

A SYSTEMATIC APPROACH TO FULL-MOUTH RECONSTRUCTION OF THE SEVERELY WORN DENTITION

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Aesthetic and functional restoration of the severely worn dentition represents a significant clinical challenge. One of the most demanding aspects of such cases involves the development of sufficient restorative space, while simultaneously fulfilling aesthetic, occlusal, and functional parameters essential to long-term success. When evaluating and diagnosing a patient with severely worn dentition, emphasis must be placed on the occlusal prematurities preventing condylar seating into the centric relation position. Success in maintaining severe wear cases depends on the development of proper anterior guidance to allow for posterior disclusion within the patient's envelope of function.

Learning Objectives:

This article demonstrates a procedure that allows the clinician to obtain the space required for restoration of severely worn dentition. Upon reading this article, the reader should:

- Be aware of a method that allows the clinician to satisfy a patient's aesthetic demands while fulfilling aesthetic, occlusal, and functional parameters.
- Understand the potential benefits of seating the condyles in a centric relation position.

Key Words: vertical dimension, centric relation, tooth wear, TMJ

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Restoration of the severely worn dentition is one of the most challenging procedures in dentistry. In order to successfully restore and maintain the teeth, one must gain insight into how the teeth arrived at this state of destruction. Tooth wear can result from abrasion, attrition, and erosion.¹⁻⁵ Research has shown that these wear mechanisms rarely act alone and there is nearly always a combination of the processes.¹⁻⁵ Evaluation and diagnosis should account for the patient's diet, history of eating and/or gastric disorders, along with the present state of the occlusion. Emphasis must be placed on the evaluation of occlusal prematurities preventing condylar seating into the centric relation position.⁶ Behavioral factors that may contribute to parafunctional habits and/or nocturnal bruxism are also important to understand and manage in order to successfully restore and maintain a healthier dentition.⁷ Once a complete understanding of the etiology of the dentition's present state is appreciated, a treatment plan can be formulated, taking into account the number of teeth to be treated, condylar position, space availability, the vertical dimension of occlusion (VDO), and the choice of restorative material.⁸

While all occlusions wear to some degree over the lifetime of the patient, normal physiological wear usually does not require correction.⁶ Severe or excessive wear refers to tooth destruction that requires restorative intervention. Severe attritional wear can result from occlusal prematurities that prevent functional or parafunctional movements of the jaw. This wear can be seen at the site of the prematurity or on the anterior teeth as a result of the "hit and slide" forward.⁶ Restoration of the worn anterior teeth then becomes a challenge as space availability for prosthetics becomes limited. If lengthening the teeth is a goal in order to achieve a more aesthetic smile, then the question of the need to alter VDO subsequently arises.

There is some debate among professionals as to what constitutes the need to open VDO in the restoration of anterior teeth.⁹ In most cases, clinicians look to alter vertical dimension for one or all of the following reasons: to gain space for the restoration of the teeth; to improve aesthetics; or to correct occlusal relationships. Understanding what determines the VDO and what the effects of altering it have on the temporomandibular joint (TMJ), muscle comfort, bite force, speech, and long-term occlusal stability are prerequisites to restoring the worn dentition. Spear clearly outlines the principles of VDO and concludes that patients can function at many acceptable vertical dimensions, provided the condyles are functioning from centric relation and the joint complex is healthy. He states that "vertical is a highly adaptable position, and there is no single correct vertical dimension." He further concludes that the best vertical

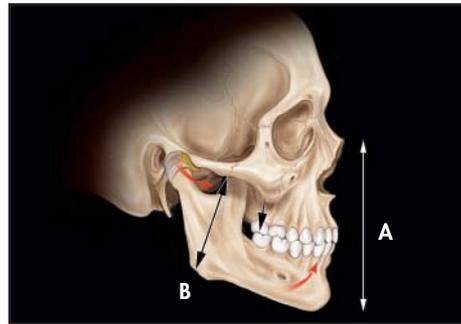


Figure 1. Posterior prematurities can cause the mandible to close in a position forward of centric relation.

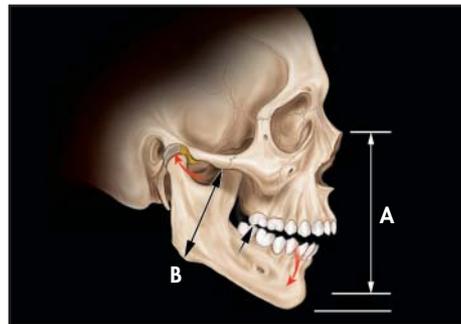


Figure 2. When the condyles are seated in centric relation, posterior teeth act as a fulcrum to prevent contact with the anterior teeth.



Figure 3. Preoperative view of a patient who presented with severely worn dentition.



Figure 4. Bonded restorations were present on the lingual aspect of the maxillary anterior teeth, originally placed to restore a combination of attrition and erosion.



Figure 5. A centric relation bite record was performed with the use of a leaf gauge.



Figure 6. Mounted study casts revealed the second molars to be in premature contact when the condyles were seated in centric relation.



Figure 7. An intraoral composite mockup was performed to establish the ideal length for the central incisors.



Figure 8. The full-mouth diagnostic waxup took into account that the second molars would be removed and aesthetic crown-lengthening procedures performed.

dimension is the one that satisfies the patient's aesthetic desires and the practitioner's functional goals with the most conservative approach.⁹

Vertical dimension is developed by the balance of ramus growth and tooth eruption⁹ and is affected by the repetitive contracted length of the elevator muscles during growth and development. It is, therefore, generally measured by a point on the maxilla and a point on the mandible at the area of first molars. Often, due to posterior prematurities the muscles of mastication are in a state of imbalance and will close the mandible in a position that is not in alignment with centric relation due to accommodation of the teeth.¹⁰ This position is usually forward of centric relation (Figure 1).

Clinical examination of this condition will reveal anterior tooth wear with minimal posterior wear. When the condyles are seated in the centric relation position and the teeth come together, the posterior teeth act as a fulcrum that prevents the anterior teeth from touching (Figure 2). This anterior separation may provide enough space for the clinician to restore the aesthetic requirements of tooth length while maintaining a position that allows restoration of maximum intercuspation in conjunction with centric relation.¹⁰

When starting from a centric relation position, opening of the anterior teeth by 3 mm will yield a posterior separation of approximately 1 mm and stretch the masseter muscle length approximately 1 mm. If the condyles are not in centric relation and are subsequently seated to a more superior position, every millimeter of vertical seating will reduce the masseter muscle length by 1 mm,⁹ thereby eliminating the need for a true opening of vertical dimension. The following case presentation demonstrates a means to obtain the space required for the restoration of severely worn dentition without altering the VDO.

Case Presentation

A 55-year-old male patient presented with the chief complaint of anterior tooth wear and requested aesthetic enhancement (Figure 3). Clinical examination revealed severely worn anterior teeth and premolars in addition to bonded restorations on the lingual aspects of the maxillary anterior teeth to restore what appeared to be an erosive process. Advanced abrasion and or erosion were present on many buccal surfaces of the canines and premolar teeth (Figure 4). The patient related a history that included clenching, grinding, and, as a young man, gastric regurgitation. His periodontal status included areas of posterior pocketing with advanced bone loss in the second molar regions. The gingiva also exhibited areas of clefting in the anterior regions.

In order to properly diagnose the case, a comprehensive examination was conducted, inclusive of a full-mouth radiographic series, caries detection, and periodontal probing. Evaluation of the TMJs was unremarkable, with normal jaw opening and range of motion. No joint sounds, signs or symptoms of instability were evident. Joint loading in centric relation was performed utilizing bimanual manipulation and a leaf gauge.^{11,12} Both methods resulted in no reported tension or tenderness and revealed first point of contacts on the second molars, with a forward slide into the maximum intercuspation position.

Impressions for study casts were then made, along with a centric relation occlusal record utilizing the leaf gauge and a facebow transfer (Figure 5).¹¹⁻¹³ Following the mounting of the study casts, it became apparent that by seating the condyles in a centric relation position, the second molars were in premature contact and there was sufficient space gained to restore the anterior teeth to the proper aesthetic length (Figure 6).

Treatment Planning

Following periodontal consultation, it was determined that all of the second molars would be extracted due to advanced bone loss. Osseous surgery would follow in all four posterior quadrants, as would aesthetic crown lengthening in the anterior region. Due to the advanced wear of the remaining teeth, the treatment plan involved full-coverage restorations on all teeth. The presence of sclerotic dentin and the possibility of continued clenching and/or bruxism established the need for cemented, as opposed to adhesive, restorations.^{14,15} For long-term predictability, the author selected porcelain-fused-to-metal (PFM) restorations. Zirconia crowns would also have represented an acceptable choice.

Once the treatment plan was accepted, an intraoral composite mockup was performed and photographed to establish an ideal length for the central incisors from an aesthetic standpoint (Figure 7). These images and the measured length of the maxillary central incisors were then communicated to the laboratory technician to aid in the fabrication of a full-mouth diagnostic waxup, which would be completed with the understanding that the second molars were to be removed and that aesthetic crown lengthening procedures would be performed to raise the gingival tissues in the anterior region (Figure 8). Prior to waxing the case, the ceramist fabricated a centric relation anterior index that would maintain the centric relation position at the desired VDO during the preparation phase (Figure 9). This index can be made from hard laboratory putty or GC pattern resin.



Figure 9. The ceramist fabricated a centric relation anterior index that held the centric relation position at the desired vertical dimension.



Figure 10. Measurement of the anterior space from marginal tissue of teeth #9(21) through #24(31) (14.64 mm) in maximum intercuspation.

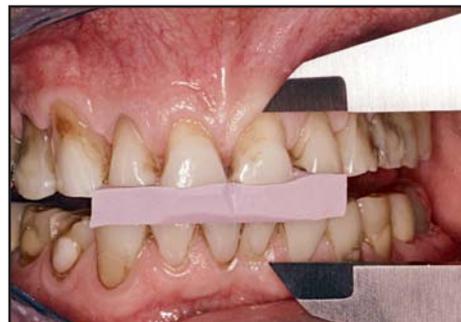


Figure 11. By seating the condyles, a gain of 2.38 mm in anterior space was achieved without appreciably stretching the elevator muscles.



Figure 12. Preparation of the maxillary posterior teeth was performed using the index, and posterior bites were taken.



Figure 13. Anterior bite record taken with posterior bite records in place, maintaining the desired centric relation and VDO position.



Figure 14. The provisional restorations were placed with petroleum jelly, in order to facilitate simple removal the following day.



Figure 15. The mandibular posterior teeth were prepared with the anterior bite records from day 1 in place to hold centric relation and VDO.



Figure 16. The mandibular anterior teeth were prepared and a new anterior bite record was taken utilizing the new posterior bite records to maintain centric relation and VDO.

Tooth Preparation

Following a two-month period of periodontal healing and maturation, the patient was scheduled for appointments on two consecutive days to prepare first the maxillary, then the mandibular arches. On the first day, the author utilized the centric relation index and measured from the marginal tissue of teeth #9(21) through #24(31)—gaining 2.38 mm of anterior space by simply having the condyles seated in centric relation. This anterior opening was accomplished without appreciably stretching the elevator muscles (Figures 10 and 11). Preparation of the maxillary right and left posterior teeth was then performed using the index to confirm clearance. With the index in place, posterior bites were taken utilizing a rigid bite-registration material (ie, Futar-D, Roydent Dental Products, Johnson City, TN) (Figure 12).

The index was then removed, and the anterior teeth were prepared utilizing the posterior bite records to verify clearance. Following completion of the anterior preparations, an anterior bite was obtained with the posterior bite records in place. By systematically recording the posterior bite with the centric index in place and then the anterior bite with the posterior bites in place, the centric relation and vertical dimension position were maintained (Figure 13).

A full-arch polyether impression (Perma-soft, Garant-L, 3M ESPE, St. Paul, MN) was then taken, followed by the fabrication of provisional restorations (Luxatemp, Zenith/DMG, Englewood, NJ) created in three sections: two posterior sections from molar to first premolar, and an anterior section from canine to canine. Since the maxillary arch was prepared on the first day, occlusion was adjusted against the provisionals through equilibration of the mandibular teeth (Figure 14).

During the second visit, the maxillary provisional restorations were removed and the anterior bite record from day one was inserted to hold the centric relation and vertical dimension while the mandibular posterior teeth were prepared. Following bilateral preparation of mandibular posterior teeth, bite records were taken with the anterior bite record in place (Figure 15). The mandibular anterior teeth were then prepared utilizing the posterior bite records to check clearance, and a new anterior bite record was taken (Figure 16).

A polyether final impression was then made, and mandibular provisional restorations were fabricated from the index of the diagnostic waxup. As with the maxillary provisional restorations, the mandibular provisionals were fabricated in three sections (Figure 17). The provisional restorations were subsequently equilibrated to establish maximum intercuspation in centric relation along with canine guidance and anterior coupling in protrusive guidance (Figure 18).

Once the provisional restorations were equilibrated and the aesthetics and phonetics were deemed satisfactory, an occlusal bite record was taken of the maxillary and mandibular provisional restorations. The maxillary posterior sections were removed and, with the anterior section still in place, posterior bite records were taken. The anterior section was then removed and, with the posterior bite records in place, an anterior bite record was taken.

Impressions of the provisional restorations were made, and a facebow recording was taken of the maxillary provisionals. Utilizing the facebow, the maxillary provisional model was mounted on the articulator; the mandibular model was then mounted using the occlusal bite record of the provisionals against each other. The ceramist was thus able to fabricate a custom incisal guide table (Figure 19). A custom incisal guide table, as described by Dawson, allows the ceramist to reproduce the anterior guidance established in the mouth with the provisional restorations.⁶ The protrusive path and lateral excursions were recorded in pattern resin on a flat guide table by movement of the articulator pin in the unset resin.⁶

Once the incisal guide table was fabricated, cross mounting began. The maxillary preparation model was mounted against the mandibular provisional restorations utilizing the third set of bite records. The mandibular preparation model was next mounted against the maxillary preparation model with the first set of bite records (Figure 20).

Along with digital photographs of the preparations and provisional restorations, the ceramist had all the information necessary to fabricate the definitive restorations. A putty index was made from the provisional model to confirm the exact length and shape for the final restorations, while the custom guide table provided information on the shape of the lingual aspects and the path taken for the canine and protrusive guidance.

Definitive Restorations

Following a three-week period, the provisional restorations were removed, the case was tried in, and then evaluated for aesthetics, occlusion, and phonetics. Since the ceramist followed the guidelines of the provisional restorations, minimal adjustments were necessary at this stage (Figures 21 through 23). Final equilibration of the case was accomplished with a leaf gauge and a computerized occlusal analysis system (ie, T-Scan III, Tekscan, Boston, MA) (Figure 24).¹⁶⁻¹⁷

Conclusion

Severe wear cases present many challenges to the restorative dentist, including gaining the space to create restorations to satisfy the patient's aesthetic desires, while



Figure 17. Final provisional restorations fabricated in three sections.



Figure 18. Occlusal equilibration in centric relation establishing canine and protrusive guidance.

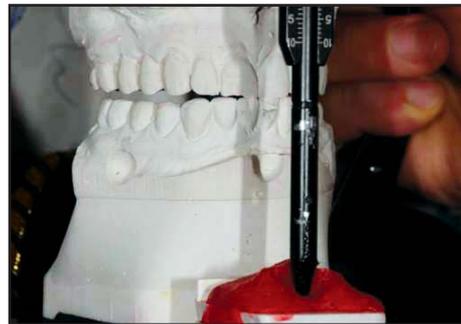


Figure 19. Fabrication of a custom incisal guide table.



Figure 20. The mandibular preparation model was then mounted against the maxillary preparation model with the first set of bite records.



Figure 21. The provisionals were removed, and the definitive crowns were tried in and evaluated for aesthetics, occlusion, and phonetics.



Figure 22. View of the completed maxillary restorations. Guidelines established through provisionalization ensured minimal adjustments were needed.



Figure 23. Occlusal view of the aesthetic final restorations seated on the mandibular arch.

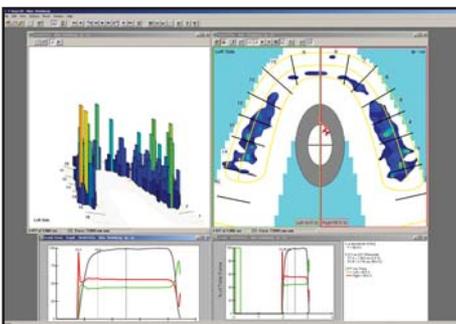


Figure 24. Final equilibration of the case was accomplished with a computerized occlusal analysis (T-Scan III, Tekscan, Boston, MA).

also fulfilling occlusal and functional parameters that are essential for long-term success. The case presented has demonstrated that the required space may be obtained by seating the condyles in centric relation position. The maintenance of severe wear cases can be ensured by the development of proper anterior guidance that allows for posterior disclusion within the patient's envelope of function. Taking this guidance into account during provisionalization ensures minimal adjustments in the definitive restorations and a greater long-term predictability of the case.

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References

1. Addy M, Shellis RP. Interaction between attrition, abrasion and erosion in tooth wear. *Monogr Oral Sci* 2006;20:17-31.
2. Beyth N, Sharon E, Lipovetsky M, Smidt A. Wear and different restorative materials—A review. *Refuat Hapeh Vehashinayim* 2006;24(3):6-14.
3. Grippo JO, Simring M, Schreiner S. Attrition, abrasion, corrosion and abfraction revisited: A new perspective on tooth surface lesions. *J Am Dent Assoc* 2004;135(8):1109-1118.
4. Verrett RG. Analyzing the etiology of an extremely worn dentition. *J Prosthodont* 2001;10(4):224-233.
5. Litonjua LA, Andreana S, Bush PJ, Cohen RE. Tooth wear: Attrition, erosion, and abrasion. *Quint Int* 2003;34(6):435-446.
6. Dawson PE. *Functional Occlusion: From TMJ to Smile Design*. St. Louis, MO: Mosby; 2006:432-433.
7. Neff P. Trauma from occlusion. Restorative concerns. *Dent Clin North Am* 1995;39(2):335-354.
8. Dahl BL, Carlsson GE, Ekfelt A. Occlusal wear of teeth and restorative materials. A review of classifications, etiology, mechanism of wear, and some aspects of restorative procedures. *Acta Odontol Scand* 1993;51(5):299-311.
9. Spear FM. Approaches to vertical dimension. *Adv Esthet Interdiscip Dent* 2006;2(3):2-12.
10. Sesemann MR. Enhancing facial appearance with aesthetic dentistry, centric relation, and proper occlusal management. *Pract Proced Aesthet Dent* 2005;17(9):615-620.
11. Long JH Jr. Location of the terminal hinge axis by intraoral means. *J Prosthet Dent* 1970;23(1):11-24.
12. Mckee JR. Comparing condylar positions achieved through bimanual manipulation to condylar positions achieved through masticatory muscle contraction against an anterior deprogrammer: A pilot study. *J Prosthet Dent* 2005;94(4):389-393.
13. Fenlon Mr, Woelfel JB. Condylar position recorded using leaf gauges and specific closure forces. *Int J Prosthodont* 1993;6(4):402-408.
14. Tay FR, Pashley DH. Resin bonding to cervical sclerotic dentin: A review. *J Dent* 2004;32(3):173-196.
15. Kwong SM, Tay FR, Yip HK, et al. An ultrastructural study of the application of dentine adhesive to acid-conditioned sclerotic dentine. *J Dent* 2000;28(7):515-528.
16. Kerstein RB, Wilkerson DV. Locating the centric relation prematurely with a computerized occlusal analysis system. *Compend Contin Educ Dent* 200;22(6):525-528.
17. Kerstein RB. Disocclusion time-reduction therapy with immediate complete anterior guidance development to treat chronic myofascial pain-dysfunction syndrome. *Quint Int* 1992;23(11):735-747.

CONTINUING EDUCATION (CE) EXERCISE No. 3



To submit your CE Exercise answers, please use the answer sheet found within the CE Editorial Section of this issue and complete as follows: 1) Identify the article; 2) Place an X in the appropriate box for each question of each exercise; 3) Clip answer sheet from the page and mail it to the CE Department at Montage Media Corporation. For further instructions, please refer to the CE Editorial Section.

The 10 multiple-choice questions for this Continuing Education (CE) exercise are based on the article "A systematic approach to full-mouth reconstruction of the severely worn dentition," by Jay Lerner, DDS. This article is on Pages 81-87.

1. Which of the following factors contribute to the development of tooth wear?
 - a. Abrasion.
 - b. Attrition.
 - c. Erosion.
 - d. All of the above.
2. Preoperative evaluation is critical to restorative success, and should include:
 - a. The patient's diet, history of eating, and/or gastric disorders.
 - b. The patient's present state of occlusion.
 - c. Behavioral factors that may contribute to parafunctional habits.
 - d. All of the above.
3. How is vertical dimension developed?
 - a. By balancing ramus growth and tooth eruption.
 - b. By allowing the teeth to grow in a state of imbalance.
 - c. By allowing the mandible to close in a state that is not in alignment with centric relation.
 - d. None of the above.
4. Which of the following reasons justify the clinician's alteration of vertical dimension?
 - a. To gain space for tooth restoration.
 - b. To improve aesthetics.
 - c. To correct occlusal relationships.
 - d. All of the above.
5. According to this article, patients can only function at only one standardized, acceptable vertical dimension. Vertical is not an adaptable position, and must be maintained at the same degree for all cases.
 - a. Both statements are true.
 - b. Both statements are false.
 - c. The first statement is true, the second statement is false.
 - d. The first statement is false, the second statement is true.
6. Severe attritional wear occurs as a result of:
 - a. Lifetime degradation.
 - b. Restorative intervention.
 - c. Occlusal prematurities preventing functional and para-functional movement of the jaw.
 - d. None of the above.
7. When a patient presents with severe anterior wear the clinician should:
 - a. Automatically open the vertical dimension.
 - b. Restore the dentition to the existing occlusal scheme.
 - c. Look to remove any posterior prematurities to centric relation before restoring dentition.
 - d. None of the above.
8. When the condyles are seated in the centric relation position and the teeth come together:
 - a. Prematurities on posterior teeth act as a fulcrum that prevent the anterior teeth from touching.
 - b. The anterior teeth will limit adequate canine guidance for compromised function.
 - c. Insufficient space will be provided for the clinician to restore the aesthetic requirements of the tooth length.
 - d. Restoration of maximum intercuspation in conjunction with centric relation is prevented.
9. Why did the clinician maintain the placement of the posterior bite records while obtaining the anterior bite registration throughout the tooth preparation sequence?
 - a. To maintain the centric relation.
 - b. To maintain the vertical dimension position.
 - c. Both a and b are correct.
 - d. Neither a nor b are correct.
10. How was the length of the central incisors determined to ensure optimal aesthetics?
 - a. Using a composite mockup.
 - b. Using clinical photography.
 - c. Using a full-mouth diagnostic waxup.
 - d. All of the above.