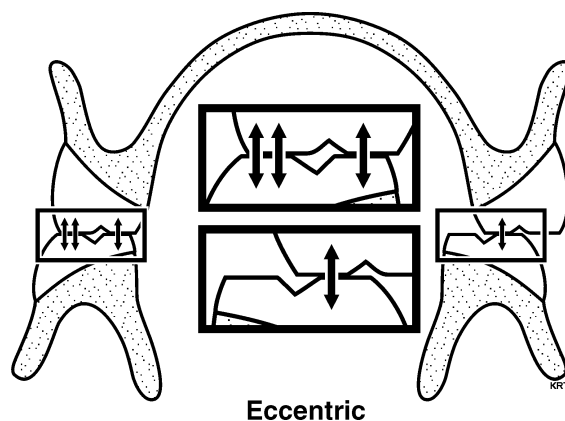


Figure 8. Zero degree occlusal scheme: Force vectors are vertical, non-equalized, and position has shifted in lateral eccentric positions.

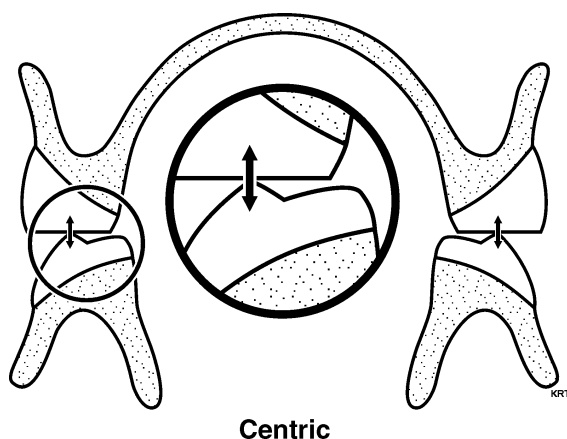


Figure 9. Linear occlusal scheme: Force vectors are vertical and equalized in centric occlusion.

abrasive paper over plate glass to ensure an ideal one-dimensional occlusal plane between left and right quadrants. The blade-line contact with the zero degree (flat plane) reduces the width component of the force seen in other zero degree denture occlusions and increases the force per unit area of contact (Fig 2).

Noninterceptive occlusion, as utilized in this technique, is developed using opposing porcelain surfaces. Porcelain teeth have been reported to maintain the vertical dimension of occlusion longer than do plastic teeth due to their ability to withstand wear.^{3,5} Occlusal disharmony in a porcelain–porcelain occlusion may also be identified earlier by causing a sore spot, as the porcelain

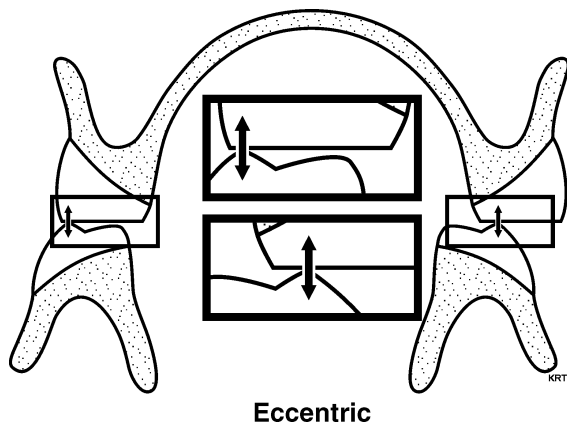


Figure 10. Linear occlusal scheme: Force vectors remain vertical, equalized, and in same position over edentulous ridge in eccentric positions.

does not wear rapidly enough to keep up with the anatomic changes of the residual ridges.³ In the authors' opinion, this enables a practitioner to eliminate occlusal discrepancies sooner, resulting in less postinsertion discomfort for the patient and significantly fewer postinsertion adjustments.

Plane of Occlusion

The plane of occlusion is set steeper than in denture tooth arrangements commonly advocated in the literature^{8,9} to help seat the mandibular denture base into the mean foundation plane of the mandible (2nd premolar/1st molar region)^{5,8} and to facilitate the development of protrusive balancing contacts for a flat occlusal plane (no compensating curve).^{2,10} The posterior determinant of the plane of occlusion is the superior extent of the retromolar pad.

Esthetics and phonetics are used to determine the maxillary anterior tooth position, and the mandibular incisors are set along this horizontal plane with no vertical overlap (Fig 11). Maxillary and mandibular incisors are set with no vertical overlap so as to reduce anterior interference (interception) in lateral and protrusive movements. Vertical overlap is permissible if a sufficient horizontal overjet will protect against premature anterior tooth contact (Fig 4).^{2,6,8} Verification of adequacy of the occlusal plane is made at the wax try-in appointment.



Figure 11. Linear occlusal scheme: Anterior determinant of occlusal plane is the central incisors. Posterior determinant of occlusal plane is the height of the retromolar pad. No anterior tooth contact in any excursive movement.

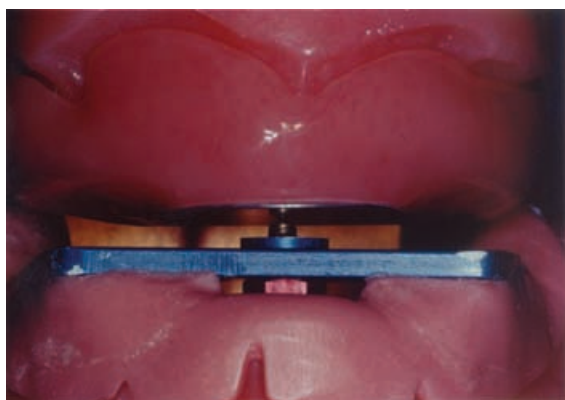


Figure 12. Intraoral central-bearing gothic arch-tracing device.

Centric Relation

For extremely resorbed ridges, a consistent, repeatable, and easily verified centric relation recording may be achieved through using an intraoral gothic arch-tracing device (Geneva Dental, Beverly Hills, CA).¹¹⁻¹⁴ The work of Kapur and Yurkstas confirmed the findings of Trapozzano and Kingery that the central bearing assembly will provide equalization of occlusal pressure and increase base stability when mucosal resiliency is modest.¹¹⁻¹³ Although the wax method of recording centric relation is accurate, it requires considerable experience to produce repeatability. The gothic tracing method is a highly reliable technique for even the inexperienced operator (Figs 12 and 13).^{12,13} Centric relation records can be readily verified at the wax try-in stage.



Figure 13. Intraoral central-bearing gothic arch-tracing device.

Clinical Technique

1. Irreversible hydrocolloid (Accu-Gel, Ivoclar North America, Inc., Amherst, NY) and stock edentulous trays (Accu-Dent, Ivoclar North America, Inc.) are used to make overextended maxillary and mandibular impressions. Maxillary and mandibular impressions are poured and casts trimmed. Muscle tonicity and frenum extensions are determined intraorally and noted for both the maxillary and mandibular denture arches. Following location of the mylohyoid ridges, external oblique ridges, and retromolar pads intraorally, a myostatic outline form is scribed on the mandibular cast.
2. Anterior tooth position, maxillary incisor length, and lip support were determined with the wax rim after which the anterior 6 teeth were set.
3. Vertical dimension of occlusion is determined by evaluating the patient's interocclusal rest space, profile, tactile sense, and comfort, and centric relation recordings were obtained with the intraoral gothic arch tracing.⁹
4. The casts are mounted and occlusal plane determined using the heights of the retromolar pads and positions of the incisal edge of the central incisors.² A metal template was set at the level of the incisal edge of the central incisors and made level with the height of the highest retromolar pad and secured to the mandibular cast. The template then serves as the flat surface to which the maxillary zero degree teeth are set (Fig 1). After the maxillary teeth are set, the mandibular anterior teeth are arranged ensuring no anterior or lateral protrusive contacts (Figs 4 and 11). The corresponding mandibular posterior bladed teeth are set in a straight line over the edentulous ridge.²
5. Centric relation, vertical dimension of occlusion, esthetic and phonetic relationships, occlusal plane angulation, and denture base stability are verified at a wax try-in appointment. After receiving patient approval, the dentures are processed and delivered.

Equilibration

Although complete denture occlusion may be equilibrated with the Coble Intra-Oral BalancerTM (Coble Denture Research Co. Inc, Greensboro,

NC)⁴ or utilizing a clinical remount, in the authors' experience, a more simplified approach does exist for linear occlusion.³ Following postprocessing equilibration on the articulator, occlusion is evaluated intraorally via a three-step clinical process. While somewhat subjective, the first step is to listen for a clear, distinctive single-click upon closing, which is indicative of uniform centric contact.¹⁵ A double-click indicates one side is occluding prematurely. Secondly, a close intraoral observation of centric relation closure will frequently enable a practitioner to determine which side is occluding prematurely. Finally, the offending contact is verified with thin articulating film before adjustment.^{3,5,15}

Discussion

Mandibular denture base stability has been reported to be increased through linear occlusion.³ It is the authors' opinion that the mandibular denture base stability is improved via linear occlusion, a steeper-than-conventional plane of occlusion, and an accurate centric relation recording by a central bearing intraoral gothic arch tracing. Linear occlusion has been reported to significantly reduce transverse force vectors and to provide a consistent vertical seating force in both centric and eccentric mandibular movement, thus improving stability.^{2,3,5,11-14}

Although linear occlusal schemes can be achieved using acrylic opposing acrylic or porcelain opposing acrylic, the use of porcelain-porcelain occlusion is most resistant to wear. Porcelain-porcelain occlusion is distasteful to some practitioners. First, the increased clicking sound during mastication may be disturbing to the patient and second, some believe it is more difficult to adapt to porcelain teeth.^{1,3,5} Some believe plastic, as opposed to porcelain, will more easily accommodate an occlusal disharmony. It seems a logical deduction that this could potentially eliminate some postoperative discomfort.³ Some practitioners prefer the hardness of composite resin teeth as well as the ease of occlusal adjustment.¹ Porcelain teeth will always wear less than acrylic teeth, and it would stand to reason that this can help preserve the vertical dimension of occlusion over time.^{4,5} Linear occlusion can occasionally cause an esthetic concern for the patient when flat plane teeth are set on the maxillary arch. This problem can be easily rectified by using either an

anatomic first premolar or by esthetically reshaping the buccal aspect of the flat plane tooth.³

Although there are many acceptable techniques, the intraoral gothic arch tracing has been proven to be repeatable and consistent even in inexperienced hands. It also increases maxillary and mandibular base stability by providing a central bearing area during the recording process. This is especially evident in severely resorbed mandibular ridges.¹¹⁻¹³

Conclusion

The purpose of this article was to present a less familiar concept for providing improved mandibular prosthesis stability with the use of linear occlusion and steeper occlusal plane selection. In this clinical technique, a gothic arch tracing device was utilized to record centric relation. In the authors' experience with linear occlusion and the techniques presented here, exceptional mandibular prosthesis stability and patient satisfaction due to lack of movement of the denture bases, lack of sore spots, and fewer postoperative visits have been the result.

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