

# Case Report 2

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## Conservative Full-Mouth Reconstruction of a Worn Dentition Utilizing Digital Impression Technology and Modern Ceramic Materials

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### ABSTRACT

Good communication and advanced planning were two keys used in this case to provide the patient with a predictable, clinically acceptable outcome of improved esthetics while preserving tooth structure. Demonstrating the successful integration of various dental specialists, the case utilized new technology that included chairside optical scanning and stereolithographic modeling. The goals of improving the patient's smile and function were achieved.

Full-mouth rehabilitation cases can often be daunting when viewed in total. Many patients requiring this level of restorative care often carry complicating aspects that are the very reason for the breakdown in the first place. Oftentimes periodontal, functional, genetic, and psychological aspects can complicate an already challenging situation. However, when strategically organized into logical component subspecialties and by following evidence-based dentistry, clinicians with modest experience can achieve remarkable success. This case demonstrates how the benefits of proper communication and advanced planning provided this patient with a predictable, clinically acceptable outcome of improved esthetics while preserving tooth structure.

## CASE PRESENTATION

A healthy, 48-year-old man presented for consultation with a chief complaint of disliking his smile. He was concerned about the incremental loss of tooth structure he had witnessed over the past few years and the general discoloration and improper display of his teeth and gums. Preoperative retracted images showed a narrow arch form with minor crowding, severe wear, and erosion, along with formation of large tori on the maxillary buccal areas<sup>1</sup> (Figure 1). As a successful computer software consultant who meets with clients on a weekly basis, he was also aware that an attractive smile might be beneficial in a competitive market. A survey conducted by the American Academy of Cosmetic Dentistry (AACD) revealed that a person with a pleasing smile is more appealing in many ways, and it can offer an advantage in business situations.<sup>2</sup> The patient previously attended consultation with a prosthodontist who offered a traditional approach of full-coverage metal-based porcelain crowns to open the bite and improve esthetics.

While there are many techniques and choices available for smile reconstruction, the patient was reluctant to have any more tooth structure removed than necessary. It quickly became apparent that offering a more conservative approach utilizing bonded porcelain restorations was more appealing to the patient, would preserve valuable limited tooth structure, and would potentially provide longer lasting restorations.<sup>3</sup> It became clear early in the process that to improve the appearance of his smile, interdisciplinary treatment

would likely be necessary. The convenience of having all specialties available in one practice appealed to the patient and enabled a rapid consultation and collaborative process with the orthodontist, periodontist, and oral surgeon to begin.<sup>4</sup> Discussions with the patient included improving the “white-to-pink ratio” by increasing the gingival height of the anterior teeth. This would improve the height-to-width ratios and provide more ideal tooth display. Reducing the bulkiness of the maxillary buccal tori was also discussed as they were very large and could present a problem during any planned tissue recontouring. It was agreed that these evaluations and treatment steps should be completed prior to any restorative care and were integral to achieving the overall goals of the case.

## PRE-RESTORATIVE TREATMENT PHASE

Orthodontic treatment was discussed and evaluation by the orthodontist was completed. A mutually agreed upon treatment plan included opening arch width to broaden the smile, thus filling the buccal corridor and reducing the posterior cross bite. General leveling and alignment of both arches would also be accomplished. This plan allowed for a more conservative surgical and restorative approach by placing the teeth in a more ideal location, thereby reducing the amount of hard- and soft-tooth structure required to be removed. After orthodontic treatment was completed, the patient was very satisfied and returned with improved symmetry, arch width, alignment, and function, and was ready for the smile design and surgical phase.<sup>5</sup> Clinical examination after orthodontic treatment revealed a long centric occlusion with flat occlusal surfaces, making it difficult to achieve a repeatable bite record. Using a face bow transfer and centric relation record to anatomically mount the preoperative models was an important foundational step. This was accomplished using a simple anterior deprogrammer, allowing the anatomy to relate and thus help to obtain a repeatable and accurate bite record.<sup>6</sup> A basic smile photograph revealed excess gingival display, and measurements revealed the length of the central incisors to be 8.5 mm. Ideal tooth length of central incisor teeth should be around 11.5 mm.<sup>7,8</sup>

The next logical step was to determine the ideal incisal edge position of tooth Nos. 8 and 9 with lips at rest by completing an intraoral composite mock-up. Flowable composite is a good choice for temporarily adding to incisal edges and/or overlaying the tissue to test various changes, visualize projected results, and gain patient approval. By adding composite to the gingival and incisal areas of tooth Nos. 8 and 9, a new incisor shape was established, which the patient approved. Phonetics and proper display of 2 mm to 3 mm with lips at rest was verified<sup>9</sup> (Figure 2). With this new contour and tooth position established, a polyvinyl impression was made and sent to the lab for complete laboratory wax-up to include an improved esthetic smile line and occlusal scheme based on the “clinically determined” incisal edge position (Figure 3).



Fig 1.

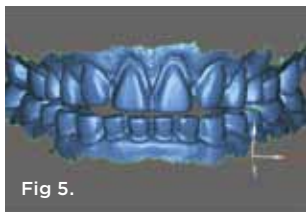


Fig 2.



Fig 3.

**Fig 1.** Preoperative retracted view showing wear, narrow arch form, crowding, and tori. **Fig 2.** Mock-up of tooth Nos. 8 and 9 showing proper display with lips at rest. **Fig 3.** Completed diagnostic wax-up on anatomically mounted casts.



**Fig 4.** Anterior bite record; note provisionals from mock-up remain on posterior to hold vertical dimension occlusal (VDO). **Fig 5.** Digital impression scan of upper and lower anterior preps. **Fig 6.** Anterior provisional restorations should reflect the planned final restorations. **Fig 7.** SLA models mounted, ready for lab; die trimming and sectioning were done virtually.

Laboratory fabricated condensation silicone prep guides and provisional guides were made using Sil-Tech® Putty (Ivoclar Vivadent Inc., [www.ivoclarvivadent.com](http://www.ivoclarvivadent.com)) and included as part of the process. Accuracy of these guides is improved by the use of a pressure pot to cure the indexes so they are well adapted to the models.<sup>10,11</sup>

With alignment and smile design completed, the surgical phase could be initiated. By saving the mock-up composite pieces that show the approved gingival height, the periodontist was able to place these sections over the teeth and determine the amount of tissue to be removed. The mock-up pieces also serve as a surgical guide for bone margin placement by measuring 2.5 mm to 3 mm from the proposed gingival line. As a result, the periodontist determined that in order to avoid invading biological width and still achieve the desired incisal/gingival height, alveolar bone would have to be recontoured on the eight anterior teeth.<sup>12-15</sup> Simultaneously, slight reduction of the tori would be accomplished while the patient was under sedation. It was agreed that

the existing bilateral tori actually provided some upper lip support, so only the areas nearest the apical section of the teeth would be reduced. The surgical phase was completed after the orthodontics and followed by a 6-week healing period.

#### RESTORATIVE TREATMENT PHASE

The laboratory technician was consulted early in the planning regarding material options. It was decided that reinforced glass ceramic such as lithium disilicate would be a good choice for restorative material due to its strength properties. It would satisfy the occlusal and esthetic demands for the anterior teeth and allow for the use of minimal prep bonded restorations. Zirconia-based porcelain crowns would suffice for the posterior teeth, as many were full-coverage crowns already. It is important to allow the patient to visualize the intended result, not only on casts but in the mouth as well. Protemp™ Plus (3M ESPE, [www.3MESPE.com](http://www.3MESPE.com)) provisional material was placed in the Sil-Tech provisional guides of the wax-up, which were then seated in the patient's mouth. Once removed, the "instant mock-up" smile can be used to visualize the intended plan. The clinician can check for any asymmetries, verify occlusal design, check phonetics, and gain patient approval prior to any permanent tooth changes.<sup>16</sup>

It is the author's opinion that using a refined checklist of each step can ensure that all critical information is gathered in a timely and low-stress fashion. Having a checklist allows the clinician and dental auxiliary to focus on the patient's care instead of trying to remember in what order each piece of information needs to be collected. Examples of the value of a checklist include dentin shade reference photos and inter-occlusal bite registration. Both of these steps must be completed prior to provisionalization. If missed, they can be difficult to obtain without removing the provisional restorations.

#### PREPARATION OF ANTERIOR SEGMENTS

With the mock-up still in place on the posterior teeth to maintain vertical dimension and bite relation, preparations were completed on the upper and lower front eight to 10 teeth using electric handpieces and diamond instrumentation. Constant reference to reduction guides allows for highly precise tooth reduction.<sup>10,11</sup> The lower incisors were a minimal prep situation with an additive approach to the facial and incisal contours only. Fabrication of an anterior bite record was made using rigid light-cure Triad® acrylic material (DENTSPLY International, [www.dentsply.com](http://www.dentsply.com)) (Figure 4).

With this vertical reference in place, the posterior provisional material can be removed, posterior teeth prepared, and traditional posterior bite records made with the jig in place. In this case, it was planned to initially restore the premolars and anterior section. Leaving the patient with an open occlusion in the posterior can help maintain an anatomical bite position by eliminating posterior



**Fig 8.** Postoperative, upper arch lithium disilicate veneers, and zirconia crowns in posterior. **Fig 9.** Postoperative, lower arch lithium disilicate veneers, and zirconia crowns in posterior. **Fig 10.** Preoperative smile prior to orthodontics and crown lengthening. **Fig 11.** Postoperative smile view of completed case.

interferences.<sup>9</sup> The underlying tooth structure is always a factor that must be considered for the final shade to be predictable. A moist dentin photo was captured prior to seating of the final provisionals.

**IMPRESSIONS**

After refinement of the preparations, retraction was accomplished using Expasyl<sup>®</sup> gingival retraction paste (Kerr Corporation, www.kerrdental.com). This syringe-deliverable putty is easy to use and gentle on the gingival tissue. After a light coat of contrast powder, the Lava<sup>™</sup> Chairside Oral Scanner C.O.S. (3M ESPE) was used to capture extremely accurate, high-resolution digital impressions of the preparations along with occlusal records.<sup>17</sup> This system is

unique due to the utilization of 3-dimensional video-capture technology and allows the user to verify that all critical components of the impression are obtained by simply monitoring the screen during capture. Individual preparation margins can also be reviewed for completeness and detail (Figure 5). Only minimal retraction is needed because all margin-marking, die-trimming, and sectioning are done virtually. Additionally, the prescription process is fully automated, as information is easily entered on a touchscreen monitor. The e-mailed file is then sent for model processing.

**PROVISIONALS**

The patient’s mouth was rinsed with chlorahexadine, and preparations were disinfected with Gluma<sup>®</sup> (Heraeus Kulzer, www.heraeus-dental-us.com). Provisionals were fabricated based on the tested design with Protemp<sup>™</sup> Plus material using the matrices of the wax-up, trimmed and cemented using RelyX<sup>™</sup> Temp Bond (3M ESPE). Photos and bite records of provisionals were made as a reference and the patient was followed for the next few weeks to ensure acceptable esthetics and function were in place (Figure 6).

**LABORATORY STEPS**

Within a few days after the margins are verified and marked by the laboratory ceramist, the mounted, articulated, pinned stereolithography (SLA) resin models are received ready for mounting and fabricating the chosen restorations. An important step for the ceramist is to confirm that the mounting is accurate and the horizontal references are correct. The models should be mounted in the same orientation as a photograph of the patient wearing a stick bite or provisionals. This reduces the chance of creating a canted midline.

After case mounting is properly verified, fabrication of the ceramics can begin. During the process of fabricating the restorations, the ceramist will often make comparisons of the porcelain with a model of the provisionals and photographs of the natural teeth. By fabricating a matrix of the incisal edge positions of the temporaries, one can confirm that the porcelain design follows the patient-approved provisional created by the doctor. The plan in this case included reducing overjet as well as building out the buccal corridor. The porcelain used was a pressed material and incisal edges were cut back and layered in several

steps to achieve the desired hue, value, chroma, and incisal character. On completion of the ceramics, the technician etched the internal surfaces with 35% phosphoric acid for 5 minutes, and they were cleaned with an ultrasonic and returned ready for resin bonding.<sup>18</sup>

**INSERTION**

On the day of insertion, the provisionals were carefully removed by making cuts interproximally; the prep model was used as a guide to avoid critical areas of tooth structure. The preparations were then cleaned and disinfected using chlorhexidine with pumice slurry. Careful attention was given to tissue health and any areas of bleeding were controlled using ViscoStat® Clear (Ultradent Products, Inc., www.ultradent.com). A dry try-in was performed to confirm marginal and proximal fit. To gain the highest bond strength with the pressed ceramics, typical total-etch porcelain-to-enamel bonding was accomplished using a 4th generation dual bottle system (ScotchBond™ Mutli-Purpose Plus Adhesive, 3M ESPE). It is important to maintain a moist dentin surface; this system uses water as a carrier for the dentin primer, allowing for excellent bond strengths.<sup>19</sup>

A rapid seating technique was used for delivery of each arch individually, starting with the center teeth and working outward. This technique ensured all veneers were seated properly and stabilized by the restoration adjacent to each. Initial cement was removed and the veneers were tacked for 1 second using a 3-mm diameter tip placed half on the tissue and half on the margin. The remaining uncured interproximal cement was cleaned using a camel's hair brush, followed by final curing for 40 seconds with an oxygen barrier of glycerin gel. Gentle cleaning and cement removal at the margins was completed with a No. 12 BP blade; no burs were used on the facial margins. Lingual margins were finished with a fine red stripe football diamond (Brasseler USA, www.brasselerusa.com) and polished after occlusion verification using rubber tips (Shofu Dental Corp., www.shofu.com) medium yellow stripe and fine white stripe. Floss was used to verify smooth interproximal areas, and any additional attention was given using a yellow stripe, narrow, perforated diamond strip (Brasseler USA). Occlusion was verified to ensure multiple functional cusp stops were present on all restored teeth.

**POSTERIOR RESTORATIVE PHASE**

After insertion of the anterior restorations, the posterior molars were then restored. Full-coverage crowns were chosen due to the amount of tooth structure missing and failing pre-existing crowns. The occlusal records scanning was simplified by prepping all posterior teeth at once and then asking the patient to bite down in centric occlusion. This was possible because phase one achieved restoration to the new anatomical position, and there was now no difference between the anatomical positional bite and the acquired position bite. Unlike traditional polyvinylsiloxane (PVS) impressions, where all restored teeth have to be retracted and isolated at the same time, C.O.S. allows sections to be captured if needed. After digital impressing is completed, the SLA resin



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models are again received by the lab in a few days, pinned, trimmed, and ready for mounting and fabrication of remaining restorations (Figure 7). The molars were provisionalized using the same technique as previously described. On return, the final crowns were tried in to check proximal contacts; adjustment was

minimal as the SLA resin models are extremely accurate and durable. The crowns were luted using a self-etching adhesive cement (RelyX™ Unicem, 3M ESPE). Slight adjustments to the occlusion were performed to again verify simultaneous centric stops on all teeth. Bite protection was provided by fabrication of a flat-plane, full-coverage maxillary occlusal guard, which the patient was instructed to wear each night and when taking naps.

**RESULTS**

The final photographs of this case reveal the kind of results that can be achieved by following proven systems and techniques (Figure 8 through Figure 11). The goals of improving the white-to-pink ratio as well as the patient's smile were achieved. Having a clear understanding of the goals of a case and being able to communicate accurately with the patient and ceramist are some of the keys to success. Use of digital cameras and digital impression technology enable shorter, streamlined delivery times while improving the ability to communicate. This case is an example of how proper planning and communication produce enhanced outcomes, excellent clinical results, and improved functional esthetics.<sup>20</sup> At the time of publication, the patient was at a one-year recall with no reported or diagnosed problems.

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**REFERENCES**

1. Mehl CJ, Harder S, Kern M, Wolfart S. Patients' and dentists' perception of dental appearance. *Clin Oral Investig.* 2011;15(2):193-199.
2. American Academy of Cosmetic Dentistry. *Can a new smile make you appear more successful and intelligent?* Madison, WI: AACD; 2010. <http://www.aacd.com/index.php?module=cms&page=75>. Accessed June 26, 2011.
3. Calamia JR, Calamia CS. Porcelain laminate veneers: reasons for

- 25 years of success. *Dent Clin North Am.* 2007;51(2):399-417.
4. Chiche GJ. Proportion, display, and length for successful esthetic planning. In: Cohen M, ed. *Interdisciplinary Treatment Planning: Principles, Design, Implementation.* Hanover Park, IL: Quintessence Publishing; 2008:2-31.
5. Kokich VO, Kokich VG, Kiyak HA. Perceptions of dental professionals and laypersons to altered dental esthetics: asymmetric and symmetric situations. *Am J Orthod Dentofacial Orthop.* 2006;130(2):141-151.
6. Dawson PE. *Evaluation, Diagnosis, and Treatment of Occlusal Problems.* St. Louis, MO: Mosby Elsevier; 1989:47-52.
7. Dontiza A. Creating the perfect smile: prosthetic considerations and procedures for optimal dentofacial esthetics. *J Calif Dent Assoc.* 2008;36(5):335-342.
8. American Academy of Cosmetic Dentistry. *A Guide to Accreditation Criteria.* Madison, WI: AACD; 2001.
9. Chiche GJ, Pinault A. *Esthetics of Anterior Fixed Prosthodontics.* Hanover Park, IL: Quintessence Publishing; 1994.
10. Rosenthal L. Preparation guidelines for less-invasive cosmetic restorations. *Gen Dent.* 2007;55(7):624-630.
11. Strupp WC Jr. Achieving predictability in anterior crown and bridge with the use of indexes. *Crown and Bridge Update.* 1997;9:65-71.
12. Silberberg N, Goldstein M, Smidt A. Excessive gingival display—etiology, diagnosis, and treatment modalities. *Quintessence Int.* 2009;40(10):809-818.
13. Kois JC. Altering gingival levels: the restorative connection, part 1: biologic variables. *Journal of Esthetic and Restorative Dentistry.* 1994;6(1):3-7.
14. Lowe RA. Cosmetic recontouring of gingival tissues and alveolar bone. *Pract Proced Aesthet Dent.* 2006;18(5):315-316.
15. Tarnow DP, Magner AW, Fletcher P. The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. *J Periodontol.* 1992;63(12):995-996.
16. Simon H, Magne P. Clinically based diagnostic wax-up for optimal esthetics: the diagnostic mock-up. *J Calif Dent Assoc.* 2008;36(5):355-362.
17. Farah JW, Brown L. Comparison of the fit of crowns based on digital impressions with 3M ESPE Lava Chairside Oral Scanner C.O.S. vs. traditional impressions. *The Dental Advisor Research Report.* No 22. June 2009.
18. Magne P, Belsler U. *Bonded Porcelain Restorations in the Anterior Dentition: A Biomimetic Approach.* Hanover Park, IL: Quintessence Publishing; 2002:342-346.
19. Kanca J III. Improving bond strength through acid etching of dentin and bonding to wet dentin surfaces. *J Am Dent Assoc.* 1992;123(9):35-43.
20. Ohyama H, Nagai S, Tokutomi H, Ferguson M. Recreating an esthetic smile: a multidisciplinary approach. *Int J Periodontics Restorative Dent.* 2007;27(1):61-69.

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