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The Aesthetic Correction of a Damaged Occlusion Using Varied Preparation Designs and Pressed Ceramic Restorations

Occlusal damage can be due to a variety of factors including primary and secondary malocclusion, parafunctional habits, missing teeth, caries, and failing restorations among others. In many cases the patient has adapted to their occlusal scheme without secondary, extra-occlusal symptoms such as temporomandibular dysfunction, muscular pain, and headaches. In such asymptomatic cases the challenge lies in restoring and strengthening the dentition without significantly altering occlusal function or reducing tooth structure unecessarily. The preservation of tooth structure is the hallmark of responsible dental care: minimally invasive, atraumatic restorative treatment by virtue of little to no tooth reduction where applicable.

When placing porcelain veneers, it has been demonstrated that little to no tooth reduction in preparation design offers many benefits including a reduced potential for fracture of the ceramic restoration[1] and the avoidance of exposing sensitive tooth structure with possible post-operative sensitivity.[2] In addition, maximum preservation of enamel imparts superior bond strengths and provides the option for a reversible procedure if needed. Following the minimally invasive treatment methodology, Cerinate Porcelain (DenMat Corp., Santa Maria, CA), a laboratory fabricated, indirect restorative material has been used successfully.

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Cerinate Porcelain is a uniquely processed feldspathic porcelain that can be created in thicknesses as low as 0.2mm. This allows for minimal to no tooth reduction[3] without the additional bulk that would create a fuller lip or cause phonetic difficulties.[1] Cerinate Porcelain has been extensively studied for over 20 years [4,5,6,7] and has been found to be a material with incredible longevity and strength.[8] Its flexural strength falls in a range occupied by aluminum oxide reinforced core porcelains. [9] Its low coefficient of thermal expansion prevents fracturing and debonding with thermal expansion characteristics similar to enamel.

Cerinate Porcelain has been used in a number of applications including veneering to aesthetically compromised natural teeth,[10] veneering to existing unaesthetic crowns,[11,12] three unit fixed anterior prostheses,[13] periodontal prostheses,[14] regaining cuspid guided occlusion[15], diastema closure,[16] inlays[17], onlays [18,19] and crowns. The following case report demonstrates the restoration of a damaged dentition using Cerinate Porcelain.

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CASE REPORT

APPOINTMENT 1: The Consultation

The patient, a 70-year-old female presented with the chief complaint that her teeth were chipping, the colors mismatched and the bonding of the two front teeth dull and dark. **FIG 1** In addition, she noticed that black areas were apparent at the gumline of all her crowns and food was collecting between the gaps of her lower front teeth. Following a complete examination including a full mouth series using digital radiography (Trophy RVG, Practiceworks, Atlanta, GA) and study models, the following findings were noted:

- #2,4,6,8,9,10,19,31: failing restorations with associated caries
- #5,7,12,13,14: porcelain-to-metal crowns with exposed metal margins due to gingival recession but with no evidence of caries.
- #11,20,22-27: severe enamel wear with fracturing and dentinal exposure
- #1,3,15,16,17,18,21,30,32: missing
- Periodontal exam and temperomandibular analysis and exam was within normal limits despite the loss of posterior teeth, decreased vertical dimension of occlusion and bilateral group function guided occlusion.

Based on these findings a simplified treatment plan was created that would treat the damaged incisal surfaces and existing carious lesions, correct the aesthetic deficiencies and enhance the occlusion all with minimal tooth reduction. It was noted that beneath the large direct

composite “crowns” on the maxillary central incisors was subgingival caries that would require the complete removal of existing restorative material as well as the infected carious dentin. These would be restored with pressed Cerinate Porcelain crowns. The remaining dentition from the right maxillary first premolar to the maxillary left first molar and the mandibular left canine to the mandibular right first premolar would have little to no preparation and be restored with pressed Cerinate Porcelain veneers. These veneers would correct the occlusal wear and damaged enamel and dentin and aesthetically correct the clinically acceptable but unaesthetic existing PFM crowns. In addition, the lingual surfaces of the maxillary right and left lateral incisors and canines would be enhanced with pressed Cerinate veneers to correct the occlusal architecture through canine protected occlusion. This plan would preserve the maximum amount of tooth structure and provide even wear by virtue of the new porcelain-to-porcelain contacts. The remaining posterior dentition would be restored with traditional full coverage Captek-to-Porcelain fixed restorations.

APPOINTMENT 2: Preparation

The maxillary left and right central and lateral incisors were locally anesthetized and all existing restorative material was removed. Upon complete removal of the defective composites, there was little remaining of the original central incisors and it appeared as if the teeth were previously prepared for full coverage preparations. Infected caries was then removed using Smartprep (SS White, Lakewood, NJ) a rotary polymer instrument at 700 rpm. Due to their subgingival nature and close pulpal proximity, the lesions were restored with Geristore Syringeable, (DenMat Corp.) a resin reinforced glass ionomer in a dual-cartridge delivery

system. Because of its histological biocompatibility[20,21], and kindness to the pulp, [22] it is an ideal restorative material in deep carious lesions.

The crown preparations of the central incisors were completed with full shoulder margins and shallow anti-rotation slots. Temporary crowns were fabricated for the maxillary centrals in shade A1 using C.B.V. TEMP (DenMat Corp.) an exceptionally strong bisacryl temporary material. These were used as a guide to determine the amount of labial reduction required in the maxillary teeth and the amount of incisal reduction needed in the lower anterior teeth. The remaining maxillary teeth were minimally prepared with facial recontouring and rounding of sharp incisal edges. **FIG 2A&B** The mandibular anterior teeth **FIG 3A** were then reduced at the inciso-labial to remove sharp, unsupported enamel and create sufficient room to accommodate adequate incisal thickness for the ceramic restorations. **FIG 3B** It should be emphasized that this technique does not require the fabrication of temporary veneers due to its minimally invasive preparation design. The provisional crowns were removed and a final polyvinyl impression made in a triple tray using 1st Impression (DenMat Corp.) Heavy (purple) base fast set followed by Light (yellow) wash as prescribed by the H&H technique and the provisional crowns temporarily cemented.

LAB COMMUNICATION:

Using simple technology and standard dental materials, the lab can be given a wealth of information. In addition to the standard prescription form and detailed final impressions, preoperative study models are a must. Also, preoperative images of the patient's dentition using a digital camera and color printer can be created in minutes. This data offers the lab

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technician a powerful view into what you are attempting to aesthetically correct and rehabilitate. Also, your vision of tooth dimension and color is critical and when conveyed through writing or as a wax-up creates the opportunity for unbelievable success. In this case, all of the above items were sent as well as measurements of the original maxillary central incisor width and the desired width in keeping with the Rule of Golden Proportions.

APPOINTMENT 3: Case Insertion

The definitive Cerinate Porcelain pressed ceramic restorations were received from the DenMat laboratory in shade B1. **FIG 4** The veneers are pre-etched in the lab by first sandblasting with aluminum oxide followed by chemical etching with hydrofluoric acid. Nevertheless, when working with the Cerinate Porcelain System, prior to evaluation with try-in paste and/or final cementation, Porcelain Conditioner (DenMat Corp.) is applied to the intaglio surfaces of the veneers for 15-20 seconds, rinsed and dried. This increases the surface tension of the surface of the porcelain and activates the Cerinate Prime (DenMat Corp.), a silane-coupling agent which is immediately applied to these surfaces for 30-60 seconds, and gently air-dried. It is important to note that there is a component of light cured resin in this unique silane and therefore the veneers should not be light cured at this time. The temporary crowns of the central incisors were removed and the maxillary teeth prophylaxed, rinsed and dried. The maxillary labial veneers and crowns were tried in using Ultra-Bond Try In Paste Clear Shade (DenMat Corp.), a non-cure try-in resin. Excess paste was removed, margins were examined and the overall aesthetic scheme was evaluated.

Using a large photographic mirror, the maxillary anterior teeth were evaluated from the incisal. **FIG 5** This provides a view of tooth contours in the vertical and horizontal, as well as arch form, tooth-width, and rotations among others. In addition, the interarch distance was examined demonstrating the amount of room easily created by this minimally invasive preparation design. The patient was then given a mirror in order to evaluate her new smile. Once it was agreed that the restorations were excellent, they were removed and the majority of the try in paste removed with a resin-saturated applicator (Dabeze, DenMat Corp.). Because Ultra-Bond Try In Paste has all the chemical components of a bonding cement minus the photo or chemical bond initiators, the remaining thin layer is incorporated into the final dual cure composite cement and therefore need not be entirely removed. The veneers and crowns were set aside and the teeth prepared for cementation.

The preparation of the intraoral surfaces required bonding to two different substrates: existing porcelain and enamel/dentin. The Ultra-Bond Try In Paste was removed from all surfaces using a cotton pellet saturated in an alcohol-based mouthrinse. The surfaces were then rinsed and dried. Gingival tissue surrounding the porcelain surfaces were isolated using Light Cure Paint-On Dental Dam (DenMat Corp.) and the porcelain surfaces of the existing porcelain-to-metal crowns mechanically etched with 50 µm aluminum oxide using an intraoral sandblaster (Microetcher IIA, Danville Engineering, San Ramon, CA), rinsed and dried. **FIG 6A** These surfaces were then acid etched for two minutes using Porcelock, a biocompatible hydrofluoric acid, rinsed and dried. The block out resin was removed and all enamel and dentin surfaces were etched for 15 seconds with EtchN'Seal (DenMat Corp.), a 25% phosphoric acid gel containing oxalate crystals designed to prevent acid etch induced sensitivity. It was then rinsed

and dried followed by the application of Porcelain Conditioner for 30 seconds, rinsed, dried and then Cerinate Prime silane to all porcelain surfaces and dried.

Tenure A and B (DenMat Corp.), a two bottle chemical curing, multipurpose adhesive system was applied in five coats to all surfaces, **FIG 6B** followed by the application of Tenure S (DenMat Corp.), a single component, light cured, hydrophilic agent that further enhances bonding. For the past two decades, the Tenure system has demonstrated a proven clinical record of high bond strengths, [23]excellent retention, [24] significant reduction of microleakage, [25] and post-operative sensitivity. These characteristics can be attributed to the formation of a hybrid zone [26] that can eliminate root sensitivity instantly. The easy 2-step process of Tenure A, B and S exhibits bond strengths of more than 20 MPa to dentin.

The veneers and crowns were then cemented to place by dispensing Clear shade Ultra-Bond Plus (DenMat Corp.) from an auto mix dual barrel syringe. Ultra-Bond Plus is a multi-purpose, dual-cure resin cement designed specifically for bonding porcelain restorations. A study reviewed an initial veneer placement of Cerinate Veneers with Ultra-Bond in 1985 and then evaluated the veneers after 17 years when they were replaced due to esthetic wear. [27] The 17-year old case showed no evidence of microleakage, gingival recession, cracks or fractures.

The restorations were all seated to place and excess cement was removed using an applicator brush saturated in an unfilled resin (Visar Seal, DenMat Corp.). Each restoration was then firmly seated **FIG 7** by directing gentle pressure from the incisal and facial aspects

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simultaneously until a thin bead of resin cement was expressed from the marginal areas. The Cerinate Porcelain restorations were held in this fashion and one-by-one light cured for 3 seconds each using the Sapphire Curing Light (DenMat Corp.), a versatile PAC (Plasma Arc) Light known for deep penetration and rapid 3-5 second curing ability. In a study by Watanabe, [28]the bond strength achieved by plasma-arc curing was found to be relatively unaffected by the shade or opacity of porcelain. It was found that plasma-arc curing for 6 seconds was sufficient to obtain bond strengths similar to those of specimens polymerized with halogen light for 40 seconds.

The same procedure was then followed for the bonding of the Cerinate Porcelain veneers from tooth #22-28 **FIG 8,9** and the upper lingual of the maxillary lateral incisors and canines.

Once cured, gross excess Ultra-Bond Plus resin cement was first removed from the facial aspects using the Schure 349, (DenMat Corp.) a non-scratching resin removal hand instrument. **FIG 10**This was followed by fine removal at the margins using carbide finishing burs (ET Carbide Combo Kit, Brasseler USA, Savannah, GA). **FIG 11** The often flake-like remaining translucent resin cement can be removed from the facial surfaces using an Occlubrush (Kerr, Orange, CA). If interproximal contacts cannot be easily flossed following curing, it is best to engage the contacts after 24-hours to avoid disturbing the ongoing curing process of the Ultra Bond Plus resin cement. In addition, the interproximal cement of porcelain veneers bonded to existing porcelain crowns should ideally be adjusted 24-hours after bonding.

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Unlike porcelain veneers bonded to enamel, porcelain veneers bonded to porcelain will attain their maximum optimal bond strength after 24 hours. In a study by Peters [29] the shear bond strengths to porcelain were evaluated using dual-cured resin cement with light/chemical curing (dual) or chemical only curing versus time. Dual curing provided significantly higher shear bond strengths versus chemical curing at both the 60-minute and *24-hour time periods*. Occlusal adjustment was accomplished with finishing diamond burs (Et Diamond Combo Kit, Brasseler USA) carefully insuring that proper canine protected occlusion, **FIG 12** anterior guidance and occlusal contacts were correct. When compared to the patient's original presentation, **FIG 13** vertical dimension of occlusion was now increased and harmony was restored to the patient's dentition. **FIG 14** The adjusted areas were polished using the Dialite Ultra Porcelain Resurfacing System (Brasseler USA). The patient was placed on a home care program and given a 24-hour follow up appointment.

APPOINTMENT 3: Follow-up

One day later, the existing interproximal resin cement had loosened in many places making the task of cleanup easier. All interproximal contacts were flossed to evaluate the areas requiring attention and noted. To separate the resin cement in these areas, a manual interproximal separating instrument, the Cerisaw (DenMat Corp.) was used. The Cerisaw, a stainless steel 0.05mm serrated blade was placed at a 45° angle to the incisal plane of the interproximal junctions, and gently rocked in a see-saw fashion toward the gingival until the cement bond was separated. **FIG 15** Any remaining

29

interproximal resin was removed and polished using the Cerisander (DenMat Corp.) a single-sided diamond coated interproximal strip that utilizes the same handle as the CeriSaw. The case was then completed by restoring the remaining posterior teeth with fixed full coverage Captek-to-Porcelain restorations (Keating Dental Arts, Santa Ana, CA) and evaluated from an occlusal view. **FIG 16** The patients before and after was evaluated from both smile close up **FIG 17,18** and portrait views. **FIG 19,20**

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CONCLUSION:

When treating a severely damaged dentition, there are many preparation designs and restorative choices available. The advantages of the minimally invasive preparation design are numerous. When combined with Cerinate, a porcelain with natural appearing aesthetics, great strength, and reliability in high stress occlusal situations, the rewards are many.

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IMAGE CAPTIONS

Fig 01 The case presented with abrasion, failing restorations, mismatched colors, black lines at the cervical of PFM's, and gaps.

Fig 02A (Top) A close up view of the upper anterior teeth prior to preparation.

Fig 02B (Bottom) Ceramic crown preparations of the central incisors and only facial recontouring and rounding of incisal edges were needed to prepare the remaining upper teeth for veneers. Provisional veneers were not needed.

Fig 03A (Top) A close up view of the lower anterior teeth prior to preparation.

Fig 03B (Bottom) Preparations were made only at the inciso-labial to remove sharp, unsupported enamel and create sufficient room to accommodate adequate incisal thickness for the ceramic restorations. This technique does not require the fabrication of temporary veneers due to its minimally invasive preparation design.

Fig 04 The definitive Cerinate Porcelain pressed ceramic restorations were received from the DenMat laboratory in shade B1.

Fig 05 With the upper restorations in place with try-in paste, this incisal view demonstrates the amount of space available for the lower veneers easily created by this minimally invasive preparation design.

Fig 06A The gingival tissue is protected using a Light Cure Paint-On Dental Dam, (DenMat Corp.) a block out resin, and the existing porcelain-to-metal crowns etched with 50 µm aluminum oxide using an intraoral sandblaster (Microetcher IIA, Danville Engineering, San Ramon, CA).

Fig 06B Following the chemical treatment of the porcelain, the Tenure adhesive system was applied to the surfaces.

Fig 07 The Cerinate Porcelain veneers were seated to place by directing gentle pressure from the incisal and facial aspects simultaneously until a thin bead of resin cement was expressed from the marginal areas.

Fig 08 The Tenure adhesive system was applied to the enamel and dentin surfaces.

Fig 09 Prior to light curing, the Cerinate Porcelain veneers were held at the the incisal using a Schure 349 and the facial.

Fig 10 Any remaining Ultra bond Plus resin cement is first removed from the facial aspects using the Schure 349 hand instrument, (DenMat Corp.) a non scratching resin remover, followed by fine removal at the margins using carbide finishing burs (ET Carbide Combo Kit, Brasseler USA).

Fig 11 (See description Fig 10)

Fig 12 carefully insuring that proper canine protected occlusion

Fig 13 When compared to the patient's original presentation,

Fig 14 vertical dimension of occlusion was now increased and harmony was restored to the patient's dentition.

Fig 15 The Cerisaw was placed at a 45º angle to the incisal plane of the interproximal junctions, and gently rocked in a seesaw fashion toward the gingival until the cement bond was separated.

Fig 16 The case was then completed by restoring the remaining posterior teeth with fixed full coverage Captek-to-Porcelain restorations (Keating Dental Arts, Santa Ana, CA) and evaluated from an occlusal view.

Fig 17 Smile before.

Fig 18 Smile after.

Fig 19 Portrait view before.

Fig 20 Portrait view after.