REHABILITATION OF SEVERELY ERODED DENTITION UTILIZING ALL-CERAMIC RESTORATIONS

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Tooth wear is becoming an increasing concern, particularly in younger patients. Clinicians will increasingly encounter such problems as more natural teeth are retained into older age and patients' aesthetic demands and expectations rise. The use of all-ceramic restorations has increased due to the materials' natural appearance and strength. This, together with the new generation of resin cements, allows the provision of predictable single-unit restorations. This article reviews the etiology of erosion, which currently appears to be a primary contributor to tooth wear. Aesthetic treatment of a patient is also presented using all-ceramic restorations.

Learning Objectives:

This article discusses the etiology of erosion and its effect on aesthetic treatment.

Upon reading this article and completing this exercise, the reader should:

- Understand the role of tooth wear on restorative material selection.
- Know the treatment parameters necessary for all-ceramic restorations.

Key Words: erosion, wear, aesthetics, all-ceramic

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Figure 1. Preoperative view of the unaesthetic anterior dentition.

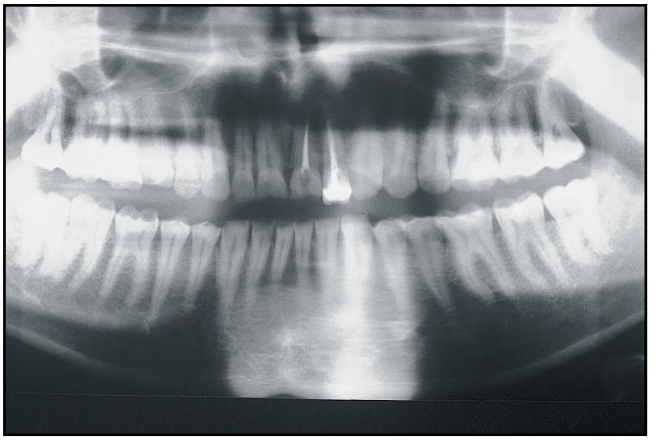

Figure 2. No legend submitted.

In order to successfully manage a patient with extensively worn dentition, the clinician must have a thorough understanding of the etiology and presentation of tooth surface loss. Although tooth wear is often caused by a combination of various etiological factors, one factor may often predominate. Clear communication between the dentist and the patient is, therefore, essential in the identification of the etiology of erosion. The patient must be made aware of the existing condition and the various forms of prevention and management. This article reviews the etiology and development of erosion prior to aesthetic treatment using all-ceramic restorations.

Normal Wear

When a patient is examined for the first time, it is difficult for the clinician to determine if the rate of wear is excessive. The patient must be monitored over a period of time so the rate of wear can be assessed to a certain degree. It is also difficult for the clinician to make comparisons with "normal" wear rates since conflicting values are described in various published articles. For example, one study reports a normal loss of enamel between 20 μm and 38 μm per year,[1] whereas another study reports a wear of 65 μm in 6 months.[2] These conflicting data could be due to the variable ages of the patients used in these evaluations.

Figure 3. Preoperative maxillary occlusal view demonstrates severely rounded incisors.

Noncarious tooth surface loss is a normal physiologic process that occurs in many patients throughout life.[3] If the rate of wear is such that it is a source of concern to the patient, or if it is likely to prejudice the survival of the teeth, then the rate is considered to be pathological, and action must be taken to minimize the damage.[4,5]

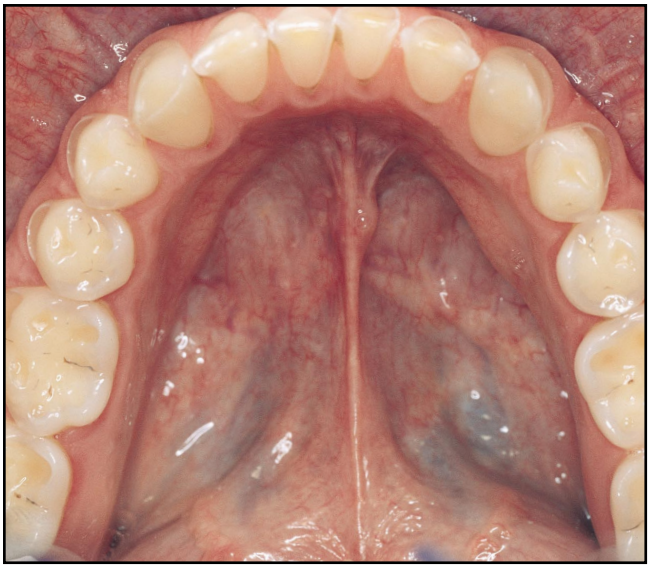

Figure 4. Preoperative occlusal view of the worn mandibular dentition.

Figure 5. Preoperative right lateral view further illustrates improper occlusion and the need to restore the patient's vertical dimension.

Potential Complications of Tooth Wear

In order to efficiently treat tooth erosion, a comprehensive understanding of the effects of tooth wear must be obtained. Potential results of tooth wear can be related to functional, aesthetic, and sensitivity concerns.

Functional: Patients tend to have difficulty with mastication, broken teeth, and failing restorations.

Figure 6. Preoperative left lateral view exhibits the severe erosion of the teeth.

Aesthetic: As the dentition undergo wear and fracture, the patient's general appearance may change as he or she reveals less teeth during speech and natural smile. In some instances, the smile line may be reversed entirely.

Sensitivity: While most patients with excessive tooth wear often experience reduced sensitivity as a result of exposed dentin, some patients have reported preoperative hypersensitivity.

Erosion

Erosion is defined as "the progressive loss of tooth substance by chemical processes that do not involve bacterial action."[6] Acid reflux appears as the most common cause of dental erosion, and it is becoming more prevalent. Factors that lead to erosion can be divided into extrinsic and intrinsic factors. Extrinsic factors include acids in various beverages and foods, oral medications (eg, chewable vitamin C), vigorous tooth brushing, and — while infrequent — airborne acids. Intrinsic erosion is often caused by vomiting and regurgitation in patients with gastrointestinal disorders (eg, hiatus hernia, reflux esophagitis, duodenal ulcers), who are pregnant, or who suffer from alcoholism.[7] Voluntary regurgitation in patients suffering from anorexia, bulimia, and the quality and quantity of saliva have also been linked to dental erosion.[7]

Figure 7. The maxillary incisors were prepared with a rounded shoulder design and supragingival margins.

Figure 8. The definitive maxillary porcelain crown restorations (IPS Empress II, Ivoclar Vivadent, Amherst, NY) were fabricated and placed on a soft tissue cast to evaluate their occlusal appearance.

Dietary Erosion

Dietary erosion can result from the acids inherent in fruits, fruit juices, and a variety of soft drinks and wines. While citric acid is a primary component of fruits and fruit juices, phosphoric acid is often found in most soft drinks. Foods that contain citric acid can cause complications, as citrate ions bind with calcium in the tooth to form soluble calcium citrate.[8]

Acidic beverages are becoming a major component of many diets, particularly in adolescents and young children. This is most evident by a nine-fold increase in the sales of soft drinks in the United Kingdom since the 1950s.[9] The sales of "diet" drinks have also dramatically increased. Although these drinks claim to be less cariogenic, their erosive potential is, nevertheless, detrimental.

Voluntary Regurgitation and Salivary Considerations

Patients with eating disorders (eg, anorexia nervosa, bulimia) often exhibit dental erosion as a result of repeated binge eating and self-induced vomiting.[10] Underlying psychological problems often associated with concerns about body weight and appearance often affect patients with these disorders. Approximately 90% to 95% of the people affected are females between the ages of 17 and 25. While the prevalence of these disorders are reported to be about 1% to 2% of the general population, this figure may be underestimated due to unreported cases.[10]

Vigorous tooth brushing often follows episodes of binge eating and vomiting. Most patients are not aware of the potential damage caused to the teeth and should be educated about the complications that may be caused by this activity. Since most of the purging episodes are preplanned, the patient can be prepared to neutralize some of the harmful effects to the teeth by not brushing after vomiting, rinsing his or her mouth with water, taking antacids, or drinking milk.

The quality and quantity of saliva also has an effect on the erosive potential of acids. Since saliva rinses away and buffers acids on tooth surfaces, low salivary flow rates may be an initiating factor in dental erosion. A recent investigation reported that patients with low unstimulated flow rates were found to have an increased risk for development of cervical lesions.[9] It has also been reported that anorexics and bulimics develop xerostomia and their saliva may have a lower buffering and remineralizing capacity.[11]

Figure 9. The completed mandibular restorations were subsequently placed on a soft tissue cast.

Figure 10. The restorations were evaluated prior to delivery to determine the degree of translucency.

Although limited-wear lesions may be treated using direct restorations, a complex prosthodontic rehabilitation may be necessary to re-create the integrity of the dentition when the extent of the erosion leads to severe limitation of function and aesthetics. All-ceramic restorations are used with increasing frequency when aesthetics is of concern. While acceptable results can be achieved using metal-ceramic alternatives, their lack of light transmission may unnecessarily darken the root and increase the need for less conservative subgingival margin placement.[12,13]

Several different high-strength ceramics are currently available (eg, Procera, Nobel Biocare, Yorba Linda, CA; InCeram, Vident, Brea, CA; IPS Empress, Ivoclar Vivadent, Amherst, NY). The following case presentation describes the stages in the treatment of an adult with severe erosion using leucite-reinforced all-ceramic full-coverage crown restorations.[14-16]

Case Presentation

A 30-year-old male patient presented with severe wear and temperature sensitivity. The patient had difficulty during mastication and expressed dissatisfaction with the aesthetics of the existing dentition (Figure 1). Dietary analysis revealed excessive consumption of fruit juices and carbonated drinks from a young age. This consumption continued to the present day, and the patient admitted to drinking several liters of acidic drinks each week. Although several dental practitioners had examined the patient, the etiology of the wear was not previously identified.

Clinical Examination

Abnormalities, asymmetry, or temporomandibular dysfunction were not evident upon extraoral examination. Intraoral examination revealed deep erosive lesions with complete lack of enamel on all functional cusps. Severe wear of the mandibular incisal edges was observed, and excessive "cupping" was noted on the palatal aspects of the maxillary anterior teeth (Figures 2 through 4). Aesthetic evaluation revealed a high smile line with symmetry of the gingival margins. There was no evidence of periodontal disease, and the patient's oral hygiene was satisfactory.

The pulp of numerous teeth was nearly exposed, particularly in the anterior region. All the teeth were vital, with the exception of two that were previously endodontically treated. Occlusal analysis revealed Class II molar

classification with a horizontal overlap of 4 mm and a vertical overlap of 6 mm, with the mandibular incisors almost contacting the palate. Bilateral canine guidance was also evident, and the loss in the vertical dimension of occlusion (VDO) was estimated to be approximately 3 mm (Figures 5 and 6).

Radiographic Evaluation

Significant enamel loss with near pulpal exposure was present on the maxillary anterior teeth. Teeth #7(12) and #8(11) were endodontically treated. The mandibular third molars were vertically impacted, and the maxillary third molars were fully erupted. Periapical pathosis was not noted, and the crown-to-root ratios were favorable. The patient was informed of the diagnosis and instructed to immediately decrease the consumption of acidic beverages. As the etiology of the wear was clearly identified and the patient managed to control it, the patient was offered the option of rehabilitation with composite restorations or full-coverage, all-ceramic crowns. Considering the clinical findings and the patient's aesthetic expectations and demands, the traditional approach — involving full-mouth crown lengthening to provide adequate clinical crown height, multiple root treatments, and restoration with porcelain-fused-to-metal crowns — was not feasible. Therefore, a complete all-ceramic rehabilitation preceded by composite buildups was selected. This approach would allow the preservation of tooth vitality with the potential to increase the clinical crown heights of some teeth using composite resin to regain a degree of the lost VDO.

Diagnostic waxups were prepared to precisely calculate the correct proportion of teeth and achieve an acceptable occlusal scheme. The waxup was also used to allow the patient to visualize the anticipated postoperative outcome. Provisional restorations were fabricated according to the diagnostic waxup at the planned increase of VDO. The incisal guide table was fabricated to reproduce the protrusive and excursive movements.

Figure 11. Placement of internal characteristics and surface irregularities allowed development of a more natural appearance.

Figure 12. Postoperative facial view of the definitive restorations demonstrates tooth vitality and optimal integration.

The maxillary and mandibular arches were initially restored using a composite resin material in one visit. A general occlusion was provided until tooth preparations could be completed the next day. In order to increase VDO and to provide occlusal stability, the maxillary and mandibular teeth were prepared in one appointment. Anesthesia was delivered, and rounded shoulder margins were prepared for all the teeth. The mandibular incisors were prepared with narrower shoulders (0.8 mm), while the molars and maxillary incisors were reduced with 1-mm shoulders (Figure 7).

Figure 13. Optimal marginal adaptation was achieved in the presence of thin periodontium. Note the healthy appearance of the mandibular soft tissues.

Figure 14. Right lateral view in maximum intercuspation demonstrates functional harmony.

At all times during the preparations, the VDO was controlled with a series of acrylic interocclusal records. The provisional restorations were relined and adjusted to achieve a stable occlusion at the desired VDO. The provisionals were cemented with a noneugenol provisional cement. The patient was reviewed a few days later, and the occlusion was further refined. The total increase in the VDO was 3 mm.

The patient was then scheduled for tooth-preparation finalization and reviewed monthly so that the authors could evaluate the condition of the provisional restorations, monitor the extent of the wear, and ensure a stable occlusion. The provisional restorations also allowed the patient to evaluate the aesthetics and phonetics, and the clinician was able to make any necessary changes before the definitive restorations were fabricated.

Final impressions were made in two appointments using a polyether impression material in custom trays 6 months following provisionalization. A face-bow transfer was used to mount the maxillary cast on an articulator, and an axiopath recorder was used to locate the hinge axis. The jaw relations were recorded in centric relation using acrylic interocclusal records. The casts of the provisional restorations were cross-mounted against the tooth preparations.

The laboratory technician initially fabricated 28 all-ceramic cores. The adaptation and fit of the cores were checked by the technician using a silicone paste. The crowns were completed according to the patient's preferred shade (Figures 7 and 8). The cores were etched with hydrofluoric acid for two minutes and rinsed. The teeth were etched with 37% phosphoric acid for 15 seconds and a dentin adhesive was placed on the tooth surfaces. The full-coverage, all-ceramic crown restorations were cemented using a low-viscosity, dual-cure resin cement (Figures 10 and 11). A thin retraction cord (3-0) was placed subgingivally, and a finishing strip was gently passed interproximally to eliminate excess cement. Two appointments were necessary to cement the definitive restorations (Figures 12 and 13).

Occlusal equilibration was completed at 1 week, 1 month, and 3 months postoperatively. Only a few modifications were necessary to stabilize the occlusion and eliminate any lateral interferences. The patient was satisfied with the definitive aesthetic result and found the rehabilitation comfortable both in function and in speech. A slight sensitivity on mastication was present during the first month following cementation, localized to the molars (Figures 14 through 16).

Figure 15. Postoperative left lateral view exhibits the restored occlusal plane and vertical dimension of occlusion in maximum intercuspation.

Figure 16. The restored maxillary arch presented an improved anatomic lingual concavity of the anterior teeth.

Conclusion

The long-term success of the aforementioned treatment approach depends on patient education and the prevention of subsequent erosion. While the etiology of erosion may not be clear in many situations, active treatment may have to coincide with preventative measures to ensure the survival of the teeth. Aesthetic restorations are now more frequently demanded by dental patients, and enormous material development and technique improvements have significantly facilitated this objective. All-ceramic restorations, besides representing the treatment of choice where anterior aesthetics is of utmost importance, have been increasingly utilized in the posterior regions. These restorations provide several advantages (eg, easier clinical procedures, supragingival margins, improved maintenance). Adhesive cementation further enhances retention and can reduce the need for crown-lengthening procedures in some situations, and thus allows a more conservative treatment approach.

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Continuing Education (CE) Exercise No. X

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 "Rehabilitation of severely eroded dentition utilizing all-ceramic restorations" by Davide Cortellini, DDS, DMD and Ali Parvizi, BDS, MS. This article is on Pages xxx-xxx.

1. How is it possible to determine normal wear?
- a. Monitoring the patient over a period of time using study casts.
- b. Measuring the Vertical Dimension of Occlusion.
- c. Evaluating areas of lack of enamel.
- d. None of the above.

2. What is the definition of erosion?
- a. The progressive loss of tooth substance by chemical processes.
- b. The progressive loss of tooth substance by mechanical processes.
- c. The progressive loss of tooth substance by bacterial action.
- d. None of the above.

3. What are the distinctive features of tooth erosion?
- a. Irregular enamel lesions with brown and white shadowing.
- b. Complete lack of an enamel layer.
- c. Enamel and dentin lesions in conjunction with well-preserved enamel in certain areas.
- d. None of the above.

4. The erosive process may be influenced by:
- a. Quality and quantity of saliva.
- b. Vigorous tooth brushing.
- c. Frequency of acid intake.
- d. All of the above.

5. In the presence of a severely worn dentition the treatment approach should consider:
- a. Serial root-canal treatment of all vital teeth and post sbuildups.
- b. Serial crown lengthening procedures to provide sufficient retention for the restorations.
- c. Preservation of periodontal integrity and tooth vitality utilizing, when possible, composite build-ups and adhesive cemented restorations.
- d. None of the above.

6. What is the purpose of a composite buildup prior to tooth preparation?
- a. To allow proper thickness and proportion of the indirect restorations.
- b. To increase retention.
- c. To modify the color of the natural abutment.
- d. All of the above.

7. All ceramic crowns may provide the following advantages over ceramometal restorations:
- a. Better aesthetics.
- b. Supragingival margins.
- c. Easier clinical procedures.
- d. All of the above.

8. What is the ideal preparation for Empress crowns?
- a. 90° shoulder.
- b. Chamfer.
- c. Knife-edge margin.
- d. None of the above.

9. Adhesive cementation may:
- a. Increase retention especially on composite buildups.
- d. Reduce the need for crown-lengthening procedures.
- c. Allow a more conservative treatment approach.
- d. All of the above.

10. When the extent of erosion leads to severe limitation of function and aesthetics, the treatment approach may include:
- a. Control of the etiology of tooth erosion.
- b. Composite buildups.
- c. Adhesive cementation.
- d. All of the above.