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Restoration of the extremely worn dentition

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Most dentists agree that minimal and gradual attrition of the occlusal surfaces of teeth is a normal process during the lifetime of a patient. However, excessive occlusal attrition can result in pulpal pathology, occlusal disharmony, impaired function, and esthetic disfigurement (Fig. 1). Patients with excessive wear often require extensive restorative treatment. This article discusses the diagnostic evaluation, treatment planning, and modes of restorative treatment for patients who suffer from extreme occlusal wear.

ETIOLOGY

Occlusal wear is most often attributed to attrition, which is defined as the wearing away of one tooth surface by another tooth surface.[1] However, there are several etiologic factors that can result in excessive occlusal wear.

Congenital anomalies

Amelogenesis imperfecta is a hereditary defect of dental enamel that occurs in a ratio of 1/14000 persons in the general population (Fig. 2). This anomaly has been classified into three basic types: hypoplastic, hypomaturation, and hypocalcified.[2] All three types result in relatively early loss of enamel with concomitant and more rapid attrition of tooth structure. In the hypoplastic type, the enamel has only one eighth to one fourth of the normal thickness, while the enamel of the hypomaturation type has normal thickness but is softer than normal and tends to fracture from the dentin. Enamel in the hypocalcified type is also of normal thickness but is extremely friable and frequently lost soon after tooth eruption.

Dentinogenesis imperfecta, or hereditary opalescent dentin, is a dominant autosomal trait with a high degree of penetrance and occurs in the general population in a ratio of 1/8000 persons. This anomaly may or may not be associated with the generalized skeletal disease osteogenesis imperfecta. Dentinogenesis imperfecta is characterized by an amber-colored translucency of the dentition, and because of a weakened attachment between the normal enamel and the affected dentin, the enamel has a tendency to shear and expose the relatively soft dentin subject to rapid and extensive attrition.

These are the most common congenital anomalies that contribute to excessive occlusal wear, but there are other more unusual dysplasias of the enamel and dentin that can result in early marked dental attrition.

Parafunctional occlusal habits

The effect of chronic bruxism and other oral habits such as biting on needles, pipe stems, pencils, and hairpins, if continued over an extended period of time, is often attrition of tooth structure (Fig. 3). The habits are usually associated with emotional stress. Bruxism may be triggered by occlusal interferences. Counseling the patient to break these destructive habits, with concurrent occlusal splint therapy and occlusal adjustment, is often adequate treatment if the condition is diagnosed early. Occlusal habits of long-standing duration may result in extensive tooth attrition that requires restoration.

Abrasion

Abrasion is defined as the wearing away of tooth tissue by external agents. Toothbrush abrasion is a common example, but it is usually restricted to the gingival portion of the facial surfaces rather than the occlusal surfaces of the teeth. Occlusal abrasion is usually attributed to diet, the chewing of abrasives such as tobacco (Fig. 4), and environmental factors such as constant exposure to dust and grit in a farming occupation.

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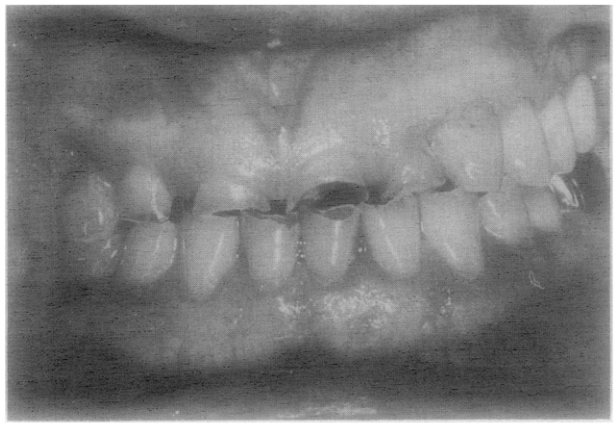

Fig. 1. Excessive occlusal attrition.

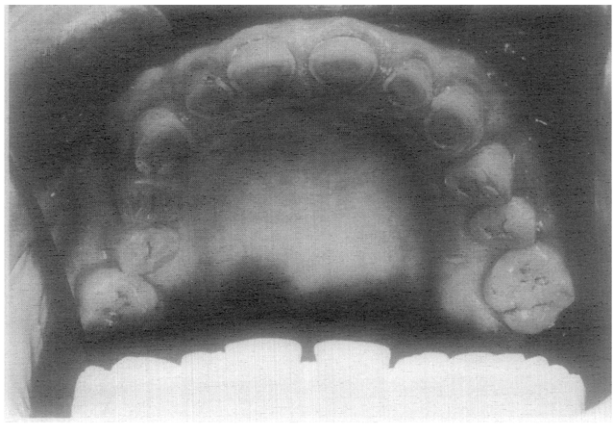

Fig. 3. Chronic bruxism with excessive occlusal attrition in a 57-year-old patient.

Fig. 2. A 12-year-old child with amelogenesis imperfecta.

Erosion

The destruction of hard dental tissues by chemical action also contributes to extensive tooth wear. Parts of the incisal edges and lingual or occlusal surfaces that exhibit a worn cupped-out appearance and do not occlude with an opposing tooth are diagnosed as exhibiting erosion (perimyelolysis). Tooth erosion may result from excessive intake of citrus juices, cola drinks and other beverages that contain carbonic acid, vinegar, and pickled foods.[3] Medicaments, such as hydrochloric acid prescribed for achlorhydria, may also eventually cause tooth erosion. Patients who continuously regurgitate stomach contents into the mouth commonly exhibit perimyelolysis on the lingual surfaces of the maxillary anterior teeth (Fig. 5).[4,5] Chronic vomiting may be self-induced in patients who suffer from psychosomatic disorders such as anorexia nervosa.

Loss of posterior support

Extensive attrition of anterior teeth often occurs when posterior support has been compromised by loss of teeth, malposition of teeth, or occlusal interference that drives the mandible forward and exerts undue force on the anterior teeth. Although loss of posterior support often results in anterior tooth mobility and/or movement, it is not unusual to see extensive wear of the clinical crown but excellent bony support without tooth mobility or periodontal disease (Fig. 6).[6]

Excessive occlusal wear may result from any of these factors. It should be emphasized that most often a combination of factors are responsible for the wear.

EVALUATION OF OCCLUSAL VERTICAL DIMENSION

It is commonly assumed that extensive occlusal wear results in decreased occlusal vertical dimension. There is no definitive evidence to support this concept. However, the literature is replete with reports that rehabilitation of an increased occlusal vertical dimension may cause postoperative problems and should be avoided when possible. Some symptoms are clenching of teeth; muscle fatigue; soreness of teeth, muscles, and joints; headache; intrusion of teeth; fractured porcelain; occlusal instability; and continued wear.[7-10] Therefore, it is critical to verify loss of occlusal vertical dimension prior to restoration at an increased occlusal vertical dimension.

Methods of evaluation

According to Sicher,[11] gradual tooth wear is compensated by continuous eruption of the teeth, which maintains occlusal vertical dimension. However, occlusal wear may occur more rapidly than continuous eruption depending on the etiology of the wear.[12] The occlusal vertical dimension of a patient who requires rehabilitation because of excessive occlusal wear should be carefully evaluated prior to definitive restoration.

Posterior support. Loss of posterior support is probably the most common cause of decreased occlusal vertical dimension. Posterior collapse that results from a combination of missing, tipped, rotated, and broken

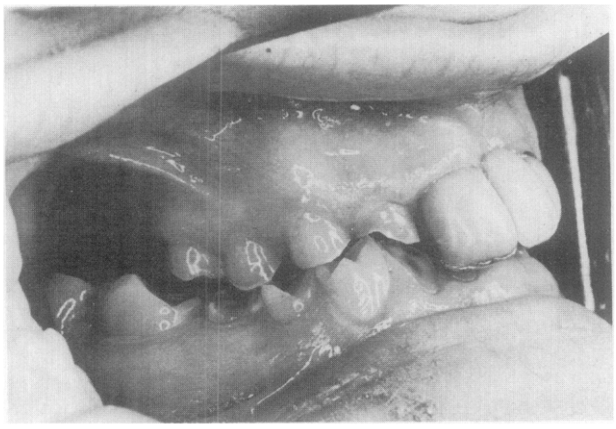

Fig. 4. Severe abrasion in a 55-year-old patient caused by chewing tobacco.

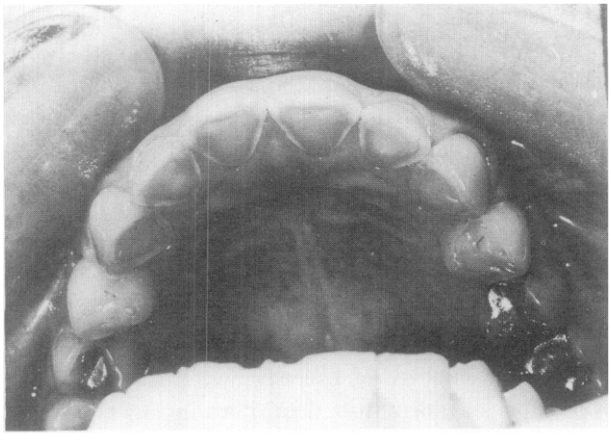

Fig. 5. Erosion of lingual enamel of maxillary anterior teeth from chronic vomiting in a 23-year-old patient.

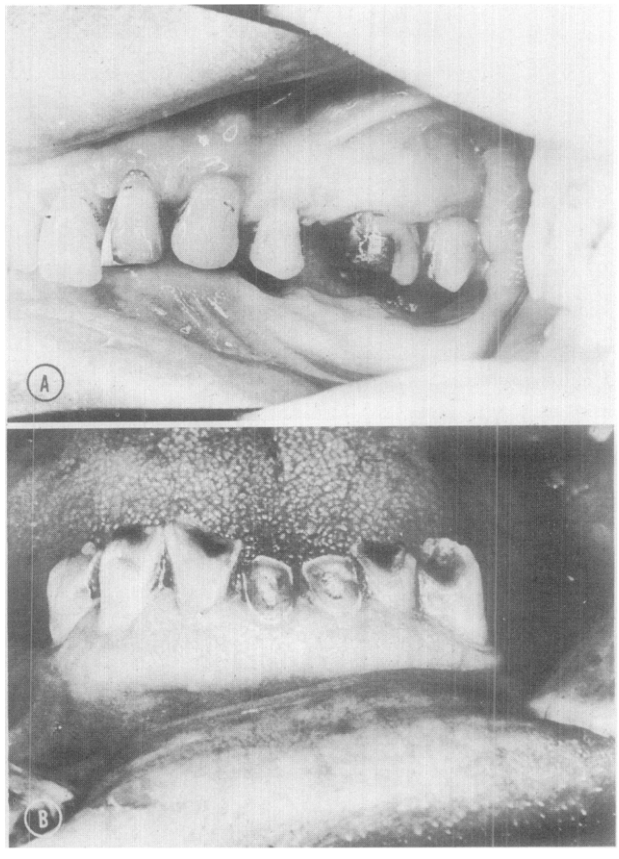

Fig. 6. A and **B,** Excessive attrition of anterior teeth in a 60-year-old patient caused by loss of posterior support.

down teeth places undue stress on the anterior segment, which eventually becomes mobile or wears excessively.[13] Either can result in loss of occlusal vertical dimension. Both the number and the stability of opposing posterior centric occlusal contacts should be evaluated for posterior support. Relatively few stable contacts can maintain occlusal vertical dimension, whereas occlusal vertical dimension can be lost in the presence of multiple contacts between opposing inclines.

History of wear. Gradual occlusal wear over many years is generally compensated by continuous eruption. Accelerated breakdown and wear exceeds the rate of eruption and results in decreased occlusal vertical dimension, for example, congenital anomalies, excessive oral habits, and acidic erosion. Gradual wear from a lifetime habit of bruxism is not as likely to result in significant loss of vertical dimension compared with the rapid loss of enamel observed in congenital defects.

Phonetic evaluation. Both Pound[14] and Silverman[15] have described the reliability of the speaking space as a method to determine occlusal vertical dimension for complete denture patients. This method can successfully evaluate occlusal vertical dimensions of the natural dentition by comparing the relative position of the anterior teeth during formation of the/S/sound. The normal mandibular position during the/S/sound places the incisal edge of the mandibular incisors about 1 mm inferior and lingual to the incisal edge of the maxillary incisors. Vertical positioning significantly more than 1 mm apart may indicate lost occlusal vertical dimension.

Interocclusal distance. Comparing measurements of rest vertical dimension and occlusal vertical dimension to determine the loss of occlusal vertical dimension is controversial and not always conclusive. Niswonger[16] studied 200 patients with excessive wear and found 83% to have an interocclusal distance of approximately 3 mm. Tallgren[17] reported that interocclusal distance remains relative to occlusal vertical dimension regardless of changes in occlusal vertical dimension. However, patients with excessive wear exhibited an increase in interocclusal distance that depended on the severity of the wear. It is important to note that some of the patients in Tallgren's study had also lost posterior support.

Methods of measuring interocclusal distance are diverse, inaccurate, and inconsistant.[18] Therefore, the measurements should be used only as a supplemental

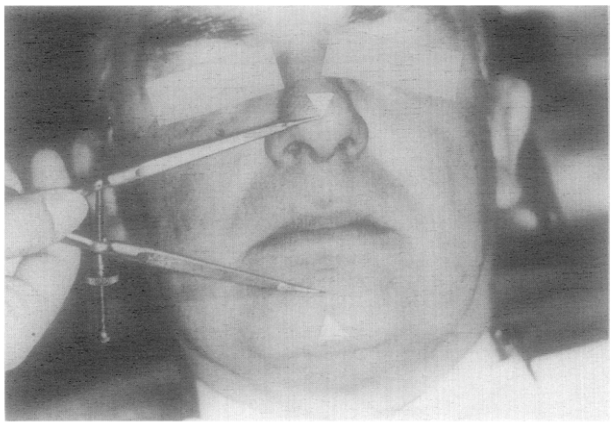

Fig. 7. Extraoral measurement of interocclusal distance in a dentulous patient.

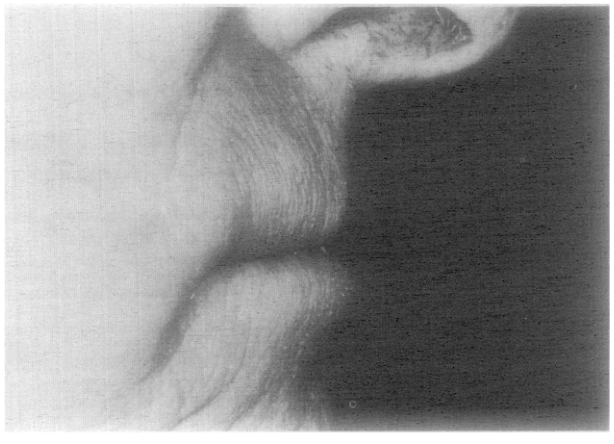

Fig. 8. Thin lips and drooping commissures associated with overclosure.

diagnostic aid for evaluating occlusal vertical dimension of the worn dentition (Fig. 7). A patient who demonstrates an interocclusal distance of 6 mm is more capable of tolerating a slight increase in occlusal vertical dimension than the patient with an interocclusal distance of 2 mm. It should be emphasized that measurements are merely guidelines, and good judgement should prevail.

Facial appearance. The external appearance of facial tissues and musculature should be carefully reviewed if loss of vertical dimension is suspected. Diminished facial contour, thin lips with narrow vermillion borders, and drooping commissures are associated with overclosure (Fig. 8).[19] However, wrinkling and loss of facial contour are normal aging processes, and the temptation to restore a youthful appearance by increasing vertical dimension must be resisted.

Necessity to restore occlusal vertical dimension

There are occasionally situations where restoration of a worn dentition can be accomplished only by increasing occlusal vertical dimension, even though a loss of occlusal vertical dimension cannot be diagnosed. Fortunately,

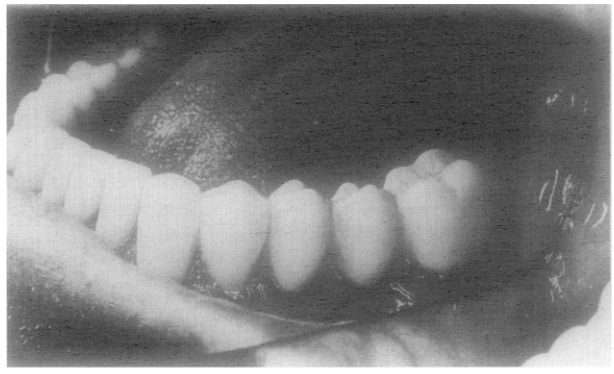

Fig. 9. Contoured provisional restorations fabricated from diagnostic wax-up are designed to function for several months.

indications for this treatment approach are not common. Alternative procedures are often preferable despite the lack of vertical space for restorative materials between maxillary and mandibular teeth.

Arbitrary increase of occlusal vertical dimension should be avoided if a feasible alternative exists. If deemed absolutely necessary, modification of vertical dimension should be accomplished through cautious trial with removable occlusal splints followed by fixed provisional restorations.

ALTERNATIVE TREATMENT PLANS

After the etiology of excessive wear is determined, evaluation of diagnostic data that includes occlusal vertical dimension and consultation with the patient to identify the need for restorative dentistry, a comprehensive treatment plan is formulated. Many patients do not realize the severity of wear and the consequences of delayed treatment. The patient can be placed into one of three categories as follows relative to occlusal vertical dimension associated with an appropriate treatment plan.

Category No. 1. Excessive wear with loss of occlusal vertical dimension

A typical patient in category No. 1 is missing a few posterior teeth, has an unstable posterior occlusion, exhibits excessive wear of the anterior teeth, demonstrates a closest speaking space of 3 mm, an interocclusal distance of 6 mm, and has some loss of facial contour that includes drooping of the corners of the mouth.

Another patient in this category is 35 years of age, has dentinogenesis imperfecta with excessive occlusal attrition, demonstrates a closest speaking space of 5 mm, an interocclusal distance of 9 mm, and appears to be prognathic in centric occlusion. It may be concluded that this patient has probably lost some occlusal vertical dimension concomitant with the occlusal wear. However, the only reliable method to confirm the diagnosis and determine a physiologic occlusal vertical dimension is

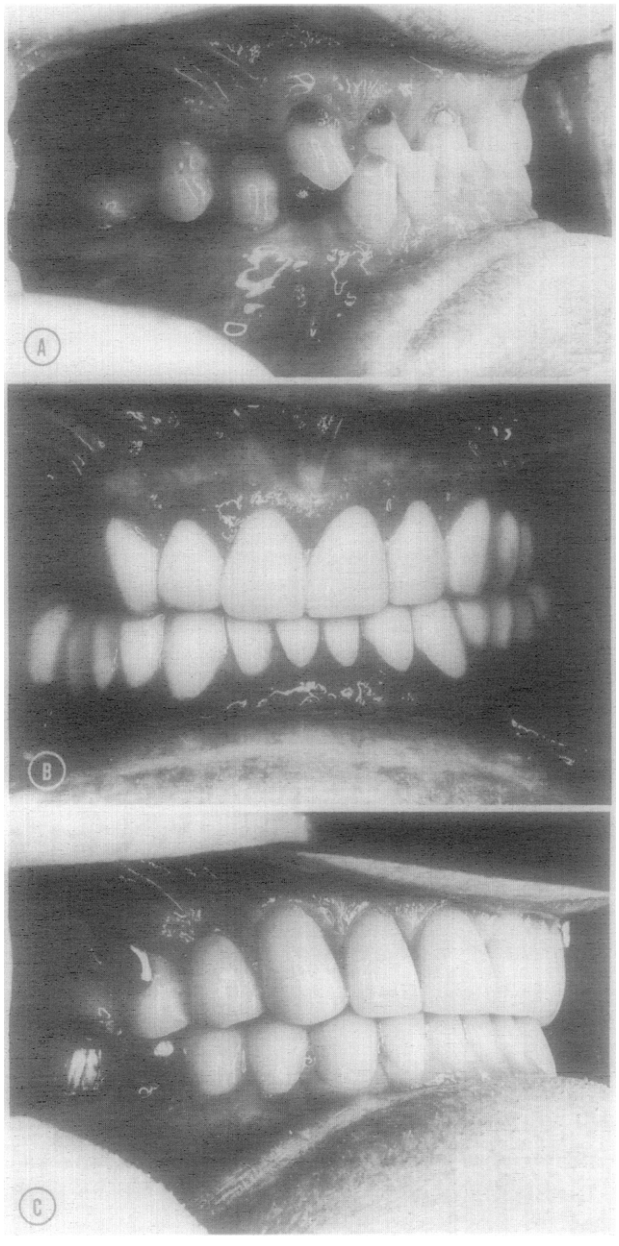

Fig. 10. Restoration of lost occlusal vertical dimension. **A,** Severe attrition of anterior teeth with complete loss of posterior support. **B,** Restoration of occlusal vertical dimension with fixed provisional restorations. **C,** Restoration of occlusal vertical dimension and occlusal plane. (Restorative treatment by Dr. Tobin Boyd.)

with trial restorations. A removable occlusal overlay splint or a treatment partial denture that restores occlusal vertical dimension to estimated optimal position for the patient is usually the first trial restoration. The patient should be observed periodically for 6 to 8 weeks while appropriate adjustments are made and the patient is evaluated for comfort and function at that dimension. Caution must be exercised not to make a firm diagnosis based solely on patient acceptance of a removable trial restoration, because the patient may have removed the prosthesis during periods of stress, fatigue, and soreness

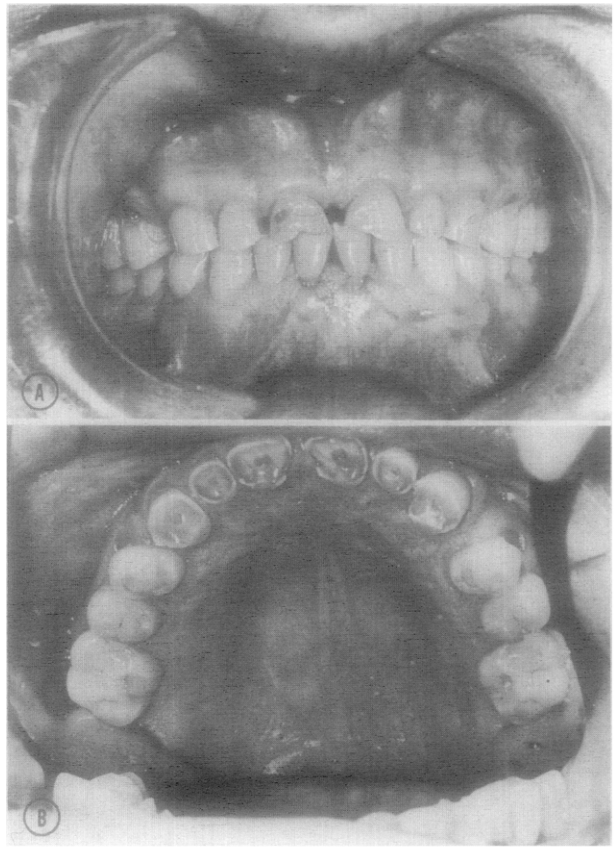

Fig. 11. A and **B,** Patient with excessive tooth wear and apparently insufficient interocclusal space for restorative materials but without need for increasing occlusal vertical dimension.

associated with excessive occlusal vertical dimension. When the patient is comfortable with the removable restoration for a reasonable time, the teeth are prepared and provisional fixed restorations are placed. These may be cast metal but are usually heat-processed acrylic resin fabricated from a diagnostic wax-up (Fig. 9). They can be contoured and adjusted readily but will withstand occlusal function for several months. This restoration allows a more critical appraisal of patient comfort, function, esthetics, and hygiene for an additional 2 to 3 months.

The final restorations mimic the occlusal vertical dimension, function, and esthetics that have been developed in the treatment restorations.

Cautious use of removable and fixed provisional restorations allows the dentist to proceed with the final restoration with relative ease and confidence that the patient will be happy and healthy with the rehabilitation (Fig. 10).

Category No. 2. Excessive wear without loss of occlusal vertical dimension but with space available

Patients in category No. 2 typically have adequate posterior support, as well as a long history of gradual

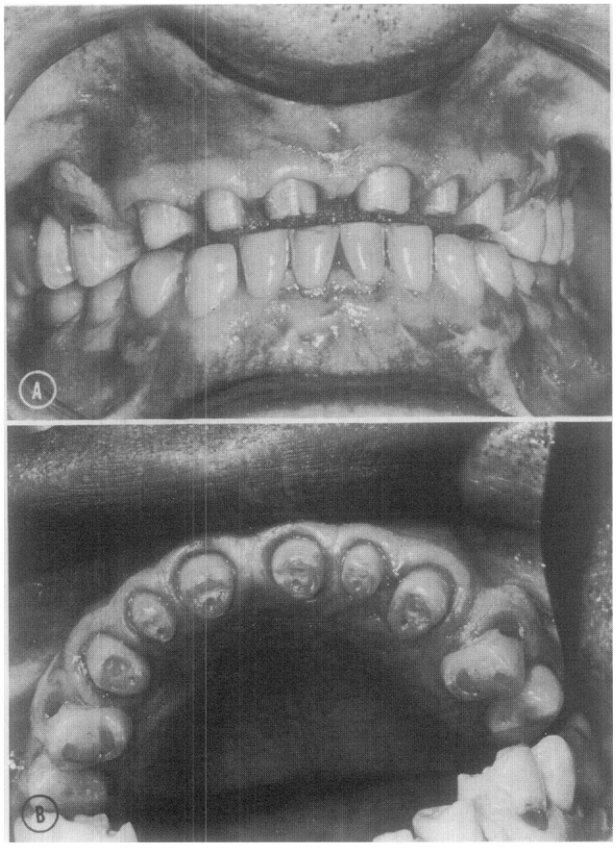

Fig. 12. A, Preparation of short clinical crowns require strict parallelism of opposing axial walls. B, Pins often provide supplemental retention and resistance form.

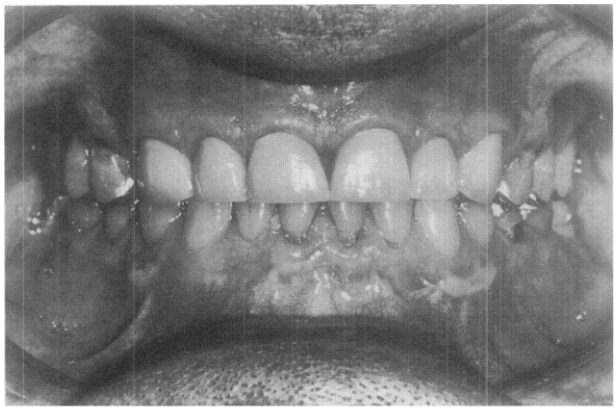

Fig. 13. Occlusal reconstruction achieves comfort, function, and acceptable esthetics without increasing occlusal vertical dimension.

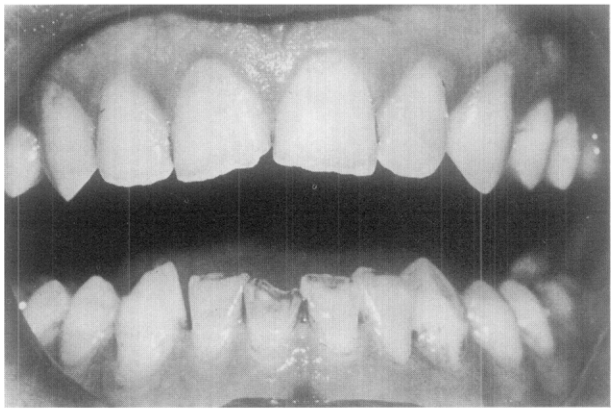

Fig. 14. Patient exhibits excessive wear of anterior teeth that occurred gradually over 25 years.

wear caused by bruxism, moderate oral habits, and/or environment. They demonstrate an interocclusal distance of 2 to 3 mm and a closest speaking space of 1 mm. In these patients continuous eruption has maintained occlusal vertical dimension, but there is seemingly insufficient interocclusal space for restorative materials unless occlusal vertical dimension is increased (Fig. 11).

Manipulation of the mandible into centric relation will often reveal a significant anterior slide from centric relation to the patient's maximum intercuspation. Equilibration and/or restoration of the posterior teeth for stability in centric relation often in combination with enamelplasty of opposing teeth can provide sufficient space for restorative materials.

Tooth preparation to establish retention and resistance form is particularly critical for the patient with short clinical crowns and a history of occlusal attrition. Strict parallelism of opposing axial walls is essential, and supplemental pins or grooves may be indicated (Fig. 12). Programmed occlusion is also essential to successful treatment. The use of dynamic recordings of mandibular movement and a fully adjustable articulator are recommended for this type of rehabilitation. However, the most critical step is the coordination of knowledge, understanding, and skill between the dentist and dental technician in the development of a physiologic occlusion that will prevent further destruction (Fig. 13).

Periodontal surgery that includes gingivoplasty and osteoectomy to gain clinical crown length is sometimes required for retention and esthetics. Because of the excellent periodontal support seen in most patients with wear, 2 to 3 mm of supporting bone can usually be removed without jeopardizing periodontal support. If pathologic bone loss has occurred, adequate crown lengthening can usually be accomplished by soft tissue surgery without further sacrifice of bone.

Category No. 3. Excessive wear without loss of occlusal vertical dimension but with limited space

An example of a patient in category No. 3 is a 40- to 50-year-old who has posterior teeth that exhibit minimal wear but shows excessive gradual wear of the anterior teeth over a period of approximately 25 years (Fig. 14). Centric relation and centric occlusion are coincidental with a closest speaking space of 1 mm and an interocclusal distance of 2 to 3 mm.

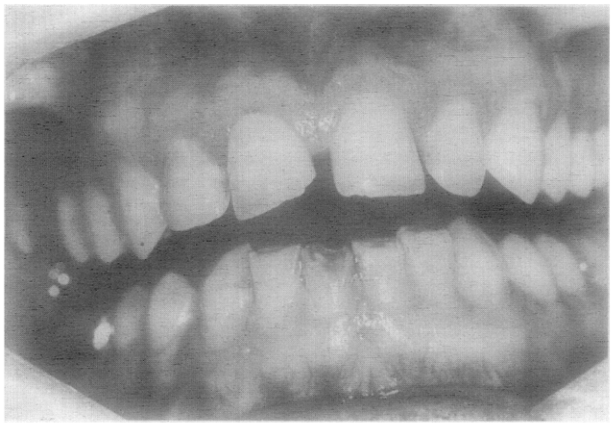

Fig. 15. Orthodontic treatment to create space for restorative materials.

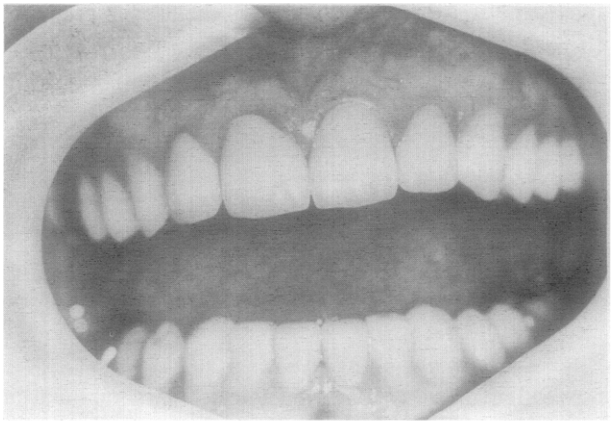

Fig. 16. Restorations can close diastemas and still satisfy esthetic demands if spaces are equalized and esthetic illusions are created.

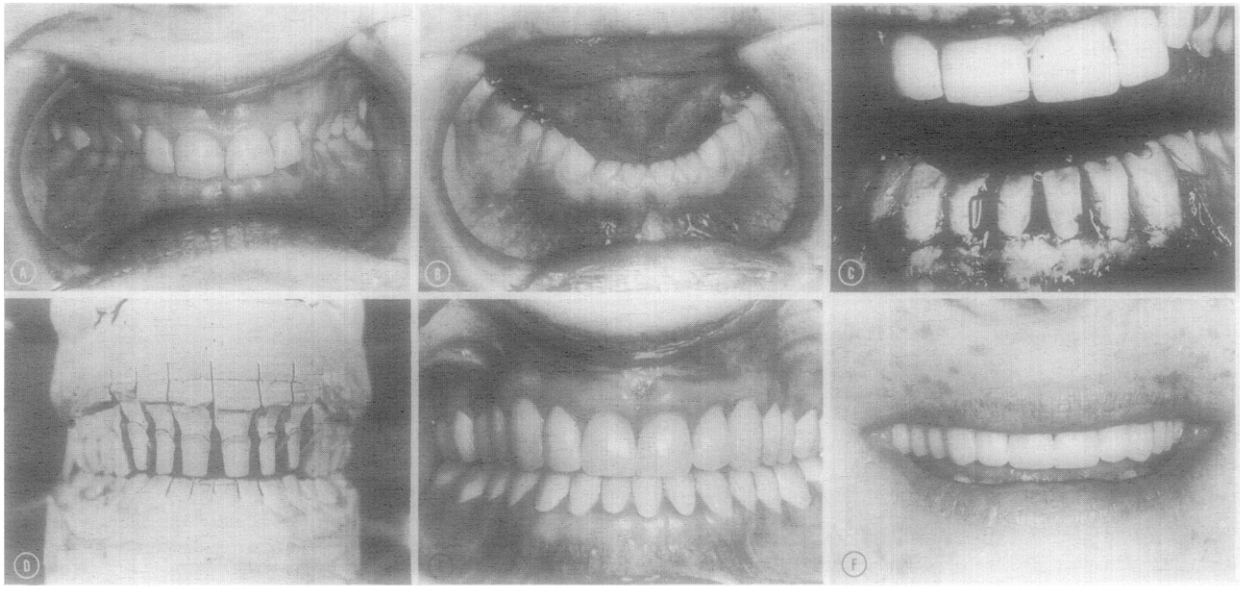

Fig. 17. Restoration of extremely worn dentition with uneven occlusal plane by means of periodontal surgery and restorative repositioning. **A,** Undesirable occlusal plane with existing restorations. **B,** Extreme wear that results in periapical abscesses. **C,** Periodontal surgery to increase clinical crown length. **D,** Vertical (superior) repositioning of maxillary anterior preparations opposing restored mandibular incisors. **E,** Restored occlusal plane, crown length, and occlusion. **F,** Pleasing smile.

Restoration of the worn dentition of a patient in category No. 3 is the most difficult because vertical space must be obtained for restorative materials. This can be accomplished by orthodontic movement, restorative repositioning, surgical repositioning of segments, and programmed occlusal vertical dimension modification.

Orthodontic movement usually involves anterior-posterior repositioning of the teeth combined with limited intrusion, although intrusion is considerably more complex with the adult patient.* Orthodontic treatment requires 6 to 12 months and it is important to equalize the mesiodistal spacing that occurs as the teeth are repositioned anteriorly (Fig. 15). Patient approval of slightly wider anterior teeth in the final restoration should be obtained prior to treatment; however, an esthetic illusion can be created to make wide teeth appear more narrow (Fig. 16).[20]

Restorative repositioning of teeth can often achieve space for dental materials, improve esthetics, and develop a more favorable plane of occlusion. Continuous eruption of the worn tooth can be accompanied by eruption of the alveolus and associated soft tissues, which

*Casko, J.S.: Personal communication, 1983.

results in an unesthetic, uneven occlusal plane and gingival margin. Periodontal surgery will remove the tissues, expose more clinical crown, and allow a more suitable occlusal plane and pleasing smile (Fig. 17).

Sufficient interocclusal space for dental materials can usually be obtained by altering the contours of opposing restorations and/or tooth structure as described by Dawson.[7] Endodontic therapy may be necessary if occlusal reduction during tooth preparation encroaches on the pulp chamber or if excessive wear threatens the health of the plup.

Surgical repositioning of a segment of teeth and supporting alveolus may be indicated if a dentofacial deformity exists in conjunction with extreme wear. Block section and movement of both the maxillary and mandibular anterior segments is possible. A LeFort I procedure combined with sectioning the anterior and posterior segments, a technique used for treating patients with open anterior occlusion,[21] can be used for intrusion of segments to create interdental space while correcting the dentofacial deformity.

Surgical repositioning should be considered only after thorough evaluation of diagnostic data that includes preoperative cast dissection, facial dimension, surgical complications, and benefits derived.

Increasing the occlusal vertical dimension to achieve space for restorative materials where there has apparently been no loss of occlusal vertical dimension is seldom advisable; but if deemed necessary, the increase should be minimal and for restorative needs only. Trial restorations are crucial and must be evaluated over longer periods of time to ensure patient accommodation to the increase in occlusal vertical dimension. Minimal increases in occlusal vertical dimension may result in tooth movement subsequent to final restoration. Patients with a Frankfort mandibular plane angle of less than 20 degrees may be particularly predisposed to intrusion and continued wear.[22] Therefore, frequent postoperative evaluation for occlusal interferences and wear is essential. It is advisable to fabricate a protective hard resin occlusal splint for the patient as a preventive measure.

CONCLUSION

Restoration of the extremely worn dentition presents a substantial challenge to the dentist. Careful evaluation of the etiology, history, and factors relative to occlusal vertical dimension are essential to appropriate treatment planning. Various modalities are successful in the treatment of patients with a worn dentition. A team approach that uses combined interspecialty expertise will assure the longevity of the restoration for the patient.

REFERENCES

1. Smith, B. G. N.: Dental erosion, attrition and abrasion. Practitioner **347**:55, 1975.
2. Stewart, R. E., and Prescott G. H.: Oral Facial Defects, ed 1. St. Louis, 1976, The C. V. Mosby Co., p 151.
3. Lewis, R. J., and Smith B. G. N.: The relationship of erosion and attrition in extensive tooth tissue loss. Br Dent J **135**:400, 1973.
4. Hellstrom, I.: Oral complications in anorexia nervosa. Scand J Dent Res **85**:71, 1977.
5. House, R., Grisius, R., Bliziotes, M., and Ficht, J.: Perimyelolysis: Unveiling the surreptitious vomiter. Oral Surg **51**:152, 1980.
6. Ainamo, J.: Relationship between occlusal wear of the teeth and periodontal health. Scand J Dent Res **80**:505, 1972.
7. Dawson, P.: Evaluation, Diagnosis and Treatment of Occlusal Problems, ed 1. St. Louis, 1974, The C. V. Mosby Co., pp 275-283.
8. Christensen, J.: Effect of occlusion-raising procedures on the chewing system. Dent Practice **20**:233, 1970.
9. Ramfjord, S. P., and Blankenship, J. R.: Increased occlusal vertical dimension in adult monkeys. J PROSTHET DENT **45**:74, 1981.
10. Schweitzer, J. M.: Restorative dentistry—Half century of reflections. J PROSTHET DENT **31**:22, 1974.
11. Sicher, H.: Oral Anatomy, ed 5. St. Louis, 1949. The C. V. Mosby Co. p 270.
12. Berry, D. C., and Poole, D. F. G.: Attrition: Possible mechanisms of compensation. J Oral Rehabil **3**:201, 1976.
13. Stern, N., and Brayer, L.: Collapse of the occlusion—Aetiology, symptomatology and treatment. J Oral Rehabil **2**:1, 1975.
14. Pound, E.: The mandibular movements of speech and their seven related values. J South Calif Dent Soc **34**:435, 1966.
15. Silverman, M. M.: The speaking method in measuring vertical dimension. J PROSTHET DENT **3**:193, 1953.
16. Niswonger, M. E.: The rest position of the mandible and the centric relation. J Am Dent Assoc **21**:1572, 1934.
17. Tallgren, A.: Changes in adult face height due to aging, wear and loss of teeth and prosthetic treatment. Acta Odontol Scand **15**:(Suppl 24) 1957.
18. Atwood, D. A.: A cephalometric study of the clinical rest position of the mandible. J PROSTHET DENT **6**:504, 1956.
19. Heartwell, C. N., and Rahn, A. O.: Syllabus of Complete Dentures, ed 3. Philadelphia, 1980, Lea & Febiger, p 214.
20. Eissmann, H. F., Rudd, K. D., and Morrow, R. M.: Dental Laboratory Procedures: Fixed Partial Dentures, ed 1. St. Louis, 1980, The C. V. Mosby Co., vol 2, p 306.
21. Bell, W. H., Proffit, W. R., and White, R. P.: Surgical Correction of Dentofacial Deformities, ed 1. Philadelphia, 1980, W. B. Saunders Co., vol 2, p 1077.
22. DiPietro, G. J., Moergeli, J. R.: Significance of the Frankfort-mandibular plane angle to prosthodontics. J PROSTHET DENT **36**:624, 1976.

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