CLASSIC ARTICLE

Occlusion in removable partial prosthodontics

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Dental literature contains voluminous information on the masticating mechanism and its component parts—their interrelationship in health and in disease, and in harmony and disharmony. Numerous opinions have been expressed as to etiology of dysfunctions of the masticatory system, the role played by each of its components, and methods of treatment and prevention.

It is doubted that any observant dentist does not relate the extreme importance of the contacting relationships between the incising and masticating surfaces of the opposing upper and lower teeth in his pursuit of success in treatment of patients. If this statement is acceptable, can we not then say that the maintenance or creation of a harmonious occlusion is a much strived-for end result in a practice oriented to preventive dentistry? What is a harmonious occlusion? Stated simply, it is an occlusion whereby the masticating mechanism can carry out its physiologic functions while the factors of occlusion remain in a state of good health. The factors of occlusion are the temporomandibular joints, the neuromuscular mechanism, the teeth, and their supporting structures.

Varying techniques are used to create harmonious occlusions in distressed mouths. Different concepts also exist among dentists concerning the contacting relationships of opposing teeth in seeking occlusal harmony. It is presumptious to assume that the proponents of varying documented concepts and techniques do not enjoy success or limited successes as those among us may enjoy. It seems, therefore, that the knowledge, judgement, understanding, and skill of each dentist is more important in treating patients than the technique or concept of occlusion to which he subscribes. As Weinberg[1] stated, "in the final analysis, the true value of our individual work can be measured only by the degree of fineness with which we practice the art of dentistry, rather than the particular school of thought to which we adhere."

Sears[2] had this to say about opinions and beliefs: "Orthodoxy, which is the agreement with currently accepted opinions, needs to be challenged. We should never hesitate to test any and all existing beliefs, no matter how well established. So long as we can agree that you will challenge me, and I will challenge you, in the true spirit of fact finding, progress will continue".[2] Another author[3] stated "The controversy about occlusion cannot be resolved for three reasons: (1) much knowledge is based upon empirical rather than scientific information, (2) the tolerance of the oral organ or the upper and lower physiologic limits are so broad that because a certain concept failed in one specific mouth, it does not mean that it would fail in all mouths, and (3) the tremendous variable factor of the individual dentist and the standards by which he evaluates his completed restorations." He continues by stating, ". . . since there is no one answer to occlusal problems, the dentist should use the philosophy that works best in his own hands and at the same time does the most good, or better yet, the least harm to the patient."[3]

Dentists are confronted with a rather vexing problem in restoring the dentition of a partially endentulous patient with removable partial dentures. The problem centers mainly around the differences in characteristics of the supporting structures of the restoration—the relatively firmly attached natural teeth on the one hand, and the displaceable soft tissues of the residual ridges on the other hand. Additionally, occlusal and incisal relationships for removable partial dentures involve both the natural and artificial teeth. Factors related to both of these conditions must be observed and correlated in creating a harmonious occlusion with removable partial dentures. All of us recognize that the vexing problems of occlusal rehabilitation, including maintenance, are somewhat reduced when treating patients with fully tooth-borne removable restorations as opposed to the distal extension type of removable partial denture.

The purpose in preparing this article was to elicit, by a review of textbooks and dental periodical literature, common denominators and differences in approaches advocated in the occlusal rehabilitation of partially endentulous patients by means of removable partial dentures. This undertaking was made more difficult because of the different meanings ascribed by authors, teachers, and clinicians to the same terms and words.

It seems that many of our problems are not with concepts, per se, but are created because we cannot always understand exactly what the other person is saying when he writes or talks about occlusion. For example, one author's concept of balanced occlusion may be "the simultaneous contacting of the upper and lower teeth on

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the right and left in the anterior and posterior occlusal areas in centric or any eccentric position."[4] Another author's concept may be "such an ideal state of equilibrium during functional movements of mastication that all teeth are as uniformly stressed as possible."[5] It is noted that one concept spells out contact relationships of opposing teeth and the other concept does not. Unless contact relationships of opposing teeth are designated by an author, or we all accept the same terminology, confusion could exist in the mind of the reader or listener by use of the term "balanced occlusion." The utopia of unanimity of the usage of terms by authors, teachers, and clinicians can hardly be expected to become a reality just yet. However, the efforts toward the achievement of this goal by the Academy of Denture Prosthetics, certain individuals, and other agencies are recognized and appreciated.

In reviewing the literature, unless otherwise stated by an author, "balanced occlusion" was considered to mean simultaneous contacting of the upper and lower teeth on the right and left in the anterior and posterior occlusal areas in centric or any eccentric positions within the functional ranges of the teeth. By the same token, "centric occlusion" was considered to mean the relation of opposing occlusal surfaces which provides the maximum planned contact and/or intercuspation.

Sixteen textbooks and 119 articles in dental periodical literature were reviewed in compiling the succeeding interpretations.[6] Inference that the available literature was exhausted to gather this information is not intended. However, it is believed that a representative cross-section of concepts and practices appeared in the literature reviewed. The continuing discussion is predominately related to the denture supported by both the teeth and residual ridges as opposed to the tooth-borne type of restoration.

APPARENT COMMON DENOMINATORS

Disagreement with the following statements could not be ascertained in the literature reviewed for the preparation of this article:

1. Whichever is the treatment of choice, it must be capable of function within the pattern of the patient's own functional requirements.
2. It should be considered basic that we cannot encroach upon the integrity of the interocclusal rest space (free-way space).
3. Great caution should be exercised before any procedure to increase the vertical dimension of occlusion is undertaken.
4. The combined occlusal patterns of natural and artificial teeth must be adjusted to function harmoniously with other parts of the masticatory system.
5. When posterior teeth of one jaw are brought into contact with their antagonists in centric occlusion, they should touch simultaneously with no deflective occlusal contacts.
6. Opposing, contacting teeth should glide freely and without cuspal interference throughout the functional range of occlusal movement.
7. Attempts to create artificial occlusal surfaces should be preceded by the elimination of any occlusal discrepancies in the natural teeth.
8. Recording of maxillomandibular relations is best accomplished for a relaxed and conditioned patient.
9. Disorders of the temporomandibular joints, the neuromuscular mechanism, or periodontium should be corrected to the greatest extent possible prior to the development of definitive articular patterns.
10. Statistical averages can be used only as beginning points of reference, not as therapeutic averages.
11. Orthodontic procedures may constitute an important part in the correction of some occlusal disharmonies.
12. Diagnostic casts, correctly oriented on a suitable anticulator, may be valuable diagnostic and treatment planning aids.
13. Natural teeth respond less favorably to horizontally directed forces than to forces directed axillary over their greatest root mass.
14. The stability of denture bases, supporting artificial teeth, is an important factor in maintaining a previously created harmonious occlusion.
15. The dental treatment program should be presented to the patient in such a way that the patient is fully aware of its benefits and also understands his responsibilities in the program.
16. A periodic recall of the patient to evaluate the response of the oral environment to dental treatment is a necessary adjunct of treatment.
17. Artificial posterior teeth should be smaller buccolingually than the natural teeth which they replace.
18. Artificial teeth should be arranged so the tongue will not be inhibited nor will the shape of the palatal vault be substantially altered.
19. The horizontal jaw position to which the removable partial denture(s) will be constructed—centric relation or centric occlusion, when these factors do not coincide in the remaining natural teeth—is an important decision which must be made prior to the construction of the restorations.
20. Lower artificial posterior teeth should not be positioned farther distally than the anterior border of the retromolar pad or upon an acute upward incline of the mandible posteriorly.
21. The portion of the occlusal plane formed by artificial posterior teeth should be as relatively parallel to the crest of the residual ridge as possible.

ALMOST COMMON DENOMINATORS

Only minimal opposition to the following statements could be ascertained in the reviewed literature:

1. The maxillomandibular tooth relationship, when the mandible is in its posterior terminal hinge position, is fundamental in treatment planning.
2. Incisal guidance is an important factor in formulating articular patterns of artificial posterior teeth.
3. Denture bases, extended within the physiologic tolerance of bordering structures, are preferable to support occlusal loading of distal extension type of removable partial dentures.

VARYING CONCEPTS AND PRACTICES

The following concepts and practices, under various headings, are listed in descending order according to agreement among the greatest number of authors of the literature reviewed:

Diagnostic casts

1. Face-bow transfer of the maxillary diagnostic cast to an articulator should be either: (a) an arbitrary type of face-bow with provision for an anterior point of reference, (b) an arbitrary face-bow, (c) a kinematic face-bow, or (d) a face-bow not necessary.
2. Mandibular diagnostic cast should be oriented to the mounted maxillary cast in: (a) centric relation; (b) centric occlusion; (c) rest position.
3. The materials for making maxillomandibular registrations include: (a) waxes, (b) impression plaster, (c) impression pastes, and (d) modeling compound.

Planning for the correction of diagnosed occlusal disharmonies of natural teeth

1. Diagnostic casts should be oriented to an articulator (occlusal corrections and diagnostic waxing of casts prior to intraoral procedures).
2. Disclosing materials are used in the mouth to evaluate tooth contacts and lack of contacts (waxes, articulating ribbon or paper, irreversible hydrocolloid).
3. Diagnostic casts are oriented on an occlusion analyzer.
4. Diagnostic casts are made and related by hand.

Methods used in correction of occlusal discrepancies of natural teeth (exclusive of orthodontic or surgical repositioning of teeth or use of individual restorations)

1. Natural or restored surfaces of teeth are recontoured using altered mounted diagnostic casts as patterns or blueprints to accomplish like oral procedures.
2. Natural teeth are recontoured as indicated by using waxes, articulating paper or ribbon, or other materials intraorally.
3. Natural teeth or restored surfaces are recontoured as indicated by using a central bearing pin device.
4. Abrasive materials (pastes) are used intraorally under patient's own movements.

A combination of 1 and 2 above seemed to be the practice in the greatest number of articles reviewed.

The methods or instruments used in developing occlusal patterns

These include (1) semiadjustible articulators, (2) adjustable articulators, and (3) functionally generated path techniques.

Horizontal jaw relationships to which occlusal patterns are developed

This may be either (1) centric relation or (2) centric occlusion (when centric relation and centric occlusion do not coincide in the remaining natural teeth).

See the tables for practices used in developing contacting relationships of opposed artificial teeth (Table I) and for methods used for the correction of occlusal discrepancies of processed dentures (Table II).

Materials used for occlusal surfaces of artificial posterior teeth

Decided preferences were expressed for the following combinations of opposing posterior artificial teeth: (1) porcelain teeth opposed by porcelain teeth, (2) gold occlusal surfaces opposing natural or restored natural teeth, (3) gold occlusal surfaces on fixed partial dentures.

AUTHOR'S OPINIONS AND PRACTICES

A stable removable restoration will cause fewer undesirable changes in its supporting structures than an unstable restoration. Stability is defined as that quality of a denture to be firm, steady, constant, and not subject to change of position when forces are applied on it.[7] A more meaningful definition to me in considering stability is "that characteristic of a removable restoration which resists forces that tend to alter the relationship between the denture base and its supporting bone."

Many factors must be considered in developing a stable removable restoration and, certainly, occlusion is one of the most important factors. Aside from kinematics; the mechanical advantages gained in promoting stability by the orientation of the artificial posterior teeth in relation to the residual ridges must be considered. The lower posterior teeth can usually be arranged with their buccal cusps over the buccal turning point of the crest of the residual ridge, thus reducing leverage factors which would otherwise accrue if the artificial teeth were positioned farther buccally. However, since the lower posterior teeth form the pattern for the arrangement of the maxillary posterior teeth, the buccal cusps of the maxil-

Table I. Practices used in developing contacting relationships of opposed artificial teeth

Restorations	Centric relation	Centric occlusion	Working side	Balancing side	Protrusive
Lower bilateral distal extension denture opposed by natural teeth or fixed partial dentures	1 2 3 *	1 2 3 4	1 2	2	2
Lower unilateral distal extension denture opposed by natural teeth or fixed partial dentures	1 2 3	1 2 3 4	1 2	2	2
Maxillary bilateral distal extension denture opposed by natural teeth or fixed partial dentures	1 2 3	1 2 3 4	1 2 3	2 3	2
Maxillary unilateral distal extension denture opposed by natural teeth or fixed partial dentures	1 2 3	1 2 3 4	1 2	2	2
Opposing bilateral distal extension removable partial dentures	1 2 3	1 2 3 4	1 2 3	2 3	2
Class IV (only anterior teeth replaced)		1			
Lower bilateral distal extension denture opposed by maxillary complete denture	1 2	1 2 3	1	1	1

*1, Largest group; 2, second largest group; 3, third largest group; 4, smallest group.

Table II. Method used for the correction of occlusal discrepancies of processed dentures

	Group				
Procedure	Largest	Second largest	Third largest	Fourth largest	Smallest
On articulator by remounting denture and indexed processing cast before recovery of denture	X	X			
On articulator by remounting finished dentures using new interocclusal records			X	X	
Intraorally on finished dentures using disclosing waxes, articulating ribbon or paper, or other disclosing agents	X	X		X	X
At the initial placement appointment	X		X	X	
After the dentures have "settled"		X			X

lary teeth will usually have to be positioned lateral (and unfavorably) to the crest of the maxillary residual ridge.

For this reason, I prefer to develop simultaneous working and balancing contacts for maxillary bilateral distal extension removable partial dentures. Of course, it is desirable to have simultaneous contact of the involved remaining natural teeth when the artificial posterior teeth contact in a working relationship. Seemingly, this would distribute forces to both the residual ridges and the supporting bone of the natural teeth. Such an arrangement would tend to lessen the forces accruing to abutment teeth when the maxillary denture had a tendency to rotate.

A further consideration of mechanics indicates that shunting tendencies of a lower distal extension removable partial denture would be lessened if the occlusal plane is not overly elevated posteriorly or a pronounced compensating curve developed in the arrangement of artificial teeth. By the same token, posterior teeth should not be arranged over a steep upward incline of the residual ridge posteriorly, and the most distal posterior tooth should not be positioned farther posteriorly than the beginning of the retromolar pad.

I believe that determining the horizontal jaw relation to which the removable restorations are to be constructed is one of the first critical decisions facing a dentist because all other mouth preparation procedures depend upon this analysis. Failure to make this decision correctly may result in destruction of the residual ridges and supporting structures of the teeth.

If most posterior natural teeth remain and there is no evidence of temporomandibular joint disorders, neuromuscular disturbances, or periodontal pathosis due to occlusal trauma, the proposed restoration may be safely constructed in the horizontal jaw relation contiguous with

Table III. Contact relationships of opposing posterior teeth to be sought when treating patients with removable partial dentures

Restorations	Centric relation	Centric occlusion	Working side	Balancing side	Protrusive
Lower bilateral distal extension denture opposed by natural teeth or fixed partial dentures	X	X	X		
Lower unilateral distal extension denture opposed by natural teeth or fixed partial dentures	X	X	X		
Maxillary bilateral distal extension denture opposed by natural teeth or fixed partial dentures	X	X	X	X	
Maxillary unilateral distal extension denture opposed by natural teeth or fixed partial dentures	X	X	X		
Opposing bilateral distal extension removable partial dentures	X	X	X	X	
Class IV (only anterior teeth replaced)		X			
Lower bilateral distal extension denture opposed by maxillary complete denture	X	X	X	X	X*

*When appearance, phonetics, and a favorable occlusal plane are not compromised.

centric occlusion. On the other hand, when most natural centric occlusal stops are missing, the restoration should be constructed so that centric relation and centric occlusion coincide. It has been my experience that by far the greatest number of distal extension removable partial dentures should be made so that centric relation and centric occlusion *do* coincide. I do not feel that it is necessary to interfere with an occlusion simply for the reason that it does not completely conform to a geometric ideal.

With the foregoing reasoning, in treating patients with removable partial dentures, the contact relationships of opposing posterior teeth listed in Table III are strived for.

To maintain the vertical dimension of occlusion and to prevent excessive abrasion of opposing occlusal surfaces, my preference is to use: (1) porcelain teeth against porcelain teeth, (2) gold occlusal surfaces to oppose natural or restored natural teeth, and (3) gold occlusal surfaces to oppose fixed partial dentures. It has been my observation that plastic teeth, regardless of the material by which they are opposed, abrade rather rapidly, thus decreasing the established vertical dimension of occlusion and altering the relationship of opposing artificial teeth.

Discrepancies in the occlusion of removable restorations, which occur as a result of processing procedures, must be corrected before the patient is given possession of the restorations. My preference is to remount the polished dentures on a suitable articulating instrument adjusted by new maxillomandibular records. I find it extremely difficult to interpret the recording of deflective contacts by the intraoral use of articulating paper or ribbon or disclosing waxes. Admittedly, many dentists can adequately correct occlusal discrepancies by intraoral methods. However, this seems not to be within my capabilities.

SUMMARY

Textbooks and representative articles from dental periodical literature related to occlusion in removable partial prosthodontics were reviewed. An attempt was made to ascertain common denominators as well as varying concepts and practices among the authors. The author of this article states his opinions and practices in developing contacts of opposing teeth with distal extension removable partial dentures and the correction of occlusal discrepancies due to processing procedures.

CONCLUSIONS

The knowledge, judgment, understanding, and skill of each dentist is more important in treating patients than the technique or concept of occlusion to which he subscribes.

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