Restoring the Worn Anterior Dentition for Function and Esthetics

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Abstract

Providing a durable restoration of the worn dentition to maintain or improve function and esthetics is a satisfying achievement for well-trained dentists and a necessary service for their patients. The case presented here demonstrates the use of conservative indirect feldspathic veneers to augment worn anterior teeth. Diagnosis, treatment planning, and clinical techniques are addressed.

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Introduction and Chief Complaint

Bonded direct and indirect dental restorative materials permit the predictable and esthetic restoration of worn dentitions. Patients who are increasingly health-conscious and who desire a more youthful appearance and attractive smiles seek these services. An entire specialty is evolving that addresses the beauty of natural healthy dentitions, with particular attention paid to function in a healthy stomatognathic environment. The predictable restoration of such dentitions is possible only with a thorough understanding and application of fundamentals of occlusal theory.1
The patient, a 42-year-old female, came to our office in September 2005 requesting treatment of her discoloured, misaligned, and worn upper anterior teeth. She believed that her teeth made her look older than she was. Of particular concern was the upper right central incisor tooth, which had been treated endodontically many years earlier and was now darker than the adjacent teeth.

**History and Examination**

Pre-treatment photographs are shown in Figures 1 through 5. There were no significant findings in the patient’s medical history. Her dental history included restoration of posterior teeth with amalgam and composite materials, endodontic treatment of the maxillary right central incisor and mandibular left first and second molars, third molar extraction, and routine hygiene therapies.

Her periodontal health was within normal limits, with normal sulcular depths and no tooth mobility. Radiographic examination was normal, with normal bony morphology and missing third molars. There were mature pulps, the previous endodontic treatment of the upper central incisor was adequate, and pulp tests of all teeth were normal.

The occlusal classification was Angle Class I bilaterally with normal overjet and overbite, and there had been no orthodontic intervention. There was no tension or tenderness in the muscles of mastication on palpation. Palpation of the tissue lateral to the temporomandibular joint and of the posterior capsule with the intrameatal approach revealed no clicks, pops, ligament laxity, or discomfort. The patient reported no history of symptoms or awareness of parafunctional habits such as clenching or nocturnal grinding. Evaluation of the occlusion revealed bilateral group function in lateral excursions involving the incisors, cuspsids, and bicuspsids, with light balancing contacts on second molars bilaterally.

**Findings**

The characteristics of wear included the loss of enamel on the inciso-lingual of the maxillary anterior teeth, and buccal cusp tip wear of the bicuspsids. The incisal edges of the maxillary central incisors were thin and transparent, which is typical of wear on the lingual of these teeth. In this case, when assessing the pattern of wear and possible dental restoration, the following findings were considered significant:

- There was a stable cusp-to-fossa relationship of opposing teeth.
- Wear was almost exclusively limited to the anterior teeth.
- There were bilateral balancing interferences on the posterior teeth.

The importance of these wear characteristics is that it suggests it is possible to restore anterior guidance with restoration. The importance of anterior guidance is that it protects posterior teeth from wear.

The esthetic evaluation revealed an overall shade Lumin A3 (Ivoclar Vivadent; Amherst, NY). The width-to-length ratio of the maxillary central incisors was equivalent, rather
than the ideal 80:100. This suggests a possible 20% loss of tooth length due to wear. There was normal gingival display on smiling and a symmetrical incisal plane. The Grid Analysis System proposed by Naylor was applied to assess the symmetry, balance, and proportion of the teeth within the patient’s smile and face (Fig 6).

**Treatment Plan**

After appropriate examination and consultation with the patient, it was decided that teeth #4–7 and #9–13 would receive indirect all-ceramic restorations, and #8 would receive a porcelain-fused-to-metal restoration. Key to the restorations’ longevity was design of the occlusion to provide cuspid-protected guidance in lateral excursions, smooth protrusive disclusion on at least two incisor teeth at all times, and absence of balancing contacts during lateral excursions.

**Treatment Description**

**Wax-up**

Study models were mounted on a SAM 3 semi-adjustable articulator (Great Lakes Orthodontics; Tonawanda, NY), in centric relation using the bilateral manipulation technique described by Dawson. Photographs and radiographs were prepared. A thorough occlusal examination and review of the stomatognathic system was conducted.

A full-contour diagnostic wax-up of all involved teeth was performed prior to beginning clinical treatment. Smile design principles, including “golden proportion” and facial esthetic analysis, were employed. Anterior disclusion in lateral and protrusive excursions were important considerations in the

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**Figure 2:** The 1:2 magnification view of the unretracted smile shows the discoloration of the right central incisor. The wear of the central incisors has made them shorter than the lateral incisors, rather than slightly longer, as in the unworn condition.

**Figure 3:** In the 1:2 magnification retracted view, the wear of the cusp tips of the cuspids bilaterally is evident. The bicusps are constricted bilaterally relative to the cuspids and molars, not filling the buccal corridors as much as is ideal.

**Figure 4:** The extent of crowding and misalignment of the maxillary incisors is evident in this 1:2 maxillary occlusal view. The cusp tips of the bicusps are beginning to wear.

**Figure 5:** The mandibular 1:2 magnification occlusal view demonstrates the crowding of the lower incisors and their labio-incisal wear.

**Figure 6:** The Grid Analysis System applied to assess the symmetry, balance, and proportion of the teeth within the patient’s smile and face.
occlusal scheme of the wax-up. Adequate inclination of the discluing surfaces of anterior teeth on the wax-up was ensured to provide prevention of working side interferences (contact of the restored bicuspids) and balancing interferences. As the patient had worn away the cuspids and bicuspids cusp tips and inclines, she had developed a flatter guidance and broader envelope of function. The wax-up would be the prototype for the provisionalization, which would test the restoration of anterior guidance and the patient’s tolerance of the more restricted envelope of function.

From this important diagnostic step, it was determined that minimal adjustments to the occlusion of the models were necessary to achieve uniform anterior and posterior contacts in centric relation without posterior balancing interferences. An omnivac matrix, Sil-Tech putty matrix (Ivoclar Vivadent), incisal matrix, and custom impression trays were fabricated by James Neuber, R.D.T., of Ocean Ceramics Laboratories in Coquitlam, British Columbia.

All mandibular and maxillary anterior 10 teeth were then bleached using ZOOM (Discus Dental; Culver City, CA) in-office power bleaching as recommended by the manufacturer (three 20-minute sessions).

**Preparation**

Three weeks after the bleaching, the restorative treatment began. Chromoscoop 030 (Ivoclar Vivadent) was selected as the preferred final shade before anesthesia or any tooth-altering procedures were done.

The teeth were anesthetised with 4% articaine with 1:100,000 epinephrine. The anterior middle superior alveolar (AMSA) protocol (Fig 7) was used. This technique is preferred to achieve sufficient anesthesia without affecting mobility and normal drape of the maxillary lip. Using the polyvinyl matrix from the wax-up (Fig 8), the information from the wax-up was transferred to the mouth by creating a mock-up on the involved teeth with Integrity Bis-Acryl chemically cured resin (Dentply Int.; York, PA).

At this point, the occlusion, with the mock-up on the teeth, was reassessed to ensure the accuracy of the wax-up as performed on the models. Again, it was noted that minimal adjustments would be required to provide uniform posterior contacts in centric relation and smooth anterior
guidance in the absence of balancing contacts. The adjustments were made.6

The lips were retracted with an OptraGate vinyl retractor (Ivoclar Vivadent) and isolation was provided with cotton rolls and paper-dry angles.

All teeth were prepared with coarse and fine Brasseler (Savannah, GA) diamond burs using the matrices and the mock-up as guides.5,7 Where possible, interproximal contacts were not violated. Care was taken to prevent penetration through enamel into the dentine so as to provide a predictable bonding substrate; and preparation was limited to enamel, particularly in marginal areas. Reduction was at least 1.5 mm incisally and .5 mm facially in three planes of space to allow for restorative material thickness. Minor adjustments to the gingival contours of the central incisors were made using a ceramic tissue-trimming bur (Axis Dental; Irving, TX). Ultradent (South Jordan, UT) 00 retraction cord moistened with Visine (Pfizer; New York, NY) was pressed into the sulci of all teeth. Aquasil Ultra (Dentsply Caulk; Milford, DE) heavy- and extra-light viscosities polyvinyl impression material was used. A facebow transfer and interocclusal records were prepared.

The early diagnosis of pathological dental wear and occlusal parafunction can reduce the complexity of replacing the missing tooth mass.

PROVISIONAL FABRICATION

Photographs of the preparations, along with the stick-bite5 (Fig 9) and stump shade (Ivoclar Vivadent) were made. The provisional were fabricated directly on the teeth using the “shrink-wrap” technique5 with Integrity self-curing resin bleach shade (Figs 10 & 11). This shade approximated the selected Chromoscop 030 shade (Fig 12). Necessary minor adjustments were made to the contours of the provisionals for esthetics. Occlusion was adjusted to ensure uniform posterior centric contact, including shim stock thickness (.01 mm) of relief anteriorly, cuspid rise in lateral excursion, and protrusive disclusion with simultaneous contact on at least two incisor teeth. The absence of balancing contacts was confirmed. The details of the patient-approved provisionals were recorded in an alginate impression and in photographs. An articulated model from this impression, accompanied by the photographs, was provided to the laboratory.

The patient received hygiene instructions and instruments to enable her to floss around the provisionals, as well as topical chlorhexidine to be applied at each brushing to reduce gingival inflammation.

After evaluation of the poured and mounted model, it was determined that the preparations required further revision. The steps above were repeated.

The laboratory prepared a custom shade map (Fig 13). A porcelain-fused-to-metal restoration for tooth #8 was fabricated according to
the Eubank™ technique developed by Ocean Ceramics (with Duceram Plus [Degussa; Rosbach, Germany] and Tilite [Talladium Inc.; Valencia, CA]). This technique utilizes a ceramic labial construction with a lingual metal framework (Fig 14). This design provides strength on the lingual of full-coverage anterior restorations where they are at highest risk of fracture from occlusal stresses.

This principle is well shown by Drs. Magne and Belser.8 Figure 15 shows, in red, the stress-bearing areas as an incisor is loaded in protrusive excursions.

Powder-liquid feldspathic veneers (Duceram Plus) were fabricated for the remaining teeth. For comparison, the two central incisor restorations are shown in Figures 16 and 17. When the restorations were returned from the laboratory, they were tried on the model for fit and draw.

**Evaluation**

The patient returned to try in the restorations. Before removal, the provisionals were examined for wear and fracture; neither was found. The patient’s absence of symptoms
and asymptomatic musculature on palpation were noted. This evaluation is important to determine if the restoration of anterior guidance with steeper lateral guidance and narrowed envelope of function reduced any parafunctional activity or produced any musculoskeletal symptoms.

The patient was again anesthetized using the AMSA protocol, and the provisionals were removed. The preparations were polished with pumice and chlorhexidine. The absence of hemorrhage from the gingival tissue was a result of excellent hygiene and the topical application of chlorhexidine during the provisionalization period. The restorations were tried in dry on each tooth individually, then in pairs and, finally, all together. Then they were again tried in all together with RelyX veneer cement try-in paste (3M ESPE; St. Paul, MN), with a darker shade on one side and a lighter shade on the other to evaluate the effect of cement shade on the final result.

A need to correct the low-value appearance of tooth #8 was identified. The area was lightly prepared again, primed, and bonded (SE Bond, Kuraray Co.; Tokyo, Japan). The dark area was coated with Esthet-X opaque white resin (Dentsply Caulk). The patient approved the restorations while they were retained on the teeth with try-in paste.

**Cementation**

A rubber dam was placed to isolate the entire restorative area and to prevent moisture contamination during the bonding procedure. The anterior six teeth were etched with phosphoric acid for 10 seconds, followed by application of the SE Bond primer and bonding agent only on any small areas of exposed dentine, according to the manufacturer’s directions. The six anterior restorations were silanated, coated with bonding agent, and loaded with RelyX translucent shade cement. They were then seated on the prepared teeth and the cement removed and cured in the “tack-and-wave” method. The remaining bicuspid restorations were bonded similarly, but in separate steps.

After all restorations were cemented, any residual cement was removed with a #12 scalpel blade and finished using Epitex strips (GC America; Alsip, IL). Margins on concave surfaces (lingual) were finished using football-shaped fine diamond high-speed instruments (Brasseler) with water. Polishing on margins was accomplished using Enhance and PoGo composite finishing points (Dentsply Caulk) and diamond polishing paste.

Adjustments were made to the occlusion to create uniform posterior contacts in centric contact with shim stock (.012 mm) relief in the anterior region. Smooth immediate cuspid rise in lateral excursions and uniform protrusive disclusion on at least two teeth at all times were confirmed (Fig 18). The adjustments were made with fine diamond burs and any affected porcelain polished using Dialite (Brasseler) cups and points. The final restorations are shown in Figures 19 through 21.

Finally, impressions were made to fabricate a maxillary full-coverage splint to ameliorate any persistent parafunctional habits and create a more predictable prognosis for the restorations. Like the final restorations, the appliance was adjusted...
for uniform posterior contacts and anterior disclusion, and checked on recall for signs of wear. Recall examinations were performed at two weeks and then at two-month intervals to confirm stability of the restored occlusion.

**Discussion**

The patient’s initial motivation for seeking treatment was her concern about the worn appearance of her teeth. Equally or more important, however, was the diagnosis of wear and its etiology. In this case, the characteristics of wear included the following:

- equal length of maxillary incisors
- worn cusp tips of cuspids
- early wear of bicuspid cusp tips
- thin and transparent incisal edges of maxillary central incisors, typical of wear on the lingual of these teeth.

The importance of these wear characteristics with respect to occlusal function is the loss, at a relatively early age, of anterior guidance. The progression of wear resulting from parafunctional habits (termed *eccentric bruxism* by Dawson) in normal occlusions begins with the loss of cuspid protected disclusion as the cuspid incisal tips wear away and the bicuspid teeth begin to interfere and wear in group function. As bicuspid wear and the molars begin to participate in the group function, there can be an increase in muscular intensity and wear resulting from parafunction. Also, occlusal interferences often are discovered in the presence of parafunctional habits.

The early diagnosis of pathological dental wear and occlusal parafunction can reduce the complexity of replacing the missing tooth mass. Thorough consideration of the occlusal scheme to be restored, the materials to be used in the restoration, and techniques to prevent recurrence of the wear are imperative.
Figure 16: This labial view of the right central incisor porcelain-fused-to-metal restoration and left porcelain bonded restoration demonstrates the excellent detail of the incisal translucent zone.

Figure 17: This internal view of the restorations in Figure 16 shows the metal on the lingual surface of the right central crown.

Figure 18: The black marks are the centric occlusal stops and the red marks are the lateral and protrusive excursions. There is immediate disclusion in excursions and, in protrusive movements, two teeth are in contact at all times.

Figure 19: As the patient becomes more confident in the appearance of her smile, the asymmetry of the lower lip is less pronounced in this 1:10 magnification view.

Figure 20: The 1:2 magnification view of the unretracted smile shows the correction of the discoloration of the right central incisor. The teeth have been restored to create ideal incisal contours and proportionate widths and lengths.

Figure 21: In the 1:2 magnification view, the bicuspids restorations correct the buccal corridor deficiency.
Eliminating occlusal interferences and providing anterior guidance may reduce or eliminate the parafunctional habits.\textsuperscript{1,3} This can be tested in the individual patient with provisional restorations, trial splint therapy, or even Bite Strips (Great Lakes Orthodontics). The final restoration may require adjustment to avoid reintroducing interferences, and should be checked on recall to confirm that the occlusion remains stable. Although it is preferable to avoid long-term splint therapy, if continued parafunctional activity is suspected, a protective appliance may be provided.

Through a systematic approach to record taking, diagnosis, treatment planning, application of fundamental concepts of occlusion, treatment delivery, and reassessment of functional esthetic results, a predictable long-term restoration of the worn dentition can be achieved.

**Conclusion**

The predictable restoration of worn teeth is very much an application of objective, clinically tested techniques. However, it also is a subjective process of understanding the patient’s goals, as well as a step-by-step approach to ensuring each patient’s satisfaction by taking into account individual appreciation of what constitutes optimal esthetics.

Restoring the worn dentition is a functional esthetic augmentative process. An understanding of pathologies of occlusion, materials science, and clinical technique are necessary to provide predictable therapies to our patients.

**References**

4. Ibid., pp. 76-81.

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