Rehabilitation of Worn Dentition Using Adhesive and Implant Dentistry

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Learning Objectives: After reading this article, the individual will learn: (1) factors in the clinical management of worn dentition, and (2) a clinical technique for treating worn dentition using adhesive and implant dentistry.

Dental wear is common, and severe tooth wear prevalence increases with age; its etiology has been mainly attributed to attrition, which is defined as the loss of tooth structure by mechanical wear from another tooth surface. However, other factors also contribute to excessive occlusal wear, such as erosion, abrasion, and parafunctional habits (bruxism). Diet, gastric reflux, congenital abnormalities, and eating disorders can also cause excessive occlusal wear. A differential diagnosis is not straightforward as a combination of conditions is often present. Nevertheless, it is important to identify the etiology of the excessive wear by evaluating the diagnostic data, especially the vertical dimension of occlusion (VDO). An estimation of the presenting VDO together with the extent of noncarious tooth loss is critical prior to deciding upon a treatment plan.

Physiological tooth wear can be compensated by continuous tooth eruption together with the development of the associated alveolar bone. When the rate of tooth wear exceeds the compensatory mechanisms, a loss of the VDO manifests. The VDO can be estimated using several methods, such as phonetics, interocclusal distance, and swallowing, amongst others. Turner and Missirlian classified patients with extremely worn dentition into 3 categories. Category I patients exhibit excessive wear with loss of the VDO. Category II patients exhibit excessive wear without loss of the VDO, but have space available for the placement of restorations. Patients in this group typically have adequate posterior support and a long history of bruxism. The continuous eruption of the teeth in these patients can maintain the VDO. Finally, Category III patients present with excessive wear and no loss of the VDO, but differ from Category II in having limited space available.

The management of extremely worn dentition is challenging yet interesting for clinicians. It is always a challenge to find sufficient space for restorative materials, and creating any increase in the VDO commits the patient to restoring all occluding surfaces of at least one arch. When there is an occlusal plane discrepancy, this is further complicated, as an uneven amount of restorative space across the arch may be required.

CLINICAL REPORT
A 60-year-old Asian male was referred by his previous dental provider for restorative dental work with a chief complaint of “my front teeth are worn down and I would like to chew well once again” (Figure 1). He presented with a Class II, division 2 type malocclusion, reporting loss of his tooth structure attributable to caries. Examination revealed a worn dentition, multiple defective restorations, defective metal-ceramic crowns, and supra-erupted mandibular anterior teeth. Intraoral examination revealed a generalized loss of dental structure (Figures 1 and 2). Abrasive wear facets were also present in the maxillary anterior sextant. An occlusal plane discrepancy where the mandibular
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Figure 1a. Occlusal view, pretreatment.

Figure 1b. Intraoral view (frontal), pretreatment.

Anterior teeth were supra-erupted and the porcelain had fractured was also observed.

Clinical and radiographic examination revealed that the right mandibular canine and left mandibular second molar had carious lesions. Further, the left maxillary lateral incisor and left first mandibular molar were absent. There was no sensitivity, pain, or temporomandibular joint dysfunction symptoms.

The dental diagnosis of the patient included dental caries and erosion, Class IV partial edentulism, periapical periodontitis, generalized moderate with localized severe chronic periodontitis, partial edentulism, and tooth wear associated with nocturnal bruxism.

Treatment Plan

Treatment objectives for the patient were to improve oral hygiene and restore function by providing tooth-supported all-ceramic bonded restorations to replace the anterior teeth alongside tooth- and implant-supported metal-ceramic restorations for the posterior teeth. Considering the periodontal involvement of the first and second right molars, it was decided to remove these teeth and to replace them with implant-supported restorations. These restorations would restore occlusal contact while providing acceptable aesthetics. Specifically, utilizing ceramic bonded restorations allowed for an aesthetic smile and restored chewing surfaces, while the patient's history of mechanical breakdown of prior restorations suggested the use of metal-ceramic restorations for the posterior teeth. Further, using a minimally invasive approach, which was an important request of the patient, it was decided not to reduce vertical dimension and to perform minimal occlusal reduction on appropriate teeth, as the plan was to utilize bonded indirect restorations.

Clinical examination and assessment of the mounted diagnostic casts revealed that insufficient restorative space was available in the anterior region of the maxilla and mandible. In order to obtain space for restorative materials, different options were considered, such as orthodontic intrusion of the supra-erupted anterior mandibular teeth to return them to their original position, crown lengthening surgery, extraction of the malpositioned teeth, and subtractive surgical procedures (osteotomy or ostectomy) with/without increasing the VDO. It was decided to deliver a fixed partial denture (FPD) for the missing maxillary left lateral incisor as the adjacent teeth were already heavily prepped. It should be emphasized that the patient requested conservative and minimally invasive procedures.

All the available treatment options were presented and discussed with the patient. The majority of the patient’s dentition already showed signs of aging and/or failing restorations that did not meet his desired aesthetics; therefore, a diagnostic wax-up was needed (Figure 3). The maxillary and mandibular pretreatment impressions were made, poured up, and the diagnostic wax-up was completed. It was decided restorative space needed would require increasing the VDO by 3.0 mm. Based on the completed diagnostic wax-up, a radiographic guide was fabricated. This guide was converted to a surgical template and utilized to place 3 implants (OsseoSpeed TX, part of the ASTRA TECH Implant System [Dentsply Implants]) in the posterior mandible (5.0 mm diameter implants, 9.0 mm length in space No. 31; and 11.0 mm length in the spaces of Nos. 18 and 30). Subsequently, a fixed bonded interim restoration was delivered to the patient, aiming at an increased VDO of 3 mm (at the incisal pin). Using this VDO, a diagnostic wax-up that satisfied the aesthetic criteria for the maxilla was completed.

The diagnostic wax-up was duplicated and tooth- and implant-supported interim fixed restorations were fabricated using polymethyl methacrylate (Jet Acrylic [Lang Dental]). Then, the tooth-supported interim fixed restorations were cemented with TempBond (Kerr Dental).

After confirming that the patient was satisfied with the form, color, shape, and function of the provisional restorations (Figure 4), the tooth preparations were completed and impressions were made using a vinyl polysiloxane (VPS) impression material (Flexitime [Heraeus Kulzer]). For bonded restorations,
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The dentin structures of the abutment teeth were immediately sealed using the Magne method. Taking into account the parafunction, it was decided to use metal-ceramic restorations for the maxillary and mandibular molars. For the premolars, lithium disilicate (IPS e.max [Ivoclar Vivadent]) was chosen for this case to be used as a monolithic (nonlayered) restorative material, to provide desirable aesthetics and mechanical strength. Considering the aesthetic demands of the patient, layered lithium disilicate (IPS e.max) was chosen for the anterior mandibular and maxillary teeth.

The restorations were evaluated and tried in clinically, confirming the fit of the restorations, appropriate interproximal contacts, and the proper occlusion of the implant-supported restorations. The implant-supported restorations were then cemented using temporary cement (TempBond) to allow for future retrieval. Subsequently, the internal surfaces of the all-ceramic restorations were etched with 9% hydrofluoric acid (Porcelain Etch [Ultradent Products]) and gently brushed and rinsed (20 seconds each) with a water-spray. The intaglio surfaces of the ceramic-bonded restorations were treated (cleaned) with 37.5% phosphoric acid (UltraEtch [Ultradent Products]) for 60 seconds, rinsed with water for 20 seconds, and then immersed in distilled water ultrasonic bath for 2.5 minutes. Next, the surfaces were thoroughly wetted with silane (Silane [Ultradent Products]) then dried at 212°F for 60 seconds. The prepared substrate tooth surfaces were cleaned using a rubber cup with a paste made of plain flour pumice and distilled water, etched for 15 seconds with the 37.5% phosphoric acid gel, followed by copious irrigation with water- and air-drying. Both the teeth and internal surfaces of the all-ceramic restorations were coated with an adhesive resin (OptiBond FL, Bottle 2 [Kerr Dental]) and left unpolymerized until the application of the luting material. The composite resin luting materials (Z100 [3M]) were warmed for 5 minutes before use (Calset Composite Warmer [AdDent]). The restorations were seated, and any excess uncured composite resin was removed. Each surface was light-cured for 60 seconds (Demi Plus [Kerr Dental]). Finally, the margins of each restoration were covered with an air-blocking barrier (DeOx [Ultradent Products]) for the final polymerization cycle. The restorations were satisfactory in terms of color, form, phonetics, and function (Figure 5). A self-etching and self-adhesive cement (G-Cem [GC America]) was utilized because of the presence of ample retentive features on the full-coverage crowns.

The management of severe tooth wear is challenging, and etiological factors should be identified; failure to address these factors compromises the long-term survival of restorations and leads to deterioration of the dentition. It is important to discuss pros and cons of treatment modalities with the patient.

This case report has described the diagnosis and treatment of a patient with a worn dentition via a treatment approach combining implant-supported metal-ceramic restorations and ceramic bonded restorations. The patient presented with a wear in the anterior sextant of the mandible with limited space available for restorations. The main cause of the worn dentition and restorations was the mechanical breakdown attributed to nocturnal bruxism. Excellent survival rates and low failure rates have been reported for lithium disilicate all-ceramic restorations when adhesively bonded to prepared enamel substrate. In this clinical case, monolithic lithium disilicate material was used for the premolars, attributable to its high strength, while layered lithium disilicate restorations were used for the anterior sextants. It should be emphasized that all preparations were done conservatively (only into enamel when possible) to optimize the bond strength and increase the survival potential of the restorations. In comparison to PFM or zirconia restorations, lithium disilicate ceramics (IPS e.max) offer a better color match and aesthetics while still possessing acceptable mechanical

DISCUSSION

Figure 2. Full-mouth radiographs of patient upon presentation.

Figure 3. Frontal view of diagnostic wax-up.
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Moreover, radiographic monitoring of the lithium disilicate restorations is possible due to the radiopaque nature of these all-ceramic materials. Further, because of the extreme importance of aesthetics, and considering the high opacity of the core material in PFM and zirconia restorations, alongside the questionable bonding of zirconia to tooth structure, it was decided that lithium disilicate should be the material of choice. An anterior guidance occlusal scheme was designed for the definitive restoration, which further protects the posterior restorations in protrusive and extrusive movements. In addition, an occlusal guard was fabricated for the patient, and the importance of wearing this device regularly was emphasized.

As a result of the aesthetic concerns of the patient, a short connector design was chosen for the anterior FPD (IPS e.max), and, unexpectedly, after 2 months, a fracture and chipping were observed on the FPD (Figure 6). The fractured FPD was retrieved, and after a thorough risk-to-benefit assessment, a metal-ceramic FPD was fabricated and delivered. After 3 years of follow-up, no further failures were observed and the patient was satisfied with the aesthetics and function (Figures 7 and 8).

Among all-ceramic systems, lithium disilicate has proven itself to be preferred in core-veneer bonding. Monolithic restorations have a tendency to outperform veneered bi-layer restorations, due to the increased core wall thickness and the smaller number of interfaces involved. A thicker core or monolithic lithium disilicate restoration should lead to improved fracture resistance. Monolithic specimens have shown significantly higher mean failure loads than bi-layered specimens, regardless of the core material. This was also true in comparisons of posterior fixed dental prostheses made of monolithic or bi-layer CAD/CAM lithium disilicate with metal-ceramic specimens, in which the failure mode was expected to be different in type and location. In the current clinical report, a compromised connector design was initially chosen because of the importance of aesthetics for the patient.
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CONCLUSION

A clinical report has been presented involving a multidisciplinary management of worn dentition, utilizing a combination of adhesive and implant dentistry. The definitive restorations comprised metal-ceramic implants along with tooth-supported ceramic bonded restorations (lithium disilicate ceramic material). These restorations were fabricated at an increased VDO (3 mm), providing acceptable aesthetics and function. During the 4-year follow-up, there were no clinical complications, and the patient was satisfied with the aesthetic and functional outcomes.

References

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POST EXAMINATION QUESTIONS

1. Attrition is defined as the loss of tooth structure by mechanical wear from another tooth surface.
   a. True.
   b. False.

2. Vertical dimension of occlusion (VDO) can be estimated using the following method(s):
   a. Phonetics.
   b. Interocclusal distance.
   c. Swallowing.
   d. All of the above.

3. According to the classification of Turner and Missirlian, which category of patients exhibits excessive wear without loss of VDO but has space available for placement of restorations?
   a. Category I.
   b. Category II.
   c. Category III.
   d. Category IV.

4. In the clinical case presented, taking into account parafunction, the following type of restoration was used for the maxillary and mandibular molar teeth:
   a. Nonlayered lithium disilicate.
   b. Layered lithium disilicate.
   c. Metal-ceramic.
   d. None of the above.

5. In the case presented, taking into account aesthetics as well as mechanical strength, the following type of restoration was used for the premolar teeth:
   a. Nonlayered lithium disilicate.
   b. Layered lithium disilicate.
   c. Metal-ceramic.
   d. None of the above.

6. In the case presented, layered lithium disilicate restorations were used for the anterior sextant teeth for aesthetics.
   a. True.
   b. False.
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7. In terms of fracture resistance, monolithic lithium disilicate restorations tend to outperform veneered bi-layer restorations. This is due to the increased core wall thickness and the smaller number of interfaces involved.
   a. The first statement is true, the second is false.
   b. The first statement is false, the second is true.
   c. Both statements are true.
   d. Both statements are false.

8. To help avoid failure of lithium disilicate restorations at the connector area, connectors should have a minimum height of:
   a. 1 mm.
   b. 2 mm.
   c. 3 mm.
   d. 4 mm.

9. To help avoid failure of lithium disilicate restorations at the connector area, connectors should have a minimum area of:
   a. 10 mm².
   b. 12 mm².
   c. 14 mm².
   d. 16 mm².

10. With monolithic lithium disilicate milled (CAD) partial dentures fabricated with large connector sizes, fracture strengths can be comparable to metal-ceramic restorations. When a fracture does occur, it tends to happen at the simulated distal connector.
    a. The first statement is true, the second is false.
    b. The first statement is false, the second is true.
    c. Both statements are true.
    d. Both statements are false.
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3. ☐ a  ☐ b  ☐ c  ☐ d  8. ☐ a  ☐ b  ☐ c  ☐ d
4. ☐ a  ☐ b  ☐ c  ☐ d  9. ☐ a  ☐ b  ☐ c  ☐ d
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