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Conservative Restoration of Worn Mandibular Anterior Teeth Combining Gingival Repositioning and a Template Matricing Technique

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Clinical Relevance

The restoration of worn mandibular anterior teeth is a challenging clinical problem. By combining gingival crown lengthening, bonding of resin composite material, and selective occlusal adjustment, a short to medium-term, conservative option can be made available for patients.

SUMMARY

Conservative resin composite restoration of worn mandibular anterior teeth may offer an alternative option to full-coverage restorations for the patient. Assessment of the occlusal condition is critical because alterations in occlusal vertical dimension may not always be possible. By exposing additional coronal tooth structure, periodontal crown-lengthening procedures can serve to increase clinical crown height when adequate attached gingival tissue is present and supra-eruption has likely occurred. Fabrication of a custom template made from a diagnostic mock-up with proximal stainless steel matrices helps contribute to a predictable restorative result and improves chairside efficiency for the dental practice. By combining gingival crown lengthening, bonding of resin composite material, and selective occlusal adjustment; a short to medium-term, conservative option can be made available for the patient.

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INTRODUCTION

The retention of natural teeth in an aging population, accompanied by the loss of posterior teeth, parafunctional habits, and tooth inclines (natural or

restorations) that interfere with mandibular border paths, can result in loss of incisal or occlusal tooth structure in the adult dentition.[1,2] Restricted anterior guidance resulting from orthodontics or improperly contoured anterior restorations can cause excessive wear, hypermobility, and migration of anterior teeth.[2] When mandibular anterior wear is present, the enamel is often worn coronally such that the dentin is exposed. The exposed dentin will erode faster than enamel because it does not resist abrasion as well and demineralizes at higher pH levels. Many times sharp, translucent ledges of enamel are left unsupported by dentin, and these are prone to fracture and have an appearance that is esthetically displeasing to the patient.[3,4]

For patients in whom functional occlusion mainly involves mandibular movement in an anteroposterior direction, the anterior teeth abrade slowly as they continue to erupt to maintain a maximum intercuspation position (MIP). Orthodontic intrusion may be necessary to create space for a definitive restoration, such as an all-ceramic crown or porcelain veneer.[5] However, it may not be desirable to increase the occlusal vertical dimension (OVD) in patients who are bruxers as this may result in premature destruction of the restorations.[6] Orthodontic treatment, however, may take significant time and requires close coordination between the restorative dentist and the orthodontist. A commonly recommended restorative solution for tooth wear involves increasing the OVD, which serves to provide space for the full-mouth restoration of the worn anterior teeth.[7] Restoring the severely worn dentition or a dentition with a deep bite is challenging when space for the restorations is inadequate.[8] Increasing the OVD to create space for restorations has proven successful in full-mouth rehabilitation; however, conservative increases (<5.0 mm) of OVD must be trialed with temporary restorations or occlusal splints for up to three months with the patient reporting no signs or symptoms of muscle soreness or temporomandibular joint pain before completing definitive restorations .[9,10] Although clinical strategies for full-mouth restoration of severely worn teeth that conservatively increase the OVD have been successful, some retrospective case studies have suggested that the prognosis and adaptability of increasing OVD in adults is not predictable and that patients tend to return to their original OVD.[11,12]

Because orthodontics and indirect restorations often involve time-consuming and expensive procedures; patients will request alternative options for restoring their worn teeth. Recently reported case studies with a clinical follow-up that evaluated the reconstruction of a complete occlusion with resin composite materials presented longevity results after three years and after five and a half years.[13,14] A vacuum-formed template was used to build up the teeth with resin composite materials to optimal anatomy and function. Out of a total of 85 restored teeth, two teeth sustained small restoration fractures after 24 months, though these were repairable. At five and a half years these build-ups showed some deterioration, but most of the marginal defects could be corrected by finishing and polishing, and the authors suggested that this approach could serve as a "medium-term" restorative rehabilitation for patients.

In another study, direct composite restorations were placed on mandibular anterior teeth for patients who wore a removable posterior occlusal overlay appliance that stabilized posterior contacts at an increased OVD.[15] Based on the results after two and a half years, the authors suggest that direct composite restorations are a "simple and time-efficient" technique to manage a worn mandibular anterior dentition but do not imply that this is a "long-term" solution. Recently, researchers from this same clinical trial published a seven-year follow-up on the longevity of the direct composite restorations.[16] Marginal breakdown was the most frequently encountered problem, but at the seven-year evaluation, 85% of the restorations remained intact and functional.

Although other studies[17,18] advocate the use of an occlusal splint to increase OVD when restoring worn anterior teeth with direct composites, selective occlusal adjustment and maintenance of the existing OVD may be desirable when restoring worn teeth with resin composite materials.[19] The use of a prefabricated template has been suggested to achieve a predetermined contour and occlusion when using direct-placement resin composite materials.[20-22] Also, worn mandibular teeth may have supra-erupted to stay in occlusion, in which case the clinical crown may then be further exposed using crown-lengthening repositioning surgery to create additional crown height and improve the esthetic appearance of the teeth.[23] This supra-eruption has been termed "delayed passive eruption" and is associated with excess gingiva covering the anatomic crown, resulting in the appearance of short teeth.[24] In these cases, the osseous crest may be close to the cementoenamel junction (CEJ), and osseous resection will be indicated in combination with soft tissue repositioning

Figure 1. *Preoperative condition of worn mandibular anterior teeth.*

typically involving gingivectomy and/or flap surgery.[25]

This clinical technique article will present a conservative restoration combining gingival crown lengthening and restoration of worn incisal edges with resin composite material using a unique prefabricated template for worn mandibular anterior teeth in the patient's acquired MIP.

CLINICAL TECHNIQUE

A 72-year-old man presented to our dental college faculty practice seeking treatment options for his worn mandibular anterior teeth. His medical history was noncontributory, except for taking medication for hypertension. The clinical exam revealed the following: all maxillary molars, mandibular third molars, and tooth #10 were missing, generalized marginal gingivitis with mild horizontal bone loss, gingival probing depths $\leq$4 mm, severe wear with dentin exposure and sharp edges of enamel on teeth #23–27, extensive amalgam restorations, porcelain fused to metal (PFM) crowns on teeth #7 and #8, and a three-unit PFM fixed partial denture (FPD) with abutments on teeth #9 and #11. The patient reported no history of bruxism, and the temporomandibular joint function was asymptomatic with no joint noise or masticatory muscle tenderness. The patient's spouse was not aware of nocturnal bruxism. The missing maxillary molar teeth were removed due to nonrestorable caries and tooth fractures that occurred when the patient was in his 30's. At the time of the current exam the patient's caries risk status was moderately high due to a high decayed, missing, and filled tooth index (DMFT), lack of access to water fluoridation, fair oral hygiene, and the use of prescription saliva-reducing medications; however, no active caries lesions were present. The patient was not in any discomfort and was referred to the faculty practice for full-mouth reconstruction to restore his worn dentition.

Diagnostic casts were fabricated, a face-bow recording was obtained, and the casts were mounted on a semiadjustable articulator in centric relation (CR). This diagnostic procedure revealed that the patient was functioning in an acquired protrusively positioned MIP that was likely an etiologic factor for incisal wear along with the mandibular tooth enamel/dentin occluding against maxillary PFM restorations. The PFM crowns on teeth #7 and #8 and the fixed partial denture from #9–11 had a lingual metal contact design opposing the incisal edges of the mandibular anterior teeth. An initial treatment plan involving reconstruction of the complete dentition with full-coverage restorations, crown-lengthening surgery for the mandibular anterior teeth, and implant restorations for the missing maxillary molars was presented to the patient.

Because of concerns about cost and time, the patient requested a secondary option. The alternative proposal involved crown-lengthening periodontal surgery for the mandibular anterior teeth followed by resin composite restoration of the incisal edges of teeth #23–27 combined with selective grinding of the lingual metal surfaces of the maxillary fixed prostheses. The rationale for restoring teeth #23–27 was to restore the worn incisal edges to an improved incisal anatomy, remove the sharp enamel edges, and to protect the exposed dentin surfaces from further loss of tooth structure. Although this treatment proposal was a compromise from the preferred reconstruction, the patient accepted this plan and understood that this would not be a long-term solution for preserving his dentition. Probing the facial aspects of the mandibular anterior teeth revealed that the CEJ was $\geq$2.0 mm from the gingival margin, which suggested that these teeth had delayed passive eruption in addition to abrasive/erosive wear. The amount of facial attached gingiva was abundant and measured $\geq$4.0 mm from the free gingival margin to the mucogingival junction on the facial aspect of teeth #23–27.

The extent of the tooth structure loss on the mandibular anterior teeth is depicted in Figure 1, and the two-week healing of the periodontal crown-lengthening surgery is illustrated in Figure 2. Although the crown-lengthening procedure resulted in apical positioning of the gingiva and increased incisogingival length of the incisors, it did not expose the CEJ. The restorative procedures were completed

Figure 2. *Two-week postoperative healing after crown-lengthening surgery of the mandibular anterior teeth.*

six weeks after the periodontal surgery. Following are the steps taken in the process.

Step One

A diagnostic mock-up using expired resin composite for teeth #23–27 was accomplished on a simple hinge articulator mounted in the patient's acquired MIP because restoration to the CR position would require replacement (either fixed implant or removable prostheses) of the missing maxillary molars and restorative establishment of a stable posterior closure coincident with CR. In addition to contouring the mock-up to avoid excessive occlusal contact, some selective grinding on the diagnostic cast of the maxillary anterior restoration lingual surfaces on metal was performed to accommodate a symmetrical esthetic result for the incisal edges of the mandibular teeth within the constraints of the patient's

Figure 3. *Model with the diagnostic mock-up on the mandibular anterior teeth.*

Figure 4. *Proximal positioning of the stainless steel matrices and the placement of a round bead on the incisal edge to create a sprue for the resin composite tip.*

acquired occlusal scheme. There was a risk of perforating through the metal on the maxillary PFM prostheses to the underlying tooth structure or buildup material; however, because the selective grinding was minimal, we were able to avoid perforating the existing restorations. The resin composite mock-up is shown in Figure 3. The OVD was not changed, so the incisal length of the mandibular anterior teeth was limited by the MIP and the patient's anterior guidance.

Step Two

Figure 4 illustrates the custom template preliminary procedures on the study model after the diagnostic mock-up was completed. Proximal cuts were made with a Ceri-saw (DenMat Holdings, Inc, Lompoc, CA, USA) to open up the interproximal areas on the stone cast. Round beads of resin composite of similar diameter to the tip of the resin composite applicator were placed on top of teeth #23–27, serving as a sprue, and sections of stainless steel (SS) matrix material (0.0015" #1 Tofflemire matrix, Safco Dental Supply, Buffalo Grove, IL, USA) were placed mesially and distally of each tooth being restored to avoid inadvertent placement of resin composite on adjacent teeth.

Step Three

A template (0.020" clear coping material, Patterson Dental Supply, Inc, Effingham, IL, USA) was then fabricated using a vacuum-former (UltraVac, Ultradent Products, Inc, South Jordan, UT, USA) that embedded the diagnostic mock-up and SS matrices. The sections of SS matrix material were removed, and these areas were opened up buccolingually with

Figure 5. *Template seated on the diagnostic cast mock-up with stainless steel matrices in place after opening up the interproximal space on the template with a #25 blade.*

a #6 Bard-Parker scalpel (Zahn Dental/Henry Schein, Cookstown, NJ, USA) with a #25 blade to facilitate subsequent placement of the SS matrices back in place when the template is transferred to the mouth. Figure 5 shows the custom template with the SS interproximal matrices in place. [27]

Step Four

Figure 6 shows the preparation design for teeth #23–27 with two retentive potholes at the incisal edge, 1.0 mm in diameter and 1.0 mm deep, in dentin using a #329 carbide bur (Brasseler USA, Savannah, GA, USA), and the peripheral enamel was prepared with a circumferential 1.0-mm bevel using a #8889 ultra-thin flame diamond (Brasseler USA). Proximal relationships between the mandibular anterior teeth were left as they existed preoperatively.

Figure 6. *Example of a tooth preparation on the mandibular left lateral incisor illustrating retentive potholes and the peripheral circumferential bevel.*

Figure 7. *Custom template in place intraorally with interproximal stainless steel matrices and resin composite tip placed in the sprue hole for building up one tooth at a time.*

Step Five

Figure 7 illustrates the interproximal SS matrices in place and the positioning of the resin composite delivery tip for filling the custom template and building up the restoration. The teeth were etched with 35% phosphoric acid, a two-step primer & bonding resin application and followed by restoration with a radiopaque, microhybrid resin composite material. The brand names of the materials used were Ultra-etch, PermaQuick, and Amelogen Plus (Ultradent Products, Inc). The teeth were built up one at a time. Etching and placement of the primer and bonding resin were accomplished before placement of the custom template. The resin composite buildup required only one increment, which was $\leq$ 2.0 mm, so incremental light polymerization was not needed. The resin composite delivery tip was placed close to the surface of the tooth inside the access hole in the custom template. While slowly being with-

Figure 8. *Mandibular anterior teeth with resin composite buildups ready for contouring and polishing.*

Figure 9. *Selective grinding completed prior to final finishing on the lingual metal of the maxillary fixed prostheses.*

drawn, pressure was generated to force the resin composite into the template space, resulting in a slight amount of excess composite requiring minimal contouring and finishing. The resin composite sprue served to minimize air voids in the buildup. Figure 8 shows the completed buildups before finishing and polishing. The sprue button on the top of the incisal edge was carefully finished to the predetermined diagnostic mock-up incisal edge configuration, and the proximal embrasures were finished to remove excess composite.

Step Six

The patient's occlusal contacts were in harmony with MIP and protrusive guidance with maintenance of the preexisting OVD. Figure 9 illustrates the lingual metal surfaces of the maxillary fixed prostheses

Figure 10. *Final occlusal markings on contoured and polished resin composite restorations on the mandibular anterior teeth. Minimal adjustment was necessary, and the resin composite restorations were subsequently polished to a high gloss with abrasive-impregnated rubber points, cups, and disks.*

Figure 11. *Frontal perspective of the patient in maximum intercuspation position after gingival surgery and resin composite restorations.*

immediately after the selective grinding was accomplished using the occlusal adjustment planning done on the diagnostic cast as a guide. These rough surfaces were subsequently smoothed using rubber abrasives. Since compromises were made in the incisal anatomy on the diagnostic mock-up to minimize increases in OVD, perforation of metal wasavoided, and the lingual metal surfaces were conservatively contoured as planned, finished, and polished. Figure 10 shows the final results of the resin composite restorations after finishing, polishing, and checking MIP and anterior guidance contacts and the healthy gingival tissues. A frontal perspective of the patient in MIP is depicted in Figure 11.

Step Seven

The patient agreed to comply with six-month recall visits for continued hygiene maintenance and restorative examination. Although a plan for a comprehensive full-mouth rehabilitation was suggested to the patient at the recall visits, his financial situation would not allow him to proceed with this level of care. A maxillary acrylic occlusal splint was fabricated for the maxillary arch at the first six-month recall for nighttime use, although the patient (and his spouse) continued to deny any awareness of nocturnal bruxism. If bruxism were contributing to the wear of his mandibular anterior teeth this would likely lead to early failure of the resin composite restorations and continued wear of tooth structure would be observed.[6]

At the two-year recall visit in January 2014, it was observed that the resin composite restoration on tooth #27 had sustained a partial cohesive fracture. The preparation was modified to increase retention,

Figure 12. *Three-year post-operative condition of mandibular anterior teeth with resin composite build-ups.*

the peripheral bevel was prepared again, and the tooth was subsequently restored to the previously established contour and occlusion on the diagnostic mock-up with resin composite using the original custom template with interproximal matrices. Figure 12 illustrates the condition of the restored mandibular anterior teeth after 3 years. These restorations continue to be retained although there are signs of wear on the resin composite material. The maxillary occlusal splint required no modifications.

SUMMARY

Worn mandibular anterior teeth are commonly observed in members of an aging population who are partially edentulous as well as those who maintain a full permanent dentition. Occasionally, increasing the OVD of the posterior teeth is necessary to create space for the restoration of worn anterior teeth. Also, the situation may present where excess gingival tissue covers the anatomic crowns of the worn anterior teeth. In such cases, soft tissue repositioning using gingivectomy and surgical flap procedures will expose additional clinical crown, thereby improving esthetics; however, the incisal edges of these teeth are typically worn and uneven. A diagnostic mounting in MIP on a simple hinge articulator facilitated a mock-up on the diagnostic cast for the incisal edge restoration with resin composite restorative materials to serve as a short- to medium-term restorative option. Subsequently, fabrication of a clear custom template with interproximal SS matrices will serve to minimize time required for chairside buildup and contouring of the direct placement resin composite restorations, thereby enhancing clinical efficiency for both the practitioner and the patient.

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Human Subjects Statement

This study was conducted in accordance with all the provisions of the local human subject's guidelines and policies of the University of Nebraska Medical Center College of Dentistry.

Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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