A Conservative Approach for Treating Young Adult Patients with Porcelain Laminate Veneers

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ABSTRACT

Controversy persists regarding the treatment planning criteria for young adult patients in need of esthetic restorations. The trend of conservative treatment modalities continues to become widely acknowledged. One of the conservative treatment modalities is porcelain laminate veneers (PLVs). PLVs not only provide suitable esthetics but also reliable functional strength. This article presents two anterior esthetic cases to demonstrate a conservative treatment planning approach and its application as a nontraditional solution for young adult patients. It is recommended that a conservative approach be used wherever possible as an alternative to treatment options that may aggressively sacrifice tooth structure as well as the health of the supporting tissues.

CLINICAL SIGNIFICANCE

By using a conservative approach to treatment with porcelain veneers, long-lasting, esthetic, and functional results may be achieved. Sacrificing as little tooth structure as possible and conserving the supporting tissues will facilitate prospective treatments for young adult patients.

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INTRODUCTION

The field of esthetic restorations has substantially expanded over the last two decades in an effort to keep pace with patients' demands. Controversy remains regarding the treatment planning criteria for young adult patients who are in need of esthetic restorations. Arguments exist for both aggressive and conservative treatment approaches for this age group. Dental professionals may advocate aggressive treatment in order to achieve a positive and predictable long-term prognosis for the restoration. However, no type of restoration will last forever, especially with the extended life expectancy nowadays. The overall survival rate of metal-ceramic and cast metal with acrylic veneers fixed partial dentures (FPDs) ranges from 61.5 to 73.1% after 20 years.[1–6] The ability to retreat the restored dentition should be taken into consideration by the dental professional when choosing a conservative or an aggressive approach to treatment, especially for young adult patients. It is important to preserve as much tooth structure in place as possible

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and to retain natural teeth to maintain the architecture of soft tissue and thereby facilitate the retreatability.[7] It is recommended that a conservative approach be used wherever possible as an alternative to treatment options that may sacrifice tooth structure.[8]

One of the most conservative treatment modalities is porcelain laminate veneers (PLVs). Since their introduction by Pincus in 1930, PLVs have become a popular dental procedure.[9] The clinical survival rate of PLVs has been high. Observation periods of PLVs reported in the literature range from 18 months to 15 years.[10–15] One study reported that 98.4% of 186 PLVs placed over a 5-year period were rated as successful.[13] Another study showed that the estimated survival probability of 191 PLVs over a period of 10 years is 91%.[10] PLVs are indicated not only for treating tooth discoloration but also for restoring fractured and worn dentition as well as malformed teeth.[16–18] Friedman reported that PLVs not only provide suitable esthetics but also reliable functional strength.[19] By using the conservative approach to treatment, esthetic and functional results may be achieved.

To date, following the study of Belser and colleagues who demonstrated the efficacy of bonding porcelain to enamel (as strong as natural dentition),[20] the use of PLVs may be expanded to more challenging cases, such as restoring endodontically treated teeth with relatively conservative endodontic access, as part of full-mouth rehabilitation, restoring the worn dentition caused by bruxism, and treating teeth with questionable prognosis to address esthetic concerns of patients where a more aggressive treatment such as implant-supported restorations may compromise the hard and soft tissue topography, which are paramount for a successful esthetic outcome.

The purpose of the following case reports is to demonstrate a conservative treatment of two young adult patients. The first of the two cases represents anterior worn dentition as a result of parafunctional habits. The second case represents advanced root resorption and discoloration of the maxillary central incisor with a guarded prognosis.

CASE 1

A 43-year-old male presented with a chief complaint of an unattractive smile (Figure 1). He occasionally felt tenderness of his masticatory muscles, especially upon waking up in the morning. The patient was primarily concerned with the appearance of his smile because his anterior teeth had become shorter over time.

During the clinical examination, a clicking sound was noted on the right temporomandibular joint (TMJ). Wear facets on the incisal surfaces of the maxillary canines and incisors were observed. These lesions presented smooth and polished surfaces. Further analysis revealed that the mandibular incisal edges match the maxillary incisors. The distal side of the maxillary central incisors was shorter than the mesial side, the cusp tips were flattened, and the wear of the anterior teeth reduced the vertical overlap (Figure 2). All of these clinical findings suggested a pathologic wear.[21,22] The severe wear of the anterior teeth had created compensatory eruption of the maxillary anterior teeth. While restoring the worn dentition, the most important factor for success is the recognition of the causative factors and the necessary restorative corrections.[23] After careful clinical examination, and judging by the wear characteristics, the patient was diagnosed with attrition caused by nocturnal bruxism.

The purpose of the treatment was to answer the patient's chief complaint and improve esthetics while pursuing a conservative alternative treatment for his dental wear. The maxillary anterior teeth were restored with PLVs to provide adequate anterior guidance and to address the patient's initial esthetic concerns, while a reversible

Figure 1. Frontal view of the patient presented with a chief complaint of an unattractive smile.

Figure 2. Preoperative view of the anterior teeth in maximal intercuspal position. Note the wear on the incisal surfaces of the maxillary and mandibular canines and incisors.

occlusal therapy was provided in the form of a heat-processed hard occlusal guard, providing the patient with mutually protected occlusion.

The treatment was sequenced in two major phases.

1. Esthetics Analysis, Diagnosis, and Treatment Planning

The first stage of the diagnostic approach consisted of defining a preliminary restorative goal, which was mostly obtained by the addition of wax to the diagnostic cast. The incisal edges of the patient's maxillary central incisors were inadequately displayed, especially at rest position (Figure 3A). The maxillary incisors were apical to the posterior teeth as related to the maxillary occlusal plane relative to the incisor position. The first step of the treatment was to use an acrylic esthetic template to determine the desired incisal edge position.[24] In this specific case, it was decided to lengthen the maxillary central and lateral incisors by approximately 2.0 mm incisally (Figure 3B). The diagnostic wax-up was made according to the esthetic template compensating for severe existing loss of tooth substance (Figure 4).

The use of the diagnostic template is a key element for enamel preservation. The tooth preparation strategies used in this case were driven by the visualized prospective restoration. Such an approach facilitates a conservative tooth preparation design.[25,26] Prior to proceeding with the tooth preparation sequence, a direct composite resin mock-up was fabricated in the patient's mouth using light-cured composite-resin molded on the existing tooth surfaces with a clear matrix of the diagnostic wax-up (Figure 5A). The composite resin mock-up simplified the visualization of the prospective restorative results (Figure 5B). Esthetics, phonetics, and occlusion were also tested during this phase.

2. Restorative Management

Tooth preparation procedures can be initiated once the patient agrees

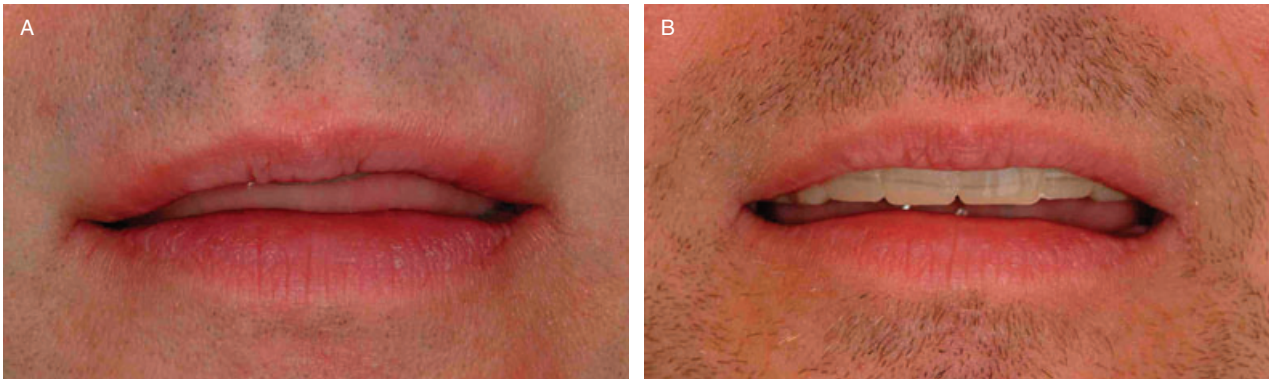

Figure 3. A, *Preoperative view at rest position. Note no display of the incisal edges of the maxillary anterior teeth.* B, *The esthetic analysis performed and the desired incisal edge position was determined clinically based on length and proportion measurements. An acrylic-resin esthetic template was used to verify the desired incisal edge position.*

Figure 4. A diagnostic wax-up was made according to the esthetic template.

to the final objective based on the direct composite resin mock-up. Following the tooth preparation procedures, a horizontal sectioned silicone matrix was used to reevaluate the availability of the required space for the prospective PLVs, and a palatal matrix was used to assess the 2-mm incisal clearance (Figure 6A,B).[17]

Various techniques were described in the literature for fabricating provisional veneers, some of which involve different fabrication times and esthetic outcomes.[27–29] In this case, after the definitive impression was made (Figure 7), a provisional restoration was immediately fabricated intraorally by using a customized rigid clear matrix fabricated with light-cured composite resin (Figure 8).[30] This technique enables clinicians to transfer the information from the diagnostic wax-up directly to the patient's mouth using light-cured direct composite resin restorative material as the provisional. As nocturnal bruxism cannot be eliminated, the patient was provided with a soft occlusal guard at the time of provisionalization to protect the restorations during his bruxing episodes.

The atraumatic removal of this type of provisional veneers is one advantage of this technique. The composite resin provisional was easily removed with the use of a curved hemostat. The areas of enamel that were previously spot etched and spot bonded were refined with a high-speed diamond bur to facilitate try-in procedures and adequate seating during the bonding procedure. Light-cured composite resin cement (RelyX Veneer, 3M ESPE, St. Paul, MN, USA) was used for bonding the PLVs. Excess cement was carefully

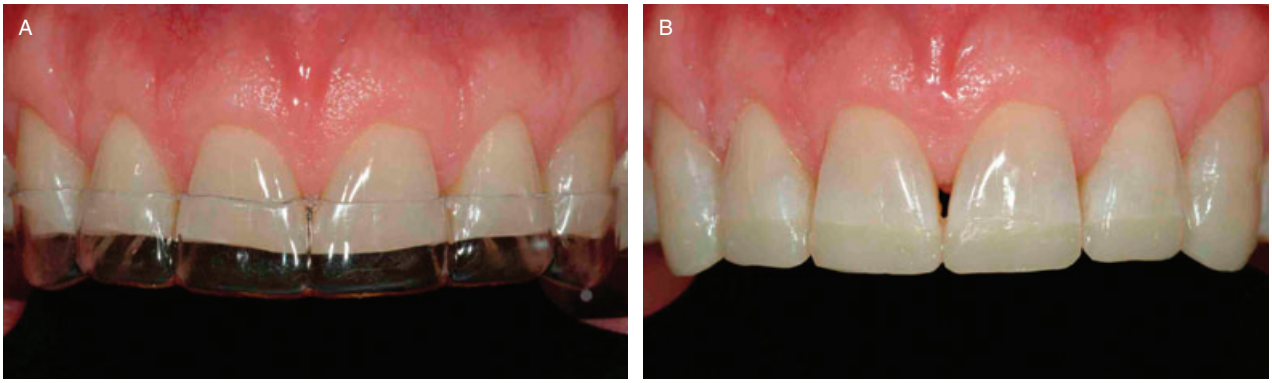

Figure 5. A, *A vacuum-formed clear matrix was made duplicating the diagnostic wax-up.* B, *A direct composite resin mock was fabricated using light-cured composite resin molded on the existing tooth surfaces.*

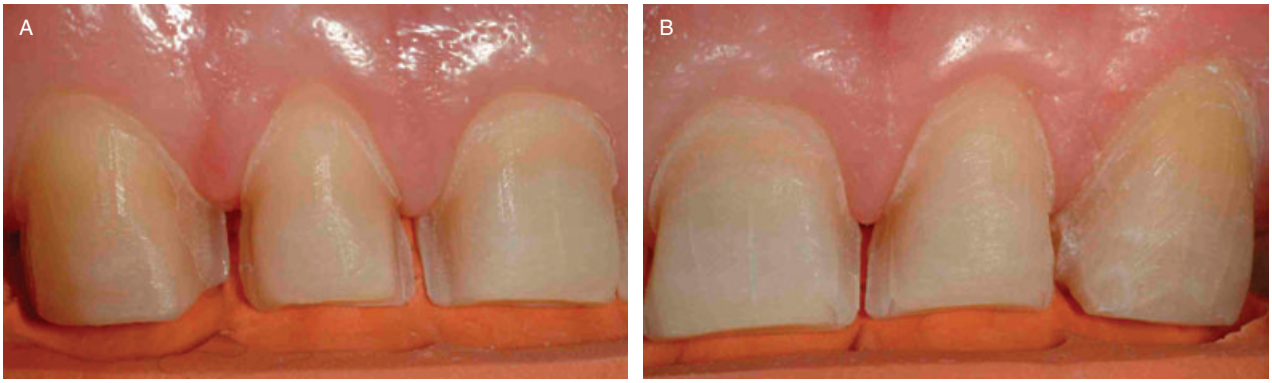

Figure 6. A *and* B, *Facial view of the right and left anterior teeth with a palatal silicone matrix showing 2-mm incisal clearance. Note the supragingival finish-line placement.*

Figure 7. The definitive impression was made with a vinyl polysiloxane.

Figure 8. The provisional veneers were fabricated using a customized rigid clear matrix with light-cured composite resin.

Figure 9. Postoperative facial view.

Figure 10. A heat-processed hard acrylic-resin occlusal guard was provided to protect the definitive restorations during the bruxing episodes.

and completely removed, and the patient was satisfied with the definitive result (Figure 9).

Bruxism may continue after the teeth have been repositioned or after new anterior guidance and esthetics have been established, as in this case.[31] Therefore, after placing the definitive restorations, the patient was provided with a heat-processed hard acrylic-resin occlusal guard to protect the restorations and to prevent the continuous dental attrition during his bruxing episodes (Figure 10).[23] In this case, based on the patient's age and initial esthetic concern, the conservative approach with PLVs was selected. A proper anterior guidance was established to distribute the occlusal forces. A balance between the desired esthetics and appropriate occlusion and function was achieved in a conservative manner (Figure 11A,B).

CASE 2

A 20-year-old patient presented with esthetic concerns regarding her maxillary central incisors (Figure 12). She went through orthodontic treatment, which was completed after 3 years, to address tooth crowding. After completing the orthodontic treatment, extensive root resorption of maxillary central incisors was observed. In addition, she had suffered a traumatic accident that caused her left maxillary central incisor to loose vitality. At the time of presentation, the severely resorbed roots resulted in extremely compromised crown/root ratios for both maxillary central incisors, leading to poor prognosis (Figure 13). However, probing depths for the central incisors were in the normal range, and the mobility of these teeth was determined as Class I mobility. She was referred for implant therapy for replacing the maxillary central incisors.

Extracting the two central incisors, which had a guarded prognosis, and replacing them with implant-supported crowns was considered a reasonable option. However, in this specific case, the patient was young and had high esthetic expectations for her treatment outcome. In addition, the patient presented with high lip mobility, a high smile line, and

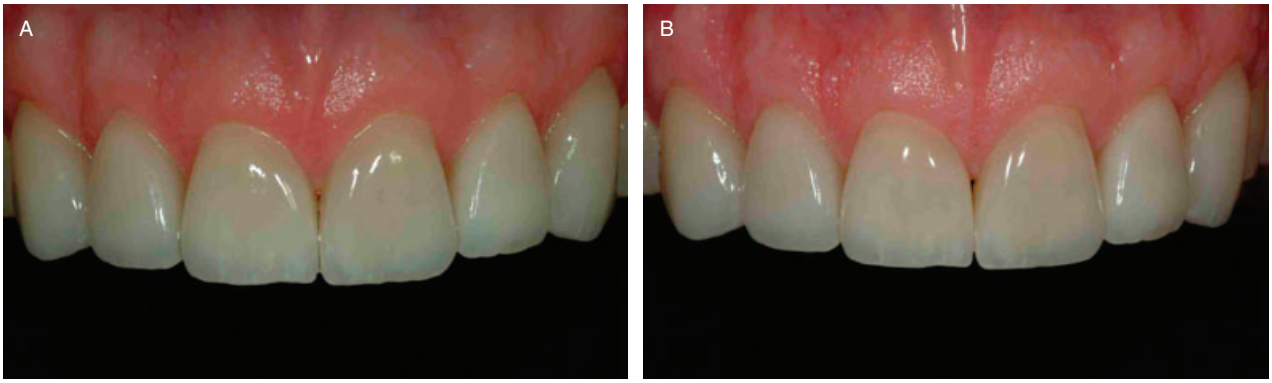

Figure 11. A, *A postoperative frontal view after the placement of the bonded porcelain laminate veneers (PLVs) 1 week after insertion. Note the excellent gingival health.* B, *A frontal view of the bonded PLVs 2.5 years after insertion. Note that the margins are intact and no cracks or fractures are noticed.*

Figure 12. A preoperative view of the patient's smile. Note the high lip mobility and the high smile line.

Figure 13. A preoperative radiograph shows the severely resorbed roots of both maxillary central incisors.

thin scalloped tissue contours. It would be highly challenging to recover her attractive smile with implant-supported restorations because achieving an adequate interdental papilla between adjacent implants may not be predictable.[32]

The patient was observed with no treatment for 1 year. At that time, the radiograph showed that no further root resorption had occurred. The left maxillary central incisor showed severe discoloration, especially at the cervical third (Figure 14). The patient was young with high esthetic demands and a high smile line. In addition to the thin biotype of her periodontal tissue, it was very challenging to obtain proper tissue contour by the implant-supported prosthesis in the esthetic zone. After considering the potential costs, risks, and

Figure 14. A preoperative close-up view of the central incisors. Note the severe discoloration of the left maxillary central incisor especially at the cervical area.

Figure 15. An occlusal view of the left maxillary central incisor with a horizontal silicone matrix showing adequate clearance for the porcelain laminate veneers.

benefits of each treatment option, it was decided to retain the severely resorbed central incisors and to address the discoloration on the left maxillary central incisor with a PLV. To address functional considerations, splinting the maxillary four incisors was planned after delivery of the PLV.

Dentofacial analysis was the first step of the treatment. As the patient's smile line and incisal edge position were adequate, it was decided to keep the tooth position, contours, and surface texture as they were. The treatment goals were to manage the discoloration and yet retain as much of the original volume of the tooth structure. A well-adapted, horizontally sectioned silicone matrix was made from the diagnostic cast to be used as a reference for tooth reduction (Figure 15). A selective subgingival finish-line placement was chosen because of the local area of the subgingival discoloration (Figure 16). Following the definitive impression, the provisional veneer was fabricated by using a rigid silicone matrix loaded with self-cured acrylic-resin and applied to the preparation until curing was complete. The tooth surface was subjected to enamel spot etching, then rinsed and dried. The provisional veneer was placed with light-cured unfilled composite resin (Figure 17).

Definitive insertion of the PLV was preceded by a meticulous try-in procedure. Following the removal of the provisional, a diamond bur was used to remove the adhesive from the spot-etched area of the tooth. Because of the severe discoloration of the abutment tooth, different ratios of try-in pastes were manipulated to match the adjacent teeth. In this case, a mixture of 50% A3, 25% white opaque, and 25% B0.5 try-in paste could achieve the best result (Figure 18). Light-cured composite resin cement (RelyX Veneer, 3M ESPE) was used to bond the PLV. The ratio of the cement mixture used was the same as that used in the try-in paste. After seating the PLV, the final and critical step was to remove the gingival cord and thoroughly remove the excess cement.

Because of the severe discoloration in the cervical area, which could not be totally masked by the PLV, walking bleaching technique was applied. A mixture of sodium perborate was directly placed in the pulp chamber. The bleaching process took four sessions and each session lasted about 1 week. The bleaching agent was replaced on each consecutive appointment until the desired color was achieved (Figure 19). Slight

Figure 16. The complete tooth preparation of the left maxillary central incisor with a selective subgingival finish-line placement.

Figure 17. A provisional veneer fabricated using a silicone matrix loaded with self-cured acrylic resin.

Figure 18. A meticulous try-in procedure of the porcelain laminate veneers.

Figure 19. A postoperative view after nonvital bleaching of the left maxillary central incisor.

overbleaching was performed to account for expected minor immediate relapse. Finally, the pulp chamber was lined with glass ionomer lining material and a layer of direct composite resin bonded to etched enamel. The four incisors were splinted with a wire on the lingual aspect (Figures 20 and 21). Esthetics, functional occlusion, and bone and soft-tissue health were maintained, and the patient was pleased with the definitive outcome (Figure 22). The patient was provided with a heat-processed hard acrylic-resin occlusal guard (Figure 23).

In this case, the decision between extraction or retention of the central incisors is the paramount component of the entire treatment plan. Weighing the pros and cons of each treatment option, the conservative treatment approach for this case allowed us to maintain the natural soft tissue and bone architecture. It would be difficult to achieve a comparable esthetic outcome by using implant-supported restorations, even if these were improved upon by sophisticated surgical procedures.[33]

DISCUSSION

The trend of conservative treatment continues to become widely acknowledged. When choosing

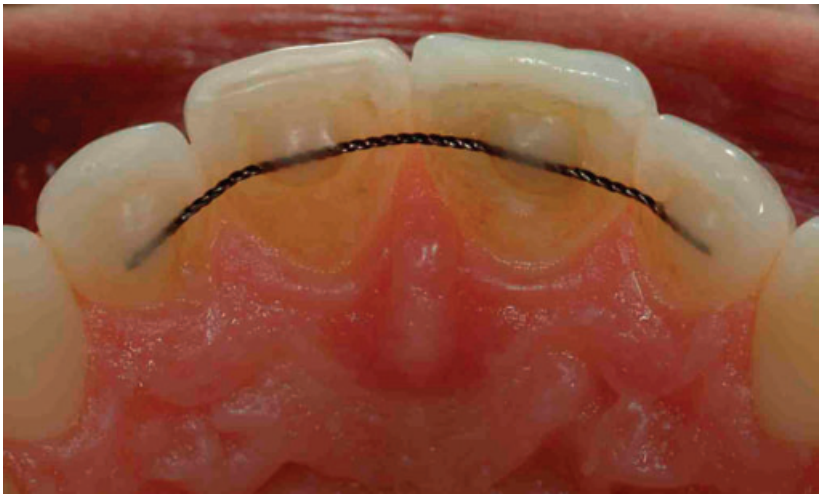

Figure 20. A palatal view of the anterior teeth splinted with a wire.

Figure 21. A postoperative radiograph shows the pulp chamber lined with glass ionomer lining material and a layer of direct composite resin.

Figure 22. Postoperative facial view.

Figure 23. A heat-processed hard acrylic-resin occlusal guard provided.

between conservative and more aggressive treatment approaches, the potential need to retreat patients in the future should be taken into account, especially in young patients. Therefore, the type of prospective failure is of major importance as well. This is especially true today as dramatic improvements in dental technology significantly improve available patient treatments. An excellent example of this is the development of the implant dentistry and the adhesive dentistry. It is important

to sacrifice as little of the tooth structure as possible in order to make future treatments possible.

The two cases presented in this article are examples of major dilemmas in the esthetic zone. These dilemmas present an esthetic as well as a functional component. In the first case, the patient presented with severe worn anterior dentition. When attrition is the main cause of wear, the teeth adapt to this process by maintaining contact relations with the opposing teeth through passive eruption.[34] This type of wear usually severely affects the incisal surface of the anterior teeth. The incisors' edge to edge relationship limits the available interocclusal space, which makes restoring the anterior dentition difficult.

To increase the available restorative space, one treatment approach would have been to increase the occlusal vertical dimension and to restore the whole maxillary arch with partial- or complete-coverage restorations.[35] The advantage of this treatment modality is to be able to shallow the anterior guidance. However, downsides include significant loss of sound tooth structure, the high cost of treatment, and attending to prospective failures in the future. The bruxing patient still runs the risk of breaking porcelain if the compliance of using the occlusal guard is inadequate.

Another option to gain more interocclusal space is to intrude the anterior maxillary teeth, or retrocline the anterior mandibular teeth. Although it is a relatively conservative treatment option as compared with full-arch tooth coverage, some patients may refrain from this option (as the patient described in this article) because of time constraints.

When restoring maxillary anterior teeth, the incisal edge position should be in harmony with the envelope of function.[36] As the maxillary anterior teeth were lengthened, the only way to determine an acceptable dental envelope of function of new restorations is trial therapy with the provisionals. The composite resin provisionals were placed with spot etching and allowed to remain in place for 3 months to test the diagnostic wax-up in terms of function. One minor fracture on the provisional was noted at the distal corner of the left lateral incisor, which could have been caused by the thinner composite on the lateral incisal edge or by occlusal interference. If multiple fractures would have occurred, then it might have been highly possible that this problem had been caused by the restricted dental envelope function. If this had been the case, then we would have needed to reevaluate the functional concerns of lengthening the maxillary anterior teeth. In this specific case, the marginal integrity and the structure of the composite resin provisionals were intact after 3 months. The success of the trial therapy implied an acceptable dental envelope function for the new restoration. Ekfeldt and Karlsson believed that mandibular movement characteristics will partly change after rehabilitation of an extensively worn dentition.[31] This could be one of the reasons for the short-term success (30 months) of this treatment.

Bruxism is a parafunctional rhythmical activity during which individuals clench or grind their teeth during the day or at night.[37] Bruxism was classified by Ramfjord and Ash into two categories: centric (vertical loading during waking hours) and eccentric (grinding into lateral excursion while sleeping).[38] Although many theories have been proposed, the etiology of bruxism still remains unclear.[39–42] Most current theories lend great importance to psychologic factors and stress and for the emergence and continuation of parafunctional habits. A study done by Kampe and colleagues showed that 69% of the investigated patients had stress as the cause of their bruxing behavior.[43] Okeson concluded that parafunctional habits are a result of the

interaction of occlusive dissonance and stress.[44] As parafunctional habits will proceed after the restorative therapy has been completed, compliance in wearing an occlusal guard is paramount to the long-term stability of restorations in worn dentition as a result of bruxism.

In the second case, the patient had advanced external root resorption and discoloration of the maxillary central incisors with a guarded prognosis. In cases of severe external root resorption in the esthetic zone, the treatment options will either be to extract or to retain the teeth.[45] If the teeth are extracted, then there are several options to restore the edentulous area, such as removable partial dentures (RPDs), FPDs, resin-bonded FPDs, and implant-supported prostheses.

In young adult patients, RPDs are never the first option in the esthetic zone.[46] In contrast, FPDs offer better function and esthetics for young adult patients. However, much of the structure of the abutment teeth needs to be sacrificed. Additionally, the pontic design may not totally satisfy esthetic demands, especially in the area of the anterior teeth.[47] Resin-bonded FPDs are a relatively conservative treatment option. However, the debonding of the metal–composite resin interface affects its long-term longevity.[48]

Because of the high success rate of osseointegrated implants,[49,50] replacing missing anterior teeth with the implant supported prosthesis becomes a well-accepted treatment modality.[51] However, the predictable success rate of this modality does not ensure outstanding esthetic results.[52] It is still very challenging to obtain proper tissue contours in the esthetic zone, especially with multiple adjacent implant restorations.[53,54] The papilla between two adjacent implants cannot predictably be maintained at the same level as it was with the natural teeth.[32] This may result in a long contact area between the two adjacent implant-supported crowns, causing square-looking teeth and an esthetic liability especially in the case of the thin scalloped tissue.

If it is decided to retain the teeth, then the treatment option will be either complete-coverage crowns or PLVs. If the teeth are severely discolored, the complete coverage crowns, capable of masking discoloration, may well achieve better esthetic results.[55,56] However, the preparation of the complete crowns requires the sacrifice of significant tooth structure. In this specific case, because of the large root canal access, the labial tooth structure was relatively thin. The other drawback of complete-coverage restorations is the difficulty of splinting adjacent teeth should this ever be required. After considering the potential costs, risks, and benefits of each option, we chose the most conservative treatment plan to retain the severely resorbed central incisor in this specific case.[57] This restoration has been successful for over 18 months.

CONCLUSION

The two cases presented demonstrate esthetic dilemmas that clinicians may face daily in their practice. The concept of conservative treatment planning and its application for two young adult patients is applied using PLVs as the treatment of choice for non-conventional clinical scenarios. The PLVs were reconstructed for the maxillary anterior teeth to provide adequate anterior guidance, to address the patient's initial esthetic concerns, and to simplify prospective retreatment. The conservative treatment approach facilitates both the preservation of tooth structure and the surrounding hard and soft tissue architecture.

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REFERENCES

1. De Backer H, Van Maele G, De Moor N, Van den Berghe L. Single-tooth replacement: is a 3-unit fixed partial denture still an option? A 20-year retrospective study. Int J Prosthodont 2006;19(6):567–73.
2. De Backer H, Van Maele G, De Moor N, et al. A 20-year retrospective survival study of fixed partial dentures. Int J Prosthodont 2006;19(2):143–53.
3. Holm C, Tidehag P, Tillberg A, Molin M. Longevity and quality of FPDs: a retrospective study of restorations 30, 20, and 10 years after insertion. Int J Prosthodont 2003;16(3):283–9.
4. Libby G, Arcuri MR, LaVelle WE, Hebl L. Longevity of fixed partial dentures. J Prosthet Dent 1997;78(2):127–31.
5. Walton TR. An up to 15-year longitudinal study of 515 metal-ceramic FPDs: part 2. Modes of failure and influence of various clinical characteristics. Int J Prosthodont 2003;16(2):177–82.
6. Walton TR. An up to 15-year longitudinal study of 515 metal-ceramic FPDs: part 1. Outcome. Int J Prosthodont 2002;15(5):439–45.
7. Edelhoff D, Sorensen JA. Tooth structure removal associated with various preparation designs for anterior teeth. J Prosthet Dent 2002;87(5):503–9.
8. Bernardo JK, Maia EA, Cardoso AC, et al. Diagnosis and management of maxillary incisors affected by incisal wear: an interdisciplinary case report. J Esthet Restor Dent 2002;14(6):331–9.
9. Pincus C. Building mouth personality. J Calif State Dent Assoc 1938;14: 125–9.
10. Friedman MJ. A 15-year review of porcelain veneer failure—a clinician's observations. Compend Contin Educ Dent 1998;19(6):625–8, 30, 32 passim; quiz 38.
11. Fradeani M. Six-year follow-up with Empress veneers. Int J Periodontics Restorative Dent 1998;18(3):216–25.
12. Dumfahrt H, Schaffer H. Porcelain laminate veneers. A retrospective evaluation after 1 to 10 years of service: part II—clinical results. Int J Prosthodont 2000;13(1):9–18.
13. Aristidis GA, Dimitra B. Five-year clinical performance of porcelain laminate veneers. Quintessence Int 2002;33(3):185–9.
14. Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12-year clinical evaluation—a retrospective study. Int J Periodontics Restorative Dent 2005;25(1):9–17.
15. Layton D, Walton T. An up to 16-year prospective study of 304 porcelain veneers. Int J Prosthodont 2007;20(4):389–96.
16. Christensen GJ. Veneering of teeth. State of the art. Dent Clin North Am 1985;29(2):373–91.
17. Ferrari M, Patroni S, Balleri P. Measurement of enamel thickness in relation to reduction for etched laminate veneers. Int J Periodontics Restorative Dent 1992;12(5):407–13.
18. Tjan AH, Dunn JR, Sanderson IR. Microleakage patterns of porcelain and castable ceramic laminate veneers. J Prosthet Dent 1989;61(3):276–82.
19. Friedman M. Multiple potential of etched porcelain laminate veneers. J Am Dent Assoc 1987;Spec No: 83E–7E.
20. Belser UC, Magne P, Magne M. Ceramic laminate veneers: continuous evolution of indications. J Esthet Dent 1997;9(4):197–207.
21. Lytle JD. Occlusal disease revisited: part I—function and parafunction. Int J Periodontics Restorative Dent 2001;21(3):264–71.
22. Litonjua LA, Andreana S, Bush PJ, Cohen RE. Tooth wear: attrition, erosion, and abrasion. Quintessence Int 2003;34(6):435–46.
23. McIntyre F. Restoring esthetics and anterior guidance in worn anterior teeth. A conservative multidisciplinary approach. J Am Dent Assoc 2000;131(9): 1279–83.
24. Phillips K, Morgan R. The acrylic occlusal plane guide: a tool for esthetic occlusal reconstruction. Compend Contin Educ Dent 2001;22(4):302–4, 6.
25. Magne P, Belser UC. Novel porcelain laminate preparation approach driven by a diagnostic mock-up. J Esthet Restor Dent 2004;16(1):7–16; discussion 17–8.
26. Gurel G. Predictable, precise, and repeatable tooth preparation for porcelain laminate veneers. Pract Proced Aesthet Dent 2003;15(1):17–24; quiz 26.
27. Nixon RL. Provisionalization for ceramic laminate veneer restorations: a clinical update. Pract Periodontics Aesthet Dent 1997;9(1):17–27; quiz 28.
28. Sheets CG, Ono Y, Taniguchi T. Esthetic provisional restorations for porcelain veneer preparations. J Esthet Dent 1993;5(5):215–20.
29. Kurtz KS. Constructing direct porcelain laminate veneer provisionals. J Am Dent Assoc 1995;126(5):653–6.
30. Raigrodski AJ, Sadan A, Mendez AJ. Use of a customized rigid clear fabricating provisional veneers. J Esthet Dent 1999;11(1):16–22.
31. Ekfeldt A, Karlsson S. Changes of masticatory movement characteristics after prosthodontic rehabilitation of individuals with extensive tooth wear. Int J Prosthodont 1996;9(6): 539–46.
32. Tarnow D, Elian N, Fletcher P, et al. Vertical distance from the crest of bone to the height of the interproximal papilla between adjacent implants. J Periodontol 2003;74(12):1785–8.

33. Savage RR, Kokich VG Sr. Restoration and retention of maxillary anteriors with severe root resorption. J Am Dent Assoc 2002;133(1):67–71.

34. Newman HN. Attrition, eruption, and the periodontium. J Dent Res 1999;78:730–4.

35. Bassiouny MA, Pollack RL. Esthetic management of perimolysis with porcelain laminate veneers. J Am Dent Assoc 1987;115(3):412–7.

36. Dawson P. Functional occlusion From TMJ to Smile Design. St. Louis (MO): Mosby; 2007:142–4.

37. Attanasio R. Nocturnal bruxism and its clinical management. Dent Clin North Am 1991;35(1):245–52.

38. Ramfjord SP, Ash M. Occlusion. Philadelphia (PA): Saunders; 1971.

39. Ramfjord SP. Bruxism, a clinical and electromyographic study. J Am Dent Assoc 1961;62:21–44.

40. Sayers P. The bruxer. Ann R Australas Coll Dent Surg 1986;9:158–66.

41. Lobbezoo F, Lavigne GJ. Do bruxism and temporomandibular disorders have a cause-and-effect relationship? J Orofac Pain 1997;11(1):15–23.

42. Rugh JD, Barghi N, Drago CJ. Experimental occlusal discrepancies and nocturnal bruxism. J Prosthet Dent 1984;51(4):548–53.

43. Kampe T, Tagdae T, Bader G, et al. Reported symptoms and clinical findings in a group of subjects with longstanding bruxing behaviour. J Oral Rehabil 1997;24(8):581–7.

44. Okeson JP. Etiology and treatment of occlusal pathosis and associated facial pain. J Prosthet Dent 1981;45(2):199–204.

45. West JD. The aesthetic and endodontic dilemmas of calcific metamorphosis. Pract Periodontics Aesthet Dent 1997;9(3):289–93; quiz 94.

46. Hummel SK, Wilson MA, Marker VA, Nunn ME. Quality of removable partial dentures worn by the adult U.S. population. J Prosthet Dent 2002;88(1):37–43.

47. Kinzer GA, Kokich VO Jr. Managing congenitally missing lateral incisors. Part II: tooth-supported restorations. J Esthet Restor Dent 2005;17(2):76–84.

48. Culy G, Tyas MJ. Direct resin-bonded, fibre-reinforced anterior bridges: a clinical report. Aust Dent J 1998;43(1):1–4.

49. Lekholm U, Grondahl K, Jemt T. Outcome of oral implant treatment in partially edentulous jaws followed 20 years in clinical function. Clin Implant Dent Relat Res 2006;8(4):178–86.

50. Noack N, Willer J, Hoffmann J. Long-term results after placement of dental implants: longitudinal study of 1,964 implants over 16 years. Int J Oral Maxillofac Implants 1999;14(5):748–55.

51. Kinzer GA, Kokich VO Jr. Managing congenitally missing lateral incisors. Part III: single-tooth implants. J Esthet Restor Dent 2005;17(4):202–10.

52. Levin L, Pathael S, Dolev E, Schwartz-Arad D. Aesthetic versus surgical success of single dental implants: 1- to 9-year follow-up. Pract Proced Aesthet Dent 2005;17(8):533–8; quiz 40, 66.

53. Belser UC, Schmid B, Higginbottom F, Buser D. Outcome analysis of implant restorations located in the anterior maxilla: a review of the recent literature. Int J Oral Maxillofac Implants 2004;19(suppl):30–42.

54. Kan JY, Rungcharassaeng K, Umezu K, Kois JC. Dimensions of peri-implant mucosa: an evaluation of maxillary anterior single implants in humans. J Periodontol 2003;74(4):557–62.

55. Antunes RP, Magalhaes F, Matsumoto W, Orsi IA. Anterior esthetic rehabilitation of all-ceramic crowns: a case report. Quintessence Int 1998;29(1):38–40.

56. Toksavul S, Turkun M, Toman M. Esthetic enhancement of ceramic crowns with zirconia dowels and cores: a clinical report. J Prosthet Dent 2004;92(2):116–9.

57. Meyer Filho A, Vieira LC, Baratieri LN, Lopes GC. Porcelain veneers as an alternative for the esthetic treatment of stained anterior teeth: clinical report. Quintessence Int 2005;36(3): 191–6.