Esthetic and Functional Rehabilitation of a Bilateral Cleft Palate Patient with Fixed Prosthodontic Therapy

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ABSTRACT

Patients with bilateral cleft lip and palate present with multiple challenges to the prosthodontist. Some of them include mobility of the premaxillary segment, multiple missing and malposed anterior teeth, unfavorable soft tissues, and a tense maxillary lip. This clinical report describes the fixed prosthodontic management of a bilateral cleft lip and palate patient with a surgically corrected lip and a mobile premaxillary segment. The patient presented with an 11-unit metal-ceramic fixed partial denture made of a base metal alloy that was made 25 years ago. He had multiple porcelain fractures over the years that compromised his esthetics and function. Prosthodontic therapy involved sectioning the old prosthesis, followed by careful treatment planning and fabrication of a new fixed dental prosthesis with improved design and superior materials. At a 3-year follow-up, the fixed dental prosthesis remained intact and functional, and no further complications were noted. A discussion of approaches to treatment planning, biomechanical principles involved, and choice of biomaterials in designing a fixed prosthesis for such patients is presented.

CLINICAL SIGNIFICANCE

As cleft palate patients require life-long prosthodontic follow-up and maintenance, revisional treatments should incorporate superior materials and methods to minimize future complications.

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INTRODUCTION

Improved knowledge of craniofacial growth and development, as well as improved surgical and orthodontic treatment, has resulted in cleft patients receiving superior care in a shorter time period.[1] Prosthodontic care has diminished but still has a critical role to play in the oral rehabilitation of these patients.[2] The most common prosthodontic treatment for cleft palate patients is replacement of congenitally missing anterior teeth, which is generally performed after orthodontic treatment for alignment of the remaining teeth. Cleft palate patients who have not received orthodontic realignment and grafting procedures are the ones who present the greatest prosthodontic challenge.[3] In bilateral cleft palate patients, mobility of the premaxillary segment occurs because the median nasal process failed to fuse with the two lateral nasal processes on each side.[4] Therefore, bone-grafting procedures are required to close the alveolar cleft and provide integrity of the maxillary arch.[4] Successful bone-grafting also provides a sound platform for placement of dental implants for replacement of missing anterior teeth.

However, bone-grafting procedures are not successful in many patients, and therefore, dental implant therapy is not an option because of the alveolar cleft and lack of available bone. This leaves the clinician with the option of using teeth on either side of the cleft as abutments

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for a fixed dental prosthesis (FDP).[5–11] This option serves to (1) stabilize the mobile premaxillary segment with the adjoining maxillary segments on each side and restore arch integrity,[5,6] (2) replace the missing teeth and thus restore esthetics, phonetics, and occlusion,[5] (3) act as a permanent retainer for the adjacent teeth that have been orthodontically aligned,[5,6] and (4) support a removable obturator when required.[8] In addition, an FDP can provide increased psychological satisfaction, as most cleft patients desire their prosthesis to be "fixed" and not "worn."

Various factors need to be considered when designing a long-span FDP across the arch. They include appropriate choice of dental materials, obtaining optimal parallelism of abutment teeth for path of draw, passive fit of framework, well-sealed margins, adequate support for porcelain to minimize fractures, and prevention of dental caries and periodontal disease of the abutment teeth. Furthermore, an important consideration should be patient's history of bruxism that may warrant metal occlusal surfaces and use of an occlusal device at the conclusion of treatment.

Very few articles in the literature have reported on the methods and techniques of fixed prosthetic rehabilitation in bilateral cleft palate patients. They include traditional metal-ceramic FDP,[5–8] metal-resin FDP,[9] and telescopic FDP supported by reinforced all-ceramic primary copings.[10] Although there is insufficient evidence to support long-span FDP using all-ceramic materials, traditional metal-ceramic FDP has a long clinical track record to be used successfully in cleft palate patients.[12–14] While choosing alloys for long-span metal-ceramic FDP, it is important for the clinician to understand the properties of various alloys and its long-term performance in the oral cavity.[15,16] The commonly accepted classification of alloys is the American Dental Association classification based on content[17] (high noble, noble, predominantly base metal) and physical properties[18] (soft, medium, hard, and extra hard). High noble and noble alloys are preferred over base metals because of their nobility, corrosion resistance, and good bonding to porcelain.[15] They have acceptable yield strength, hardness, and moduli of elasticity amenable for use in the oral cavity.

Although base metals are cheaper, have superior moduli of elasticity, hardness, and yield strength compared with high noble and noble alloys, several factors preclude them from being the first choice for long-span FDP. They include:[15] (1) higher corrosion in acidic environments, (2) dark thick oxides that are detrimental for porcelain bonding and esthetics, (3) difficult to cast and ensure a good marginal seal, (4) difficult to finish and polish, (5) difficult to solder, and (6) higher potential for patient allergy. The purpose of this clinical report is to describe the fixed prosthodontic management of a bilateral cleft palate patient who presented with an 11-unit FDP made of base metal alloy that had multiple porcelain fractures.

CLINICAL REPORT

History

A 42-year-old white man presented to the prosthodontist requesting an evaluation of his existing FDP that had multiple porcelain fractures (Figure 1). Evaluation of his history revealed that he was born with a bilateral cleft lip and palate. His lip had been surgically corrected during childhood, and he had undergone multiple unsuccessful attempts to surgically correct his palatal defect. The patient had a complex medical history that included supernumerary cervical vertebrae, gastroesophageal reflux disease, gall bladder

FIGURE 1. Pretreatment frontal view of the patient at the time of presentation. Note the surgically repaired maxillary lip and compromised fixed dental prosthesis.

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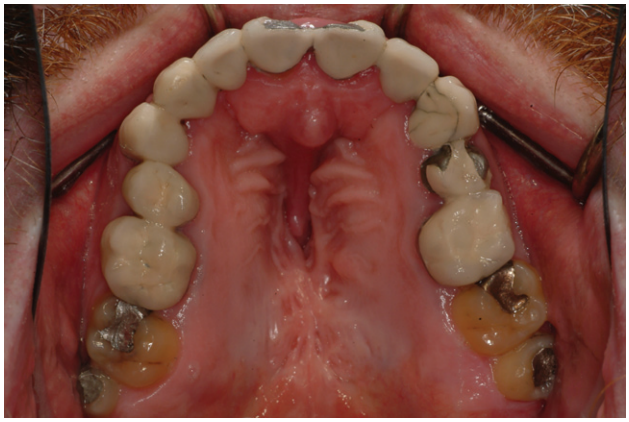

FIGURE 2. Pretreatment maxillary occlusal view showing bilateral cleft of the palate and multiple porcelain fractures in the long-span fixed dental prosthesis (#3 through #14).

FIGURE 3. Pretreatment frontal view of the teeth in maximum intercuspation.

disorder, and hypothyroidism. He had been ruled out as having any recognizable syndrome. The patient took numerous medications for his conditions that had predisposed him to xerostomia. The patient presented with his previous dental records that confirmed his congenitally missing lateral incisors. Both of his maxillary and mandibular first premolars had been extracted for orthodontic treatment, and an 11-unit metal-ceramic maxillary FDP had been fabricated from teeth #3 through #14. There were three abutments on each side of the cleft, and the pontics included teeth #6, #7, and #10 (Figure 2). This metal-ceramic FDP was made 25 years prior to initial presentation, and the metal used was a base metal alloy. The patient had been experiencing multiple porcelain fractures over the years, which were repaired unsuccessfully by his general dentist (Figure 3).

Findings

Extraoral examination revealed hypertelorism of his eyes, surgically corrected maxillary lip, and a straight midfacial profile. Intraoral examination showed the unrepaired bilateral cleft in the hard palate region. The patient had never worn an obturator to cover this cleft and did not experience any nasal leakage or problems with mastication or deglutition; his speech was not hypernasal and was intelligible. The gingival soft tissues showed minimal to moderate inflammation around the margins of many restorations, and the maximum probing depth was 3 mm. The hard tissues revealed silver amalgam restorations on all posterior maxillary and mandibular teeth except tooth #28.

The patient presented with Angle's Class I molar relationship with a 3-mm vertical overlap in the anterior region. A mutually protected occlusal scheme had been developed in his existing restorations. The patient's maximum intercuspal position and centric occlusion appeared to be coincident. Multiple laterotrusive and mediotrusive interferences were noted with respect to teeth #16 and #17. Dental caries were noted around the restorations on teeth #30 and #31. The patient's caries risk assessment revealed a high score because of the number of restored teeth and his predisposition to xerostomia because of his medications. Radiographic examination showed acceptable crown–root ratios on all teeth and minimal horizontal bone loss with no vertical bone loss. The bone levels especially around abutment #6 and #11 were good (Figure 4). There was no mobility noted on any of the teeth.

Treatment Planning

Based on patient's history and clinical, radiographic, and occlusal findings from mounted diagnostic casts, a treatment plan was developed. The patient refused to undergo any additional surgeries for correction of his palate and desired fixed prosthetic solutions. Therefore, it was decided to remove the existing

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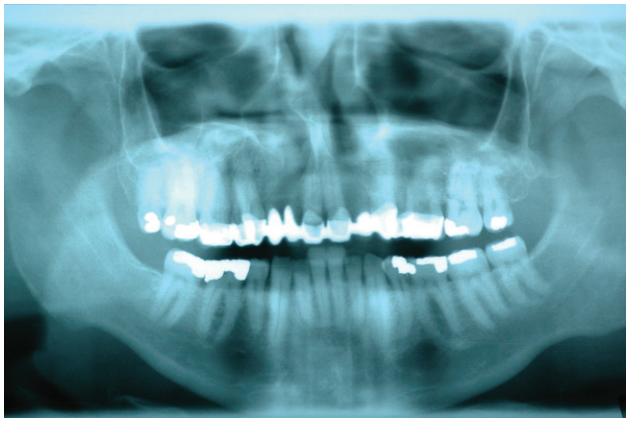

FIGURE 4. Pretreatment panoramic radiograph showing acceptable bone levels, crown–root ratios, and long-span fixed dental prosthesis.

FIGURE 5. Frontal image of teeth with interim restorations in maximum intercuspation. Note acceptable health of gingival tissues.

11-unit FDP and fabricate a new metal-ceramic FDP with an improved design using a high noble alloy. A new 9-unit FDP was planned to extend from tooth #4 through #13, including only two abutment teeth on each side of the cleft. Teeth #3 and #14 were planned for single metal-ceramic crowns. The mandibular arch included complete cast gold crowns on teeth #30 and #31. It was planned to extract all remaining third molar teeth because of their occlusal interferences and to promote patient's oral hygiene. The patient was prescribed 1.1% sodium fluoride topical dentifrice (Prevident 5000 Plus, Colgate-Palmolive, Morristown, NJ, USA) for use twice daily. The patient's oral health and hygiene were closely monitored during the entire course of the treatment.

Prosthodontic Treatment

The existing maxillary incisal edge position was acceptable to the patient and clinician. Using this as a guide, diagnostic waxing was accomplished on the mounted casts, correcting the horizontal cant of the existing incisal plane. After patient's approval of the diagnostic waxing, interim restorations were fabricated accordingly. The treatment commenced by extraction of teeth #1, #16, and #17. After healing, the existing FDP was sectioned using diamond burs for porcelain and carbide burs for metal. The process of sectioning was challenging and time-consuming because of the hardness of the base metal alloy and the long span of the FDP. The existing tooth preparations were refined, and the interim FDP was inserted in the mouth and relined with autopolymerizing resin.

During subsequent appointments, the preparations were refined conservatively in order to obtain parallelism between the abutments and definite finish lines. No dental caries were noted on any of the maxillary abutments. Tooth #30 had dental caries extending to the pulp and required endodontic therapy and amalgam core build-up. The interim restorations were modified to patient's satisfaction, and appropriate health of soft tissues around the restorations was achieved (Figure 5). Subsequently, final impressions were made using polyether impression material (Impregum Pentasoft, 3M ESPE, St. Paul, MN, USA), and master cast and dies were prepared from these impressions (Figure 6). The casts were then mounted on a semiadjustable articulator (Hanau Wide Vue, Whip Mix Corp, Louisville, KY, USA).

It was predicted that the maxillary final impression was distorted across the arch because of the mobile premaxillary segment. Therefore, the metal framework was cast in three individual sections that allowed less distortion during casting procedures and provided well-sealed margins (Figure 7A). They were fabricated using a high noble alloy (JP-I, Jensen Dental, North Haven, CT, USA) whose contents were gold 51.5%, palladium 38.5%, indium 8.5%, gallium 1.5%, and traces

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FIGURE 6. Image of the maxillary master cast with dies. Note that previous tooth preparations were refined conservatively to obtain parallelism of abutments and definite finish lines.

of ruthenium. To ensure that the metal framework could provide adequate support for porcelain, a matrix prepared from the interim restorations was used as a guide during fabrication (Figure 7B). Each section of the metal framework was individually tried in the mouth, and fit was confirmed using a silicone material (Fit Checker, GC America Inc., Alsip, IL, USA) (Figure 8A). Subsequently, the premaxillary segment was recorded in its physiologic position[7,8] by splinting the three sections of the metal framework using autopolymerizing resin (Pattern resin, GC America). The metal framework was removed from the mouth and reinforced with additional acrylic resin (Figure 8B). It was returned to the mouth, and a passive fit with closed margins was confirmed; the patient was allowed to perform physiologic movements, such as chewing, coughing, sneezing, and blowing to test for comfort of the recorded position of the premaxillary segment. After obtaining patient's approval, the jaw relation record was verified intraorally on the metal framework using prefabricated jigs on the mounted casts.

Thereafter, standard soldering procedures were accomplished on the splinted framework prior to porcelain application.[19] The restorations were tried in the mouth at bisque bake stage, and minimal adjustments were made for esthetics, occlusion, and pontic form. Single crowns were also tried on teeth #3, #14, #30, and #31. A modified ridge lap form was developed on all pontics, and a mutually protected articulation was achieved. After glazing and polishing, the final restorations were then cemented with resin-modified glass ionomer cement (RelyX Luting Plus, 3M ESPE) (Figures 9A and B).

Post-Treatment Therapy

After final cementation, an occlusal device was fabricated, and the patient was instructed to wear it daily at night. The patient was given detailed oral hygiene instructions and was advised to continue using the 1.1% sodium fluoride dentifrice for the rest of his life because of his predisposition for xerostomia. The patient was educated about oral hygiene maintenance around the FDP using superfloss and proxabrush. The patient was placed on a 6-month recall program for maintenance of his oral health (Figure 10). At a 3-year recall, the integrity of the FDP and health of the soft tissues remained stable (Figure 11). The patient remained satisfied with esthetics, function, and comfort of his restorations.

DISCUSSION

The term "habilitate" is defined as "to make fit or capable," and "rehabilitate" is defined as "to restore to a former capacity."[20] With the advent of improved clinical techniques and knowledge, most cleft palate patients undergo habilitation at a younger age.[1] Consequently, while treating older cleft palate patients, the prosthodontist is actually performing a rehabilitation of the patient's dental and associated structures. Therefore, routine life-long prosthodontic follow-up with adequate maintenance and potential revisional treatments is essential for long-term care for cleft palate patients[21]; this will maintain adequate masticatory function, speech, esthetics, and thereby support psychosocial function.[6,21] Goodacre and colleagues[22] reported some of the most common complications in fixed partial dentures as dental caries, need for endodontic treatment, loss of retention, esthetics, periodontal disease, tooth fracture, prosthesis fracture, and porcelain veneer fracture. Though porcelain veneer fracture has been reported to occur in about 2% of all

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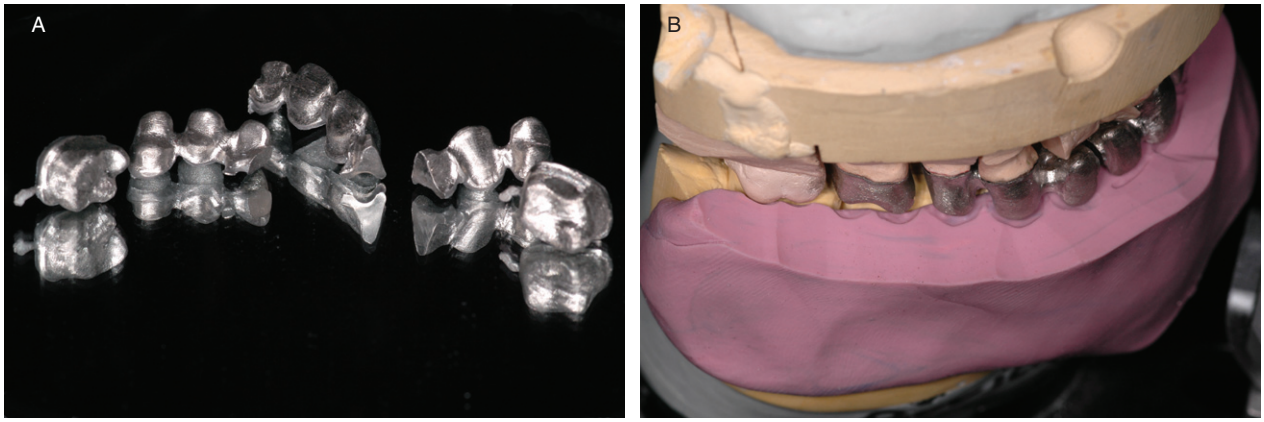

FIGURE 7. A, Image showing the maxillary metal framework cast in high noble alloy in three sections and single-crown copings of teeth #3 and #14. B, A matrix of the interim restorations was used during fabrication of the metal framework to ensure adequate support for porcelain.

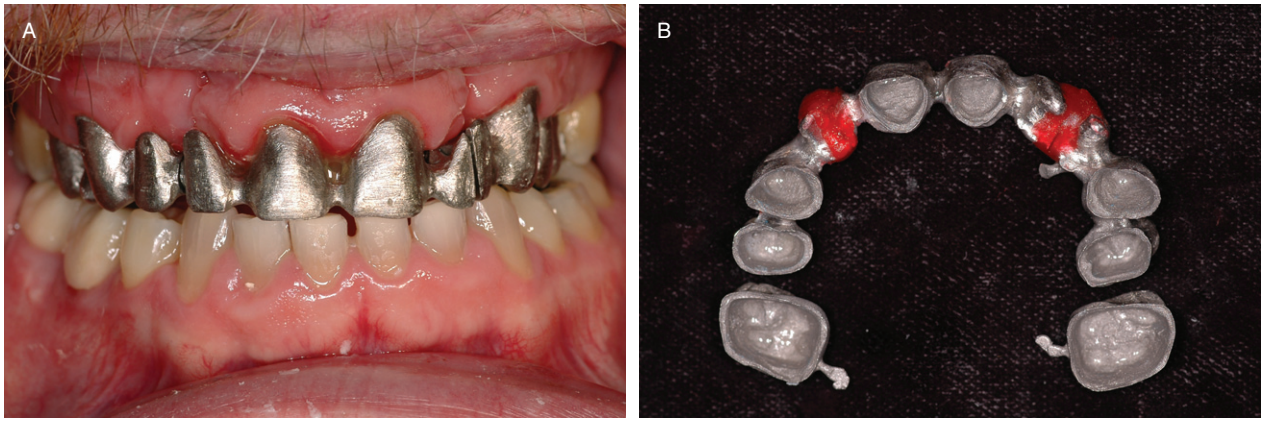

FIGURE 8. A, Frontal image of three sections of maxillary framework in the mouth before being splinted at the physiologic position of the premaxillary segment. B, Image showing the splinted maxillary framework with autopolymerizing resin.

reported studies, it leads to additional expenses for the patient, as the entire prosthesis has to be remade. This is of critical concern for bilateral cleft palate patients because of the long span of the FDP involved in their treatment.

Porcelain veneer fracture primarily occurs when the porcelain is not adequately supported by metal framework or because of poor bonding with the alloy.[23] Microscopically, failures of metal-ceramic restorations have been classified as adhesive failure or cohesive failure.[23] In this patient, multiple porcelain fractures probably occurred because the previous metal framework was made of a base metal alloy, which resulted in thicker oxides for porcelain bonding and hence, an adhesive failure. Furthermore, the FDP was 25 years old, and modern porcelain-alloy systems and techniques have significantly improved. Therefore, steps for future prevention of porcelain fractures in the new FDP were taken by (1) using a high noble alloy for thinner oxides, (2) careful contouring of the metal framework based on the planned shape of the final restorations, (3) reducing the span of the FDP from 11 to 9 units, and (4) providing the patient with an occlusal device for wear at night.

The treatment plan chosen for this patient was based on a confluence of factors. First, the patient refused additional bone-grafting procedures, which precluded the possibility of dental implants for the missing teeth. Second, the patient was accustomed to an FDP for 25 years and desired a similar prosthetic solution.

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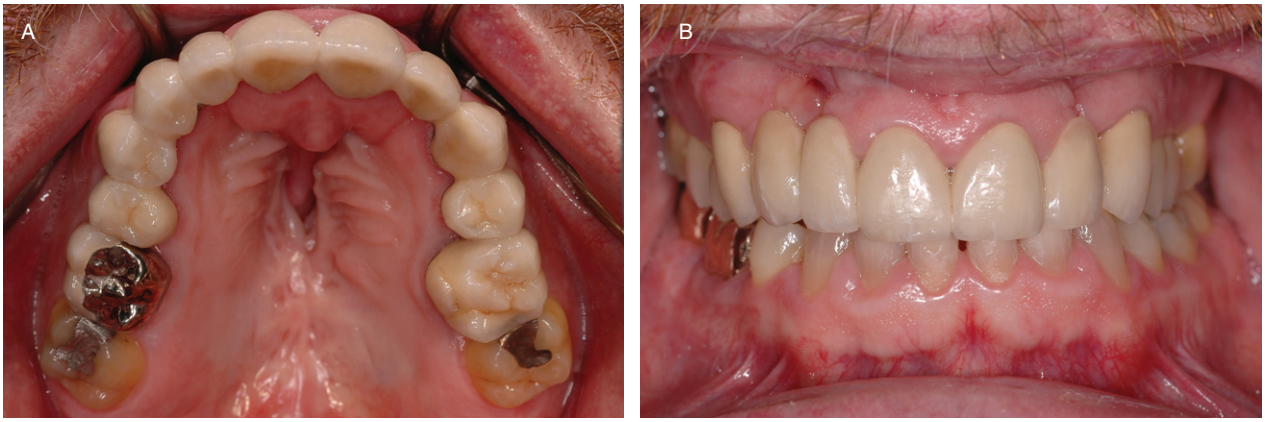

FIGURE 9. A, Post-treatment maxillary occlusal view showing the 9-unit metal-ceramic fixed dental prosthesis with two abutments on each side of the cleft. Teeth #3 and #14 were restored with single crowns. B, Frontal image showing the post-treatment condition of the teeth in maximum intercuspation. Also note the gold crowns on #30 and #31.

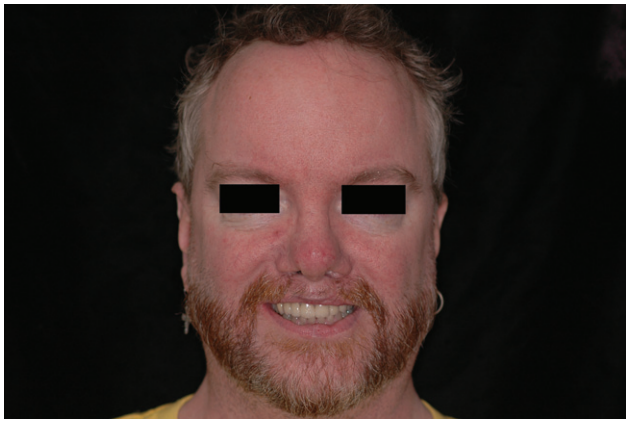

FIGURE 10. Post-treatment frontal view of the patient.

FIGURE 11. Frontal image of teeth in maximum intercuspation at the 3-year follow-up.

Furthermore, the premaxillary segment had to be splinted to the adjoining maxilla by a fixed prosthesis. The patient's speech and deglutition appeared normal, so a removable prosthesis was ruled out. Finally, only two abutments were used on either side of the cleft for the new FDP in comparison with the three abutments in his previous FDP. This was done in order to keep the design simple and short and at the same time provide adequate retention and support for the prosthesis. Two is the minimum number of abutments empirically recommended by previous authors,[5–10] and a clinical study also showed that inclusion of more than two teeth does not provide any additional advantages on the functional loading capability of the maxilla.[11] The patient's previous FDP had two maxillary canines as pontics on the right side, as tooth #6 had been distalized orthodontically to position #5. In the new FDP, tooth #6 was prosthetically converted to tooth #5 in order to improve esthetics and establish symmetry and balance in smile.[24]

The intraoral splinting of the metal framework was done to record the most accurate physiologic position of the premaxillary segment and attain passive fit with well-sealed margins. The three sections were soldered using a gas-oxygen torch in the pontic areas in order to provide increased soldering surface area[19]; moreover, the soldered areas were distant from the margins of the retainers so that the heat from soldering would not distort the margins. Some authors

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have reported concerns about movement and potential loss of cement seal and possible dental caries when the premaxillary segment is being splinted through a long-span FDP.[4,10] However, passive fit of the metal framework, well-sealed margins, carefully controlled occlusion, and use of resin modified glass ionomer cement can obviate these concerns in this patient. In addition, this patient had a similar FDP design for 25 years that had not resulted in any of these problems. Use of a telescopic FDP supported by primary copings has been reported as an option to ameliorate this situation.[10] This alternative was not utilized because of increased expenses, technique sensitivity, and additional restorative space/teeth preparation required in this patient.

SUMMARY

This clinical report described the esthetic and functional rehabilitation of a bilateral cleft palate patient with fixed prosthodontic therapy. The patient presented with a mobile premaxillary segment that was splinted by an 11-unit metal-ceramic FDP made of a base metal alloy that was made 25 years ago. He had multiple porcelain fractures that compromised esthetics and function. Prosthodontic treatment involved fabrication of a new 9-unit FDP using a high noble alloy. At a 3-year follow-up, the FDP remained intact and functional, and no further complications were noted. As cleft palate patients require life-long prosthodontic follow-up and maintenance, revisional treatments should incorporate superior materials and methods to minimize future complications.

DISCLOSURE

The author does not have any financial interest in any of the companies whose products are included in this article.

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