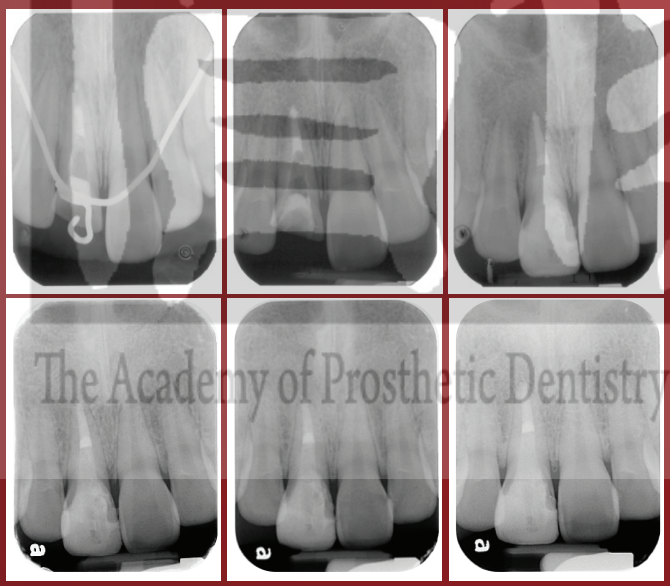
The Academy of Prosthetic Dentistry R.O.C., Taiwan

Journal of Prosthodontics and Implantology



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Journal of Prosthodontics and Implantology

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Journal of Prosthodontics and Implantology

Editorial

This volume marks the special time when the real first Covid-19 outbreak occurred in Taiwan in April. Like many other aspects of life, the COVID-19 pandemic had a significant impact on the publication and distribution of our articles. Due to the closure or limitation of dental practices and research institutions, we encountered delays in publishing articles. Nevertheless, we remained committed to providing informative articles that addressed the pandemic's unique challenges. This volume includes three case reports, and we encourage our APDROC members to contribute their experiences and insights to this journal. Despite the challenges, we are proud of our journal's resilience and adaptability, as well as the dental community's ability to overcome the obstacles. We recognize that the pandemic presented unprecedented challenges, but we remain confident that we will continue to navigate them with determination and innovation.

Sincerely,

Li-Deh Lin

Li-Deh Lin, Editor-in-Chief

The Academy of Prosthetic Dentistry R.O.C., Taiwan

Case Report

Prosthetic management of a patient with an excessive overbite and overjet: A case report

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Abstract

Oral rehabilitation for patients with a Class II deep bite malocclusion is among the most complicated treatments to manage in clinical situations. Although interdisciplinary care should be anticipated for comprehensive treatment, a prosthetic-only approach satisfies most patients and is often chosen for financial considerations. This case report describes a prosthetic reconstruction treatment process combining fixed and removable prostheses for a 66-year-old woman who presented with a severe deep bite. After restorative management, dental appearance and chewing function were improved. The clinical techniques used and their associated prosthodontic principles are discussed.

Key words: **deep bite, full-mouth rehabilitation, fixed partial denture, removable partial denture, vertical dimension**

Introduction

Deep bite is defined as an excessive vertical overlap of the lower incisors by the upper incisors when the mandible is in centric occlusion[1] and is one of the most commonly encountered malocclusions. Overlap that ranges from 5%–25% is considered ideal, whereas overlap exceeding 40% is defined as deep bite.[2] According to Proffit and Fields, severe deep bite (overbite ≥ 5 mm) occurs in nearly 20% of children and 13% of adults.[3] The etiology of deep bite can be multifactorial, and various skeletal and dental components are involved in the development of this type of malocclusion. Increased overbite is often associated with the occurrence of other malocclusions, especially in individuals with Class II incisor relationships and a Class II skeletal pattern.

Moyers and Riolo reported that clinically, deep bite is not defined in terms of the current presentation of overlap but rather in terms of future potential changes to both esthetics and function.[4] In most cases, deep bite is asymptomatic, and unless the appearance is esthetically unacceptable, patients rarely request treatment. However, some patients may seek treatment to restore function and improve esthetics if deep bite results in periodontal destruction, tooth wear, or missing teeth that require replacement. When combined with a Class II jaw relationship, an excessive overbite and overjet can pose a daunting challenge for restorative dentists. The management options available to address deep bite and associated problems vary with each individual situation and can depend on the patient's main concerns. A

multidisciplinary approach for optimal treatment may include orthodontic therapy, orthognathic surgery, periodontics, and the use of fixed or removable restorations. In most circumstances, patients are unwilling or unable to participate in an optimal treatment approach due to the associated complexity, duration, and costs of procedures. In such cases, compromises must be made; however, certain prosthodontic principles should continue to be followed. The purpose of this clinical report is to describe a prosthetic rehabilitation using fixed and removable partial dentures in a patient with severe deep bite and a Class II malocclusion, with consideration for the associated prosthodontic principles.

Case report

A 66-year-old woman was referred to the Department of Prosthodontics of National Cheng-Kung Hospital during regular periodontal maintenance treatment, with chief complaints regarding the instability and poor esthetics of old dentures, difficulty chewing, and the replacement of missing teeth. The patient's medical and dental histories were recorded, and a diagnostic radiograph was made. No medical or dental history was identified that contraindicated dental treatment, and no temporomandibular joint disorder or pain in the masticatory muscles was identified. Upon clinical examination, the patient presented in a partially edentulous state of Kennedy Class III, modification 2, in the maxilla, and Class III, modification 1, in the mandible (Fig. 1–3). The overbite and overjet were determined to be 6 mm, measured as the distance between the incisal edges from 12 to 42. Attrition and spacing of the mandibular anterior teeth were also noted. In the maxilla, multiple restorations, including splinted crowns on teeth 11, 12, and 13 and a surveyed crown on tooth 25, were noted. The crowns on teeth 11, 12, and 13 had previously been removed, and tooth 11 was extracted due to extensive structural defects caused by secondary caries. Another practitioner had placed 13–12–X cantilevered temporary restorations to fit the existing denture. During the periodontal examination, pocket charting and radiographs revealed generalized horizontal bone loss without isolated deep probing depth. Without the removable dentures, occlusal contact was observed between teeth 12 and 13 and 42 and 43, and light contact was observed between teeth 27 and 38. No stable vertical occlusal stops were present, resulting in a deformed occlusal scheme, and altered vertical occlusion dimension, and insufficient restorative space in the anterior and bilateral premolar region.

To confirm the diagnosis and define an appropriate treatment plan, dental casts of both jaws were mounted on a semi-adjustable articulator in centric relation. The treatment goal

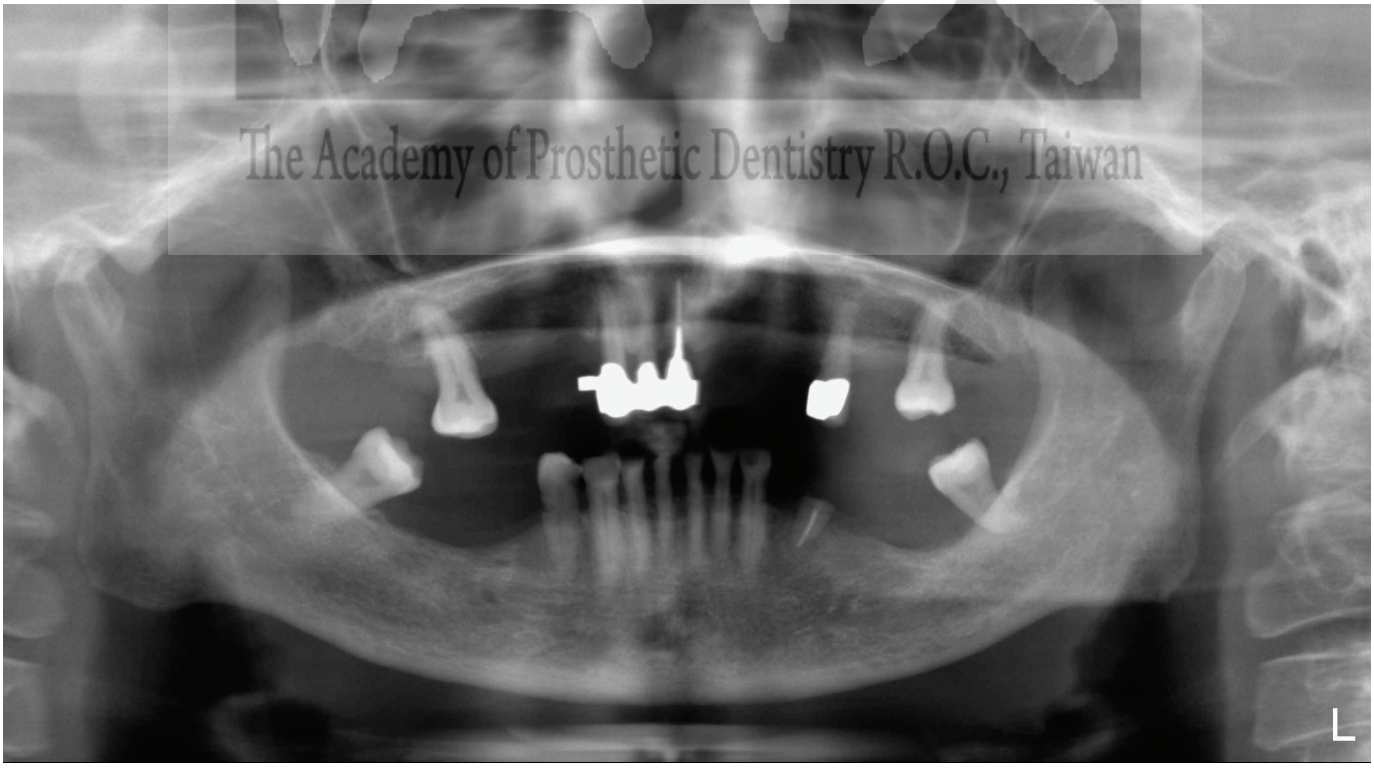

Figure 1. Pre-treatment panoramic film

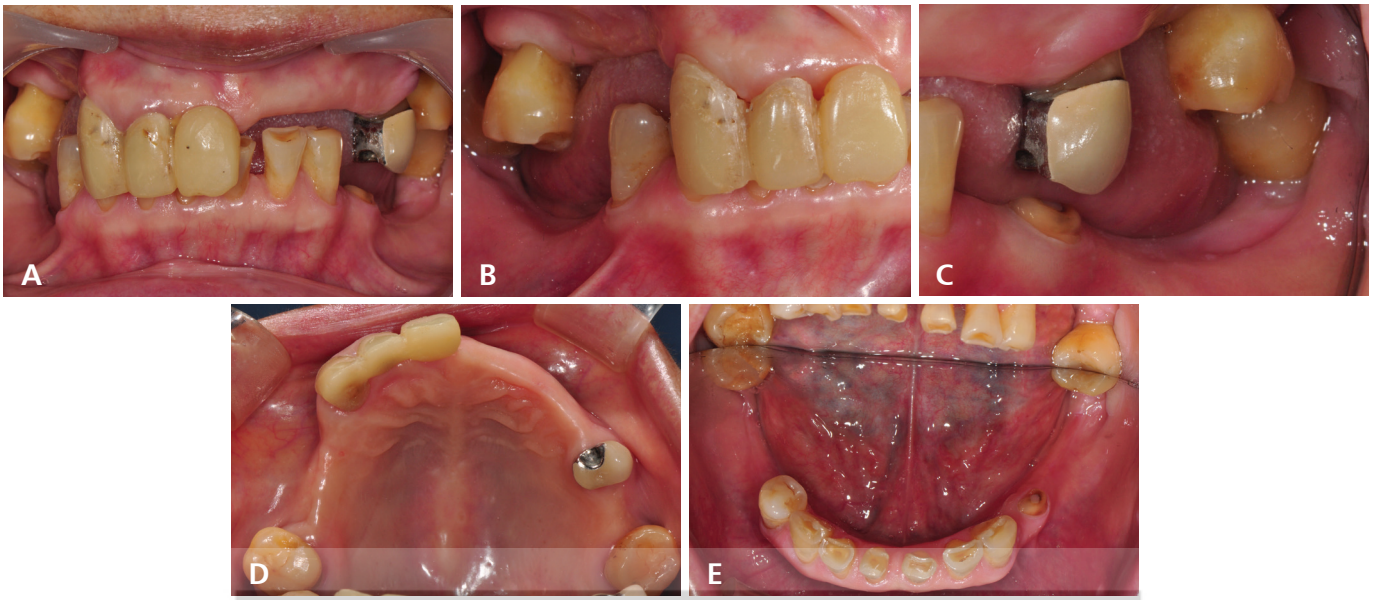

Figure 2. Pre-treatment intra-oral view. (a) Facial aspect. (b) Right side. (c) Left side. (d) Occlusal view of maxillary arch. (e) Occlusal view of mandible arch.

Figure 3. Pre-treatment extra-oral view. (a) Frontal view. (b) Lateral view.

was to restore the vertical height and improve masticatory function and esthetics. Alternative treatment options were discussed with the patient. Orthodontic treatment and surgical therapy were offered to correct the maxillomandibular relationship and restore the edentulous posterior regions using dental implants. She did not accept this option and selected rehabilitation with a prosthodontic approach because this option was less destructive, less time-consuming, and less expensive. According to the treatment plan, the applied prosthetic procedures included the use of provisional prostheses and the fabrication of definitive removable partial dentures (RPDs) and fixed partial dentures (FPDs). The contributions made by interim restorations to diagnosing and evaluating the functional and occlusal stability of definitive treatments were emphasized; however, the patient refused interim restorations due to financial constraints. The existing dentures were modified to fit a temporary prosthesis for interim use (Fig. 4a–d). A definitive treatment plan was implemented using a combination of fixed and removable prostheses in both jaws. The fixed prostheses included splinted and surveyed crowns for teeth 12 and 13 and a single surveyed crown for tooth 25. The appropriate occlusal vertical dimension was established by using a baseplate with a wax rim and was verified using a combination of techniques (phonetics, esthetics, swallowing,

physiological rest position, and record of existing dentures). The orientation of the upper occlusal plane was determined using the ala-tragus line and the interpupillary line as reference landmarks. The space distribution was designed to provide an optimal restorative space, a favorable crown–root ratio, and the minimal reduction of the occlusal surface to maintain the pulp vitality of abutment teeth. A diagnostic wax-up was generated for the fixed prostheses created for teeth 12, 13, and 25 and for the composite resin filling that was applied to the lower anterior teeth to close the spacing and repair the area of attrition (Fig. 5a–c). Acrylic teeth were then arranged on the wax rim of the maxillary and mandibular edentulous area. Full wax dentures were clinically tested to re-evaluate the occlusal vertical dimension, occlusion, phonetics, and appearance. The diagnostic wax-up of the lower anterior teeth was transferred to the mouth using the putty index (Fig. 6a and b). The adequate preparation of the selected abutment teeth was performed using preparation guides derived from the diagnostic wax-up.

Final impressions were made using vinylsiloxanether material (Identium; Kettenbach), and master casts were obtained by filling the impression with Type V dental stone (Die-Keen; Kulzer). Wax patterns of the crowns were surveyed, and contours were corrected to obtain ideal retention. The patterns were then cast, and the metal substructure was tested in the patient's mouth to verify marginal and internal fit. After a satisfactory trial of the metal framework, shade selection was performed for ceramic layering. The contours of the crowns were surveyed again at the bisque stage. The crowns were cemented with RelyX U200 resin cement after glazing was complete. Final impressions of the fabricated maxillary and mandibular RPD frameworks were generated using polyvinylsiloxane impression material. The obtained master casts were placed on a surveyor for the examination and design of the cast framework. Before the construction of the RPD framework began, the master casts and refractory casts were mounted on a semi-adjustable articulator based on the bite record obtained at an increased vertical dimension (Fig. 7a and b). The mandibular anterior teeth were designed to experience light contact with the palatal plate of the maxillary RPD, and the occlusal vertical dimension was increased by 2 mm after wearing the RPD designed for the anterior

Figure 4. Pre-treatment intra-oral view with the old dentures. (a) Facial aspect. (b) Right side. (c) Left side. (d) Occlusal view of maxillary arch.

Figure 5. Diagnostic wax-up made at an increased vertical dimension. (a) Frontal view. (b) Right side. (c) Left side.

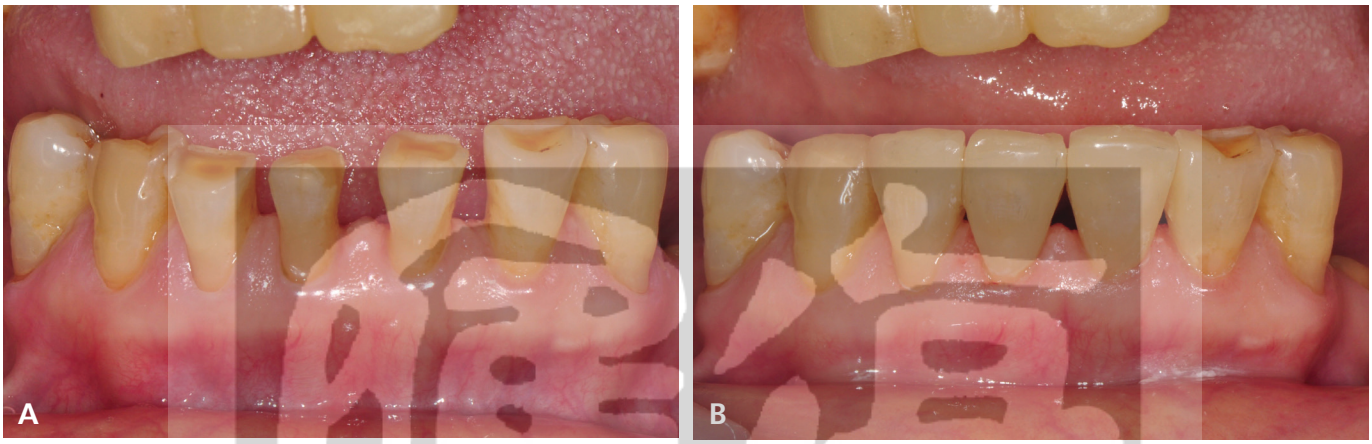

Figure 6. Direct composite restoration application at lower anterior teeth. (a) Pre-treatment. (b) Post-treatment.

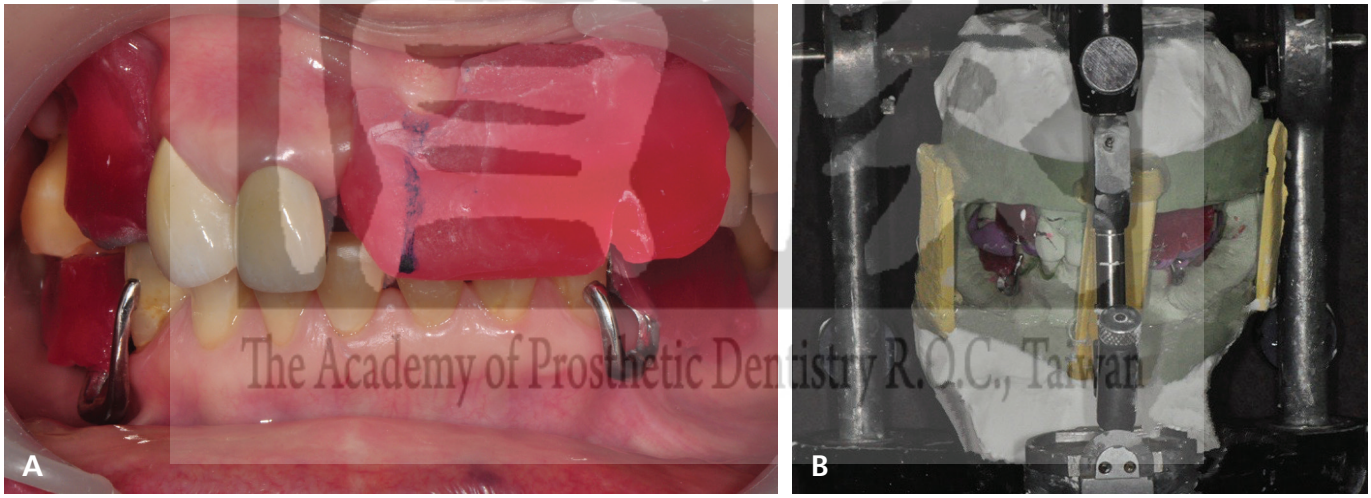

Figure 7. (a) Bite record registration at an increased vertical dimension. (b) Master cast mounted on a semi-adjustable articulator before maxillary removable partial denture (RPD) framework fabrication.

region. The completed framework was clinically examined, and both acceptable and passive fit were verified. Subsequently, teeth were arranged, and the occlusion was verified intra-orally. The prosthesis was then delivered to the patient, and denture care instructions were provided (Fig. 8a–e). The patient was advised to wear the maxillary and mandibular removable dentures on alternate days while sleeping to allow for better occlusal load distribution at night. Soft splints for both jaws were also provided to protect the abutment teeth for those circumstances during which the patient opts not to wear the dentures. The patient was then scheduled for regular follow-up and maintenance. During the follow-up visits, the patient reported satisfaction with the esthetics, function, and comfort of the dentures. Frontal and profile views showed improved appearance after the insertion of the new dentures (Fig. 9a and b). Postoperative periapical films revealed the

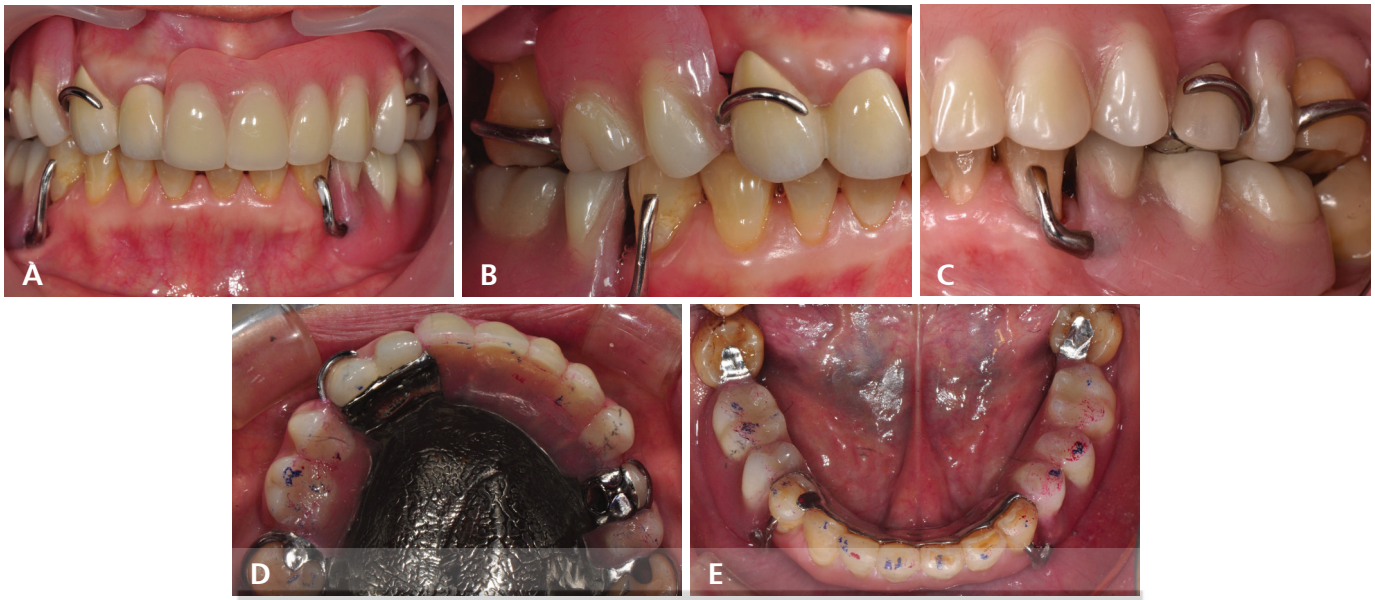

Figure 8. Delivery of maxillary and mandibular removable partial denture (RPD). (a) Frontal view. (b) Right side. (c) Left side. (d) Maxillary arch. (e) Mandibular arch.

Figure 9. Postoperative extra-oral view. (a) Frontal view. (b) Lateral view.

stable periodontal and periapical status of the remaining teeth (Fig. 10). At the 2-year follow-up visit, mild marginal discoloration and wear on the lower anterior composite restorations were noted. The finishing and polishing procedures were repeated to improve the marginal integrity.

Discussion

The reconstruction of mutilated dentition that features missing teeth and excessive overbites using fixed or removable prostheses is challenging for prosthodontists. A deep bite combined with a Class II malocclusion is often difficult to correct due to the dominance of the skeletal morphology.[4] The treatment goal not only includes the replacement of the missing teeth but also involves correcting the improper bite position and restoring the reduced vertical dimension. The causative factors that underlie excessive overbites include both inherent factors and acquired factors. A developmental deep bite can be caused by skeletal and dental discrepancies, such as variations in the growth patterns of both arches, the overeruption of incisors, or the infra-eruption of posterior teeth. An acquired deep bite can develop due to habits, such as tongue thrust, or the wear or early loss of the posterior teeth.[5] Therefore, the provision of stable occlusion with established posterior support is crucial when performing reconstruction in cases of deep bite. Restorative treatment using both

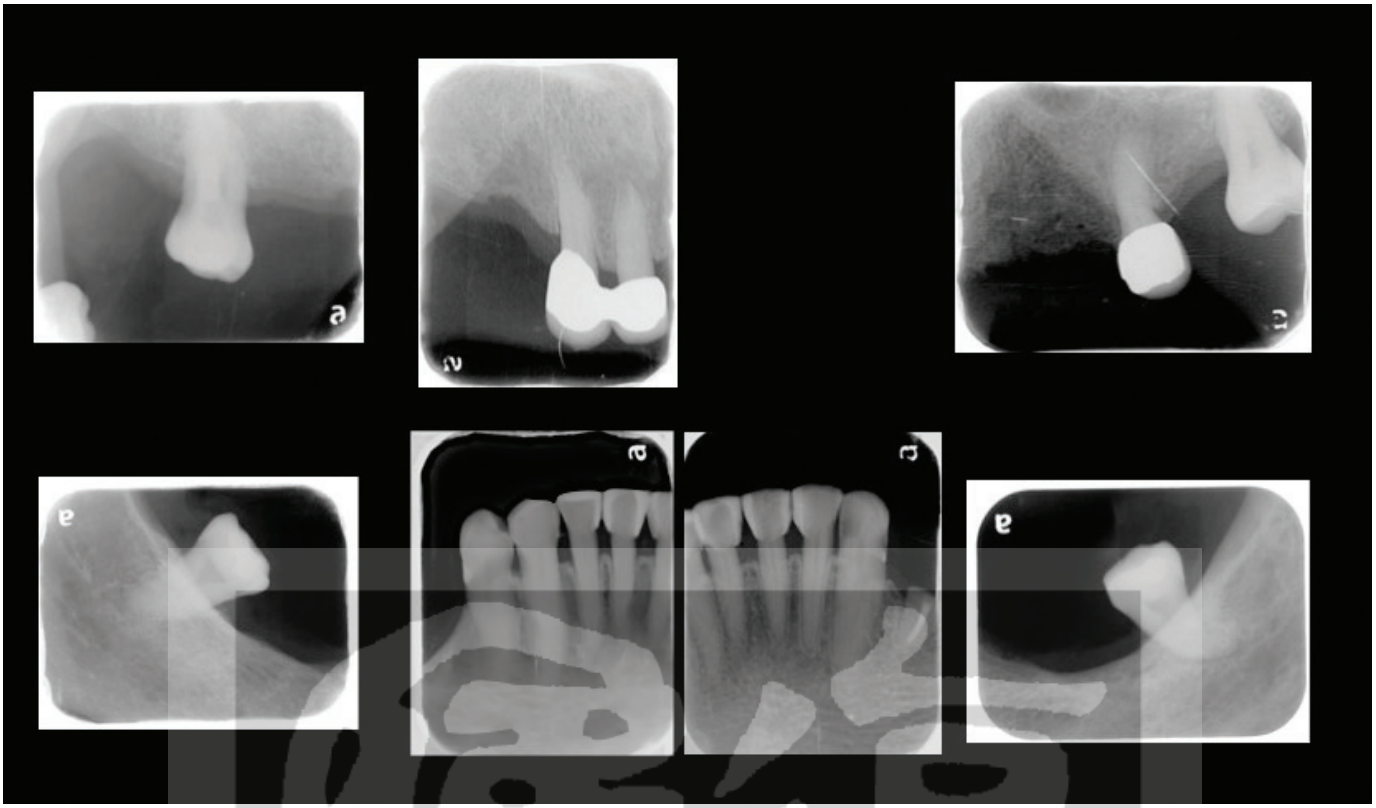

Figure 10. Postoperative periapical film.

fixed and removable dentures is the preferred approach for many patients.[6, 7] However, implants represent a better intervention because they can provide superior support and stability to the dentures. When performing restorations using removable dentures, periodic maintenance is likely to be necessary, especially in free-end cases. The development of wear on resin teeth and the failure to provide denture stability may worsen a deep bite. The patient in our case did not accept the use of interim dentures due to financial constraints; however, the role of interim prostheses during the complete treatment process should be emphasized in these types of cases. Interim prostheses not only enhance esthetics and function but also serve as diagnostic tools for identifying occlusal stability, abutment prognosis, and the patient's tolerance for the alternating vertical dimension with and without the dentures.

The most common problems encountered when performing restorations in patients with deep bite include trauma to the soft tissue, a lack of inter-occlusal space, and tooth wear.[5] An increased overbite can create excessive stress, wedging plaque and food debris into the gingival sulcus and aggravating periodontal destruction, especially when combined with poor oral hygiene.[8] When replacing missing teeth, limited inter-arch space can make the provision of restorations with adequate thickness impossible, particularly if no consideration is given to increasing the occlusal vertical dimension or interfering with the guidance patterns. Increasing the vertical dimension is often necessary to gain restorative space and establish proper anterior tooth relationships and can be accomplished using fixed and removable prostheses, such as posterior occlusal onlays, crowns, and overlay RPDs. Raising the vertical dimension reduces overbite; however, overjet can be increased by the downward and backward rotation of the mandible, which is undesirable in patients with Class II malocclusions. Excessive overjet is a limiting factor when determining the magnitude of an increased vertical dimension.[9] Minimizing the increase in the occlusal vertical dimension has been suggested to reduce the complexity of treatment, and an increase greater than 5 mm is rarely indicated.[10] The labial positions of the lower anterior incisors or the palatal positions of the maxillary incisors require alteration to maintain the coupling of the anterior teeth and prevent the overeruption of the lower incisors. In this case, the anterior bite plane was incorporated into the maxillary denture to provide contact with the mandibular anterior teeth, which may compromise the stability of the dentures, causing the dentures to flip during use. To avoid this outcome, clasping should be provided as far as possible from the

edentulous ridge.[11] Fortunately, this case presented with bilateral terminal abutments, and the stability of the maxillary dentures was not significantly affected.

Tooth wear is frequently observed in deep bite patients. If extra-coronal restorations are required at an existing vertical dimension, selective endodontic treatment and surgical crown lengthening may be indicated to provide adequate space, proper retention, and resistance form.[6] The application of direct composite restoration for the management of localized anterior tooth wear has been demonstrated to be a viable and conservative treatment option. According to Poyser et al.[12], direct resin composite materials are recommended, placed at a minimal increment thickness of 1.5 to 2.0 mm in areas of functional loading, to ensure appropriate longevity. Milosevic reported a low annual failure rate of 5.4% for the use of composite restorative materials in the worn dentition. In addition, composite failure was not associated with an increased vertical dimension or bruxism but was significantly associated with older patients and a lack of posterior support.[13] Previous studies indicate that the survival rate of composite restoration used to treat localized anterior tooth wear ranges from 50% to 83% during 5 to 7 years of follow-up. When only major failures were considered, the survival rate increased.[13–15] The placement of resin composite restorations for localized anterior tooth wear has a favorable short- to medium-term survival rate. This technique is relatively easy to maintain and does not preclude the use of other options in the future. In this case, resin restorations at the mandibular anterior teeth remained functional at the 2-year follow-up visit, with only slight marginal discoloration and wear.

Conclusion

This case report describes a full-mouth rehabilitation treatment using a prosthetic-only approach in a patient with excessive overbite and overjet. By combining fixed and removable prostheses, masticatory function and esthetics were restored, using a cost-effective approach. However, comprehensive assessments and careful treatment planning remain essential, and regular maintenance to verify stability and the wear on the dentures over time is also crucial to ensure a durable and satisfactory result.

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Case Report

Implants Supported Fixed Dental Prosthesis with Conventional Impression Technique – a Case Report

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Abstract

Dental implant is an alternative treatment to conventional dentures for patients who have lost their teeth. It is generally accepted that a suitable surgical technique and the passive fit of the associated prosthesis are keys to the success of the treatment. One of the most critical steps for the long-term success of implant prosthesis is to accurately and precisely perform the impression procedure. This report presented a case in which the impression was taken via a direct impression (open tray) technique using splinted impression copings with self-cured resin. Using this method, the accuracy of the definitive prosthesis was much enhanced, and the longer-lasting functional performance can be expected.

Key words: Dental implants, direct impression technique, implant impression procedure, passive fit, splinted impression copings

Introduction

Dental implant is an alternative treatment to conventional dentures for patients who have lost their teeth. It can provide long-term stability and comfort as well. An initial surgery is required to facilitate its placement of dental implants into the bone. Then in the second step a prosthesis is connected to the fixture by the screw. It is generally accepted that a suitable surgical technique and the passive fit of the associated prosthesis are keys to the success of the treatment. From a biomechanical perspective, a poor-fitted connection in-between prosthesis and the dental implant can increase stresses in the bone surrounding the dental implant which may lead to marginal bone loss. Furthermore, abutment loosening and subsequent prosthetic failure can be expected.[1]

To achieve passive adaptation of the prosthesis, obtaining a precise working model, which depends directly on if the impression is accurately taken, is very important.[2] With this issues in mind, the impression of a case presented in this report was taken via an open tray technique using splinted impression copings with self-cured resin. Therefore, the accuracy of the definitive prosthesis was found improved and the longer-lasting functional performance can be expected.

Case report

An old long-span bridge 17-xxx-13-x-11-21 of this 48-year-old female patient was dislodged from the upper right area. She denied having any systemic diseases or drug allergies. The clinical and radiographic examination showed that severe horizontal and vertical bone loss was found on teeth 13, 17 and 21. The intraoral photo showed 13,17,21 severe gingival recession, and lower dental midline was shifted to left side about 2mm. The extraoral photo showed mild concave of midface due to lost upper anterior prosthesis(Fig.1,2,3). And chronic apical periodontitis with incomplete endodontic treatment and secondary caries was noticed on tooth 24(Fig.4). Therefore, she came to the department of stomatology at NCKUH to seek for an acceptable prosthetic treatment plan for her esthetic and functional needs.

Tentative treatment plans given to the patient were included conventional removable partial dentures with extraction of tooth 13,17,21; implant-retained or -supported overdenture with extraction of tooth 13,17 and 21; implant retained fixed dental prosthesis with extraction of tooth 13,17 and 21.

Patient chose the treatment plan of implant retained fixed dental prosthesis with extraction of tooth 13, 17 and 21, and the clinical procedures were described as follows :

For the initial prosthetic treatment, remove bridge of tooth 24-25-x-27 and post-&-core of tooth 24, then fabricate provisional crown and bridge for tooth 24, 25-x-27 (Fig.5). Extracted tooth 13 and 21 with xenograft (Terudermis®) placement for soft tissue preservation and further ridge augmentation was performed. 3 weeks after the extractions of tooth 13, 17 and 21 primary impressions of upper and lower arch were taken with alginate for fabrication of upper interim denture. Upper jaw was fabricated and border molding was done for

Figure 1. The initial panoramic x-ray showed 13,17,21 advanced bone loss

Figure 2. The initial intraoral photo of frontal view

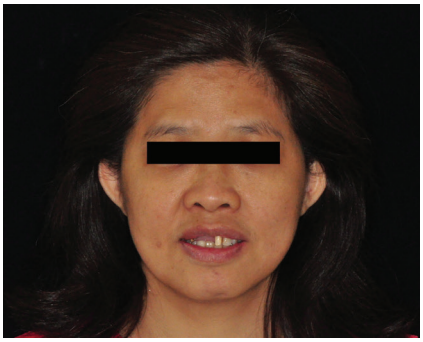

Figure 3. The initial extraoral photo of frontal view

Figure 4. The periapical film of tooth 24

performing final impression. The impression was poured to form master casts. Then occlusion rims were fabricated for recording jaw relation and tooth selection. Tooth setup trial was done to correct and verify maxillomandibular relations. Fabrication of upper interim was finally accomplished. The interim was delivered to the patient after minor adjustments and polishing (Fig.6).

For the guided bone regeneration treatment, surgeon used BioOss and auto-bone graft, which were placed over tooth 13-16 area. FDBA and BioOss were applied at tooth 11 area. Ti mesh and several tag screws were used for bone augmentation. Two weeks later, the sutures were removed and the patient was advised to come for follow-up.

Impression for fabricating upper surgical stent was taken after upper right area bone augmentation 10 months later. Then surgical stent try-in was arranged and dental CBCT was also checked (Fig.7,8). Four implants were placed over tooth 17-21 area. The diameters and lengths of used implants were listed as blow (Brand: Tapered groovy, NOBEL REPLACE) : Tooth 13: 3.5x10mm, Tooth 21: 3.5x10mm, Tooth 15: 4.3x10mm, Tooth 16: 4.3x8mm. Ti mesh was used for bone augmentation with BioOss bone graft. (Fig.9). Two weeks later, the sutures were removed and the patient was advised to come for follow-up.

After six months of implant placement, second-stage surgery was performed. Implant site 13, 15, 16 and 21 were surgically exposed, and healing collars were placed on the implants. Xenograft (Terudermis®) was also placed for soft tissue thickening. Two weeks later, the sutures were removed and the patient was advised to come for keratinized gingiva (KG) augmentation. Three months after 2nd stage surgery, we found the insufficient of KG around implants (Fig.10). Therefore, we performed another surgery for KG augmentation. The free gingival graft was harvested from the upper left palate. The size of the graft was about 2.0–3.0 mm in thickness and 30.0 mm in length. The graft was placed at the buccal site of implants 13,15 and 16.

Figure 5. The upper right edentulous ridge s/p 13,17,21 extraction

Figure 6. The upper interim delivery

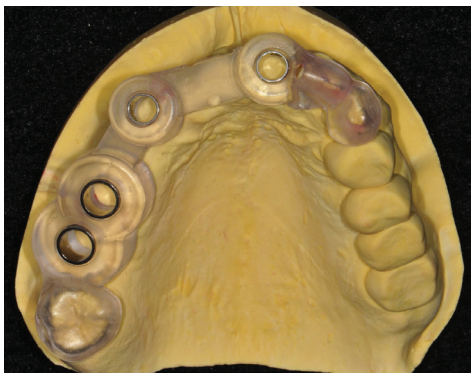

Figure 7. The CT guided surgical stent on the working cast

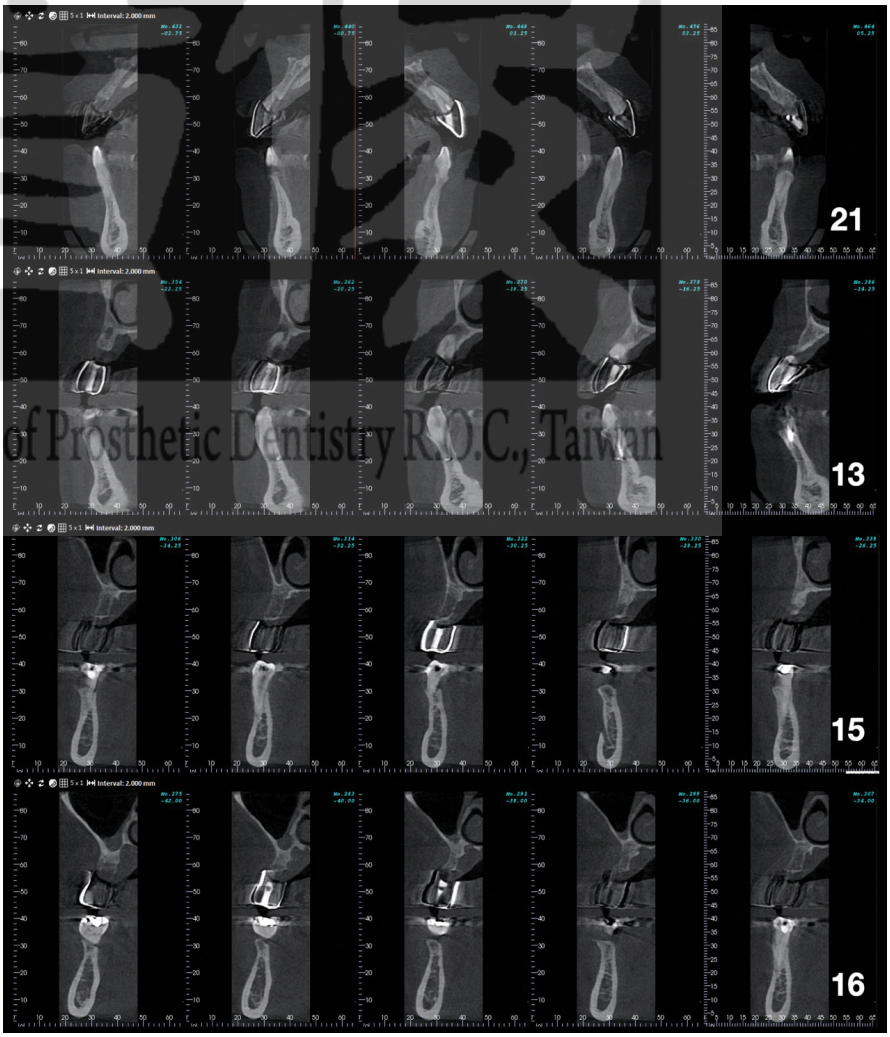

Figure 8. The CT images of teeth 21,13,15,16

After three months later, an increase in keratinized tissue was observed over the area of implants of 13,15 and 16, which makes the area more suitable for definitive prosthesis fabrication.

For the definitive prosthetic treatment, final impression for fabricating crown 24 and bridge 25-x-27 was taken using polyvinyl siloxane impression material after finishing endodontic treatment of tooth 24 and 25 and installing casting post for tooth 24. Impressions were poured and master casts were made. Zirconia crown 24 and bridge 25-x-27 were delivered to the patient after try in and adjustment.

Impression copings were placed on the implants, which were splinted with self-cured resin (Fig.11,12), and transferred impression technique was taken using polyvinyl siloxane impression material (Open-tray technique) (Fig.13). Impression was poured, and master cast was made (Fig.14). The temporary implant supported FDPs was fabricated after mounting on semi-adjustable articulator, then it was tried intraorally to ensure the implants' position and their passive fit (Fig.15). Scanning and planning for zirconia framework fabrication was done using CAD-CAM techniques. An try-in appointment of the zirconia framework was done to ensure the passive fitting on the master cast and intraorally. Radiograph was taken to evaluate the fit between bar frameworks and implant interface via one-screw test (Fig.16). Then bisque of definitive prosthesis was tried gingival contour was checked for veneering pink porcelain on 11-15,21 implanted teeth. Finally, upper hybrid denture was delivered to the patient after adjustment (Fig.17,18,19). Patient was advised to the routine follow-up after 1 year and re-checked the panoramic film to evaluate the fit between the definitive prosthesis and implant interface. (Fig.20).

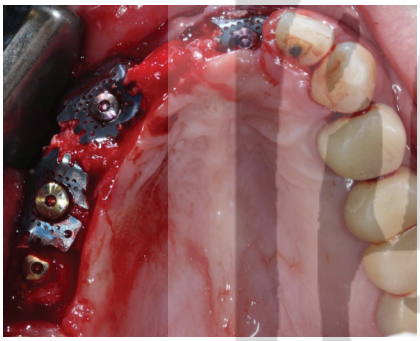

Figure 9. The implants placement over 13,15,16,21 area

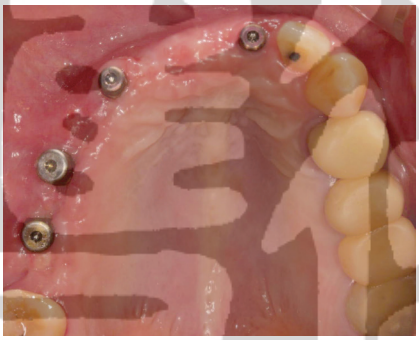

Figure 10. The 2nd stage implants surgery over 13,15,16,21 area

Figure 11. The verification jig fabrication

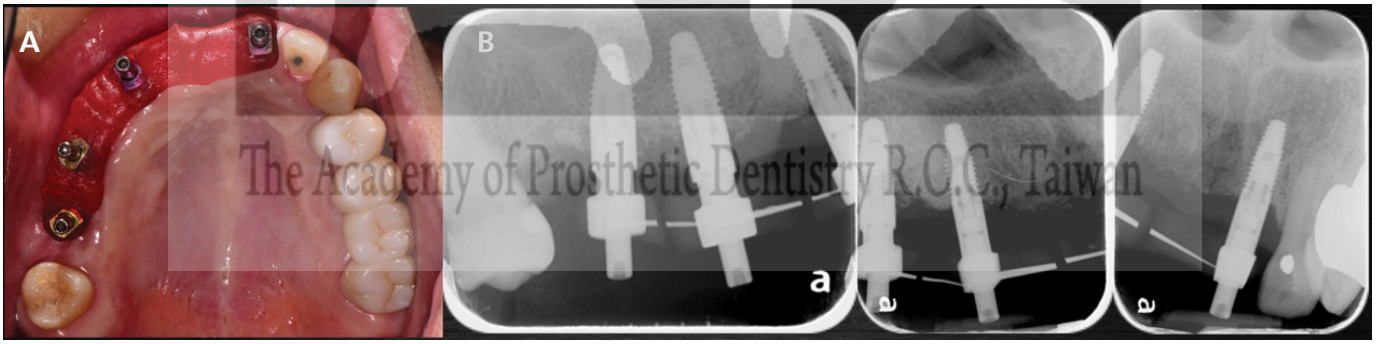

Figure 12. Splinting the 13,15,16,21 impression copings with self-cured resin material. (a) occlusal intraoral view; (b) periapical film

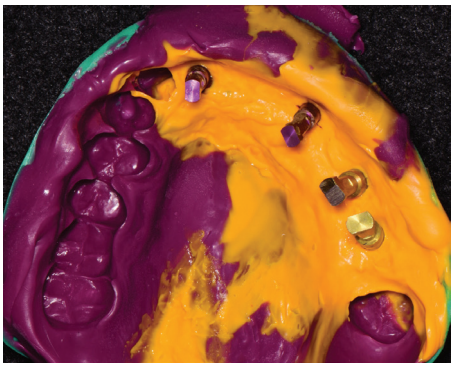

Figure 13. Open tray impression technique with PVS impression material

Figure 14. The upper master cast

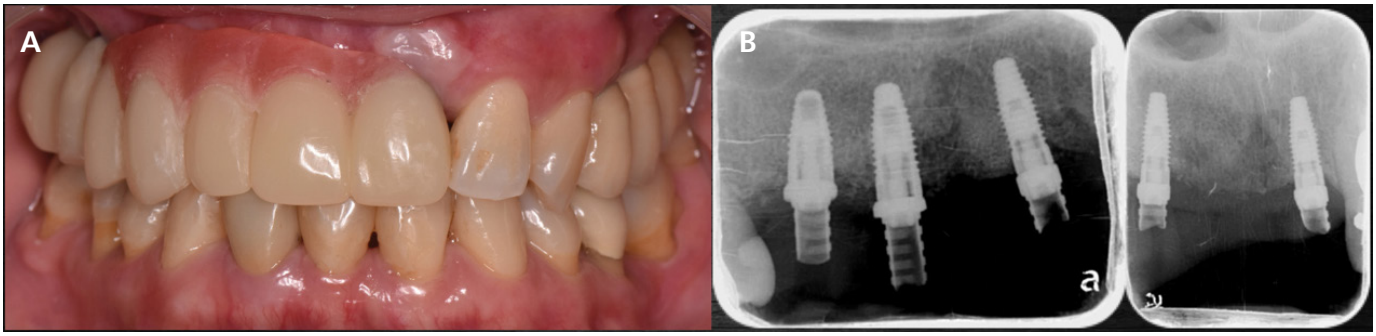

Figure 15. The frontal view after temporary implant supported FDPs delivery. (a) frontal intraoral view; (b) periapical film

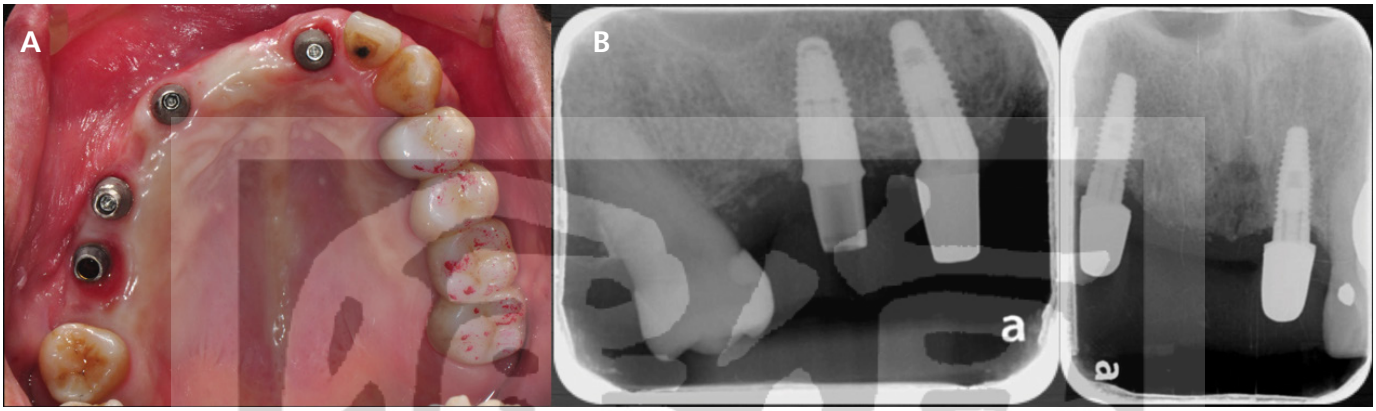

Figure 16. The 13,15,16,21 implant abutments. (a) occlusal intraoral view; (b) periapical film

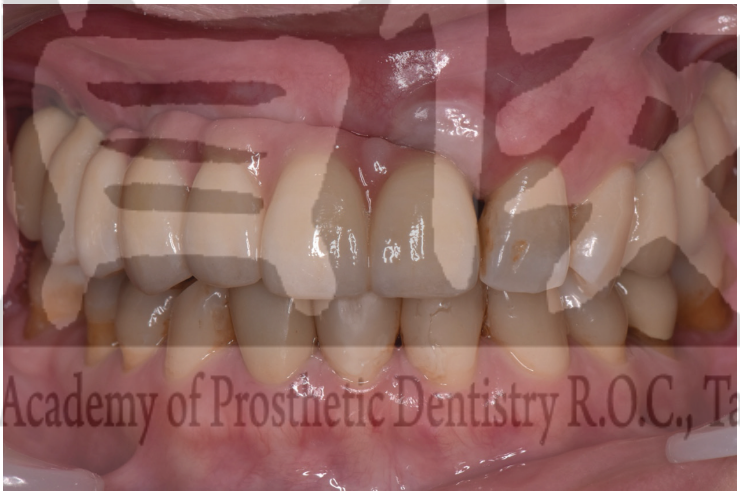

Figure 17. The intraoral frontal view after definitive implant supported FDPs delivery

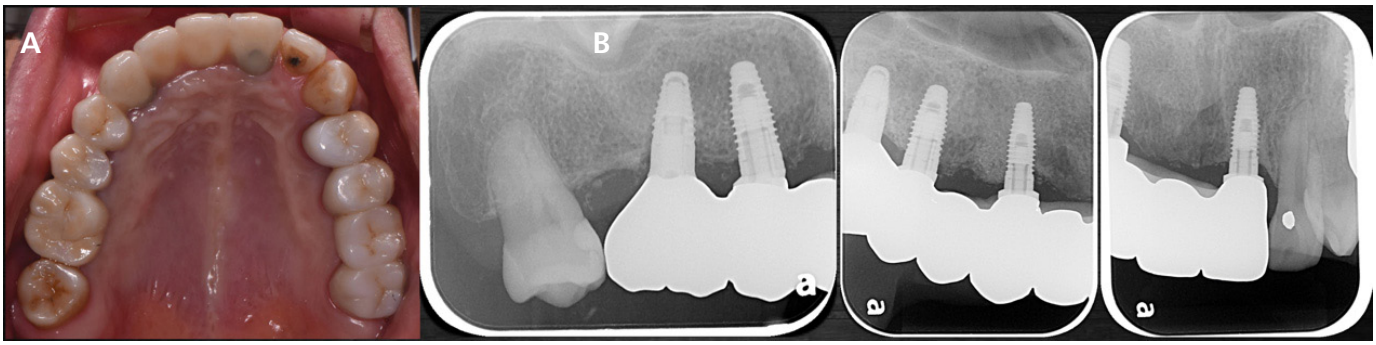

Figure 18. After definitive implant supported FDPs delivery. (a) occlusal intraoral view; (b) periapical film

Figure 19. The extraoral frontal view after definitive implant supported FDPs delivery

Figure 20. The panoramic film of definitive implant supported FDPs for 1 year follow up

Discussion

There are so many influential steps in the production of an implant-supported prosthesis which affect the fit between implants and the final prosthesis. One of the most critical steps for the long-term success of implant prosthesis is the accuracy during the impression procedure, which is affected by several factors such as the impression material, tray design, splinted or non-splinted impression copings, implants' angulation, and conventional impression or digital intraoral scan.[3]

The most often used impression materials are polyvinyl siloxane and PE (Polyether). Many authors indicate the importance of impression materials and their effect on the accuracy of the intraoral coping acquisition.[3,4] According to the studies conducted by Del'Acqua[5] and Lee and Cho[6], their results show PE materials result in better accuracy than VPS material. This could be explained by the greater rigidity of PE, which prevents movements of the impression copings inside the impression material.

The most common impression techniques are the closed tray (indirect) and the open tray (direct). The indirect technique typically uses tapered impression copings with impression caps, and closed trays that match the height of the transfer. Next, light body impression material is injected around the impression coping and into the tray and then the impression is separated from the mouth and leaves the copings intraorally. The copings are then removed from the implants, connected to implant

analogs, and positioned in its corresponding place in the impression. Finally, the assembled set is sent to the laboratory. The direct technique uses square copings with long retaining screws and custom open trays with holes, which lines up with the transfers when the impression is made. Next, the copings are unscrewed by removing the retaining screws from the implants. This allows the copings to be removed along with the impression. After removing the impression tray, the implant analogs were connected to the impression copings and sent to the laboratory.[3]

According to many studies, most of them advocated the open tray technique. Because many inaccuracies were indicated during impression procedure, such as implant angulation, coping shape, and cap design for closed tray techniques.[3,7,8]

Some studies showed that four or more implants are used, applying the open tray technique can generate more accurate impression. On the other hand, even for three or fewer implants, some authors suggest that the open tray technique should be for the best accuracy.[9]

A study reports that the breakage and distortion of the impression cap engaging the implant shoulder can compromise its reliability. Therefore, the close tray technique is less accurate than the open tray technique.[10]

Whenever multiple implants are restored with a single prosthesis, many techniques have introduced to improve the accuracy of prosthetic fabrication. One of the most important methods is the splinted technique during the impression. Several studies proposed that splinting the impression copings with self-cured resin material to maintain the relationship between the impression copings by rigid fixation.[3,5,6] However, the intraoral splinting of impression copings is time-consuming. And it is difficult to apply the materials to the very posterior region where the access is limited. Furthermore, due to the shrinkage of self-cured resin, distortion of the implant position may still occur.[4] Therefore, some studies advocate sectioning and luting of the splint material as a solution to improve accuracy and prevent shrinkage.

The angulation of implants were usually associated with the accuracy of implant impressions. When implants' angulation increases, the deformation increase during implant impression, which affect the passive fit and success rate of definitive prosthesis. Therefore, the multiple unit implants were required an unique impression technique that allows precise inter-implant relationship.[6,11,12] Therefore, several studies investigate the accuracy variations of parallel and non-parallel implants.[3]According to a study conducted by Elshenawy et al.[13], the indirect technique showed the highest distortion values when angulated implants were used followed by direct unsplinted technique then direct acrylic resin-splinted technique. Therefore, the accuracy of definitive casts was affected by the impression technique only in angulated implant conditions where direct splinted technique provided the most accurate position transfer. In parallel implant situation, these three techniques were similar.

The accuracy of master cast highly depends on the impression. The development of digital dentistry has impacted the impression and fabrication procedures of dental implants. Therefore, the accuracy of digital intraoral scanner has been evaluated from conventional impression. The development of scan bodies has made it easier for clinicians to record implants' locations, and patients feel more comfortable when the intraoral scanner is used than when conventional impressions are made. Moreover, the use of an intraoral scanner can reduce the number of connecting procedures; therefore, its use might minimize the amount of unavoidable component displacement. According to a vitro study conducted by Paulo Ribeiro[1], which studied a model with four parallel implants and found that the deviations of the digital impressions were smaller than those associated with the conventional techniques. This improvement was not observed when using a model with four angled implants, however, where the conventional techniques yielded similar results. Therefore, digital impressions of full arch models were able to achieve the accuracy of conventional impressions in an in vitro model. But the clinical situations were exhibited a number of limitations. The conditions for obtaining conventional and digital impression are easily controlled in in vitro studies, which might not be similar in clinical situations. The presence of saliva, blood, and gingival crevicular fluid will influence the results.[14] For those in vitro studies, the investigation was limited to only one scenario of number of implants, position, and angulation. All of these variables are identified as influencing factors in the accuracy of both conventional and printed casts. However, further in vivo studies are needed to confirm the in vitro results.

Table 1. The better methods of implant impression procedure

The implant impression procedure	Methods	Advantages
The impression material	PE (Polyether)	The greater rigidity
Tray design	The open tray (direct)	The breakage and distortion of the impression cap engaging the implant shoulder can compromise its reliability. Therefore, the close tray technique is less accurate than the open tray technique.
Splinted or non-splinted impression copings	The splinted technique	Splinting the impression copings with self-cured resin material can maintain the relationship between the impression copings by rigid fixation.
Conventional impression or digital intraoral scan	Digital intraoral scan	The use of an intraoral scanner can reduce the number of connecting procedures; therefore, its use might minimize the amount of unavoidable component displacement.

Within the limitation of our case report, it was presented in which the impression was taken via an direct impression (open tray) technique using splinted impression copings with self-cured resin. Then the transferred impression technique was taken using polyvinyl siloxane impression material (open-tray technique). Further, the definitive prosthesis was delivered to this patient and followed every six months. For about two years follow up, this patient was satisfied with the definitive prosthesis which was fabricated from these impression procedures. In conclusion, the accuracy of the definitive prosthesis was achieved with these impression techniques which were mentioned above. (Table 1.)

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Literature Review

Restoration of flared incisor roots: a case report with 16 years of follow-up and review of literature

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Running title: Restoration of flared incisor roots

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Abstract

The deteriorated anterior tooth is always a challenge for dentists to ideally restore to proper form and function for long-term usage. Sometimes, compromised treatment of a flared root is indicated to avoid its extraction and to prolong the use of the tooth in function until the final treatment plan can be done. This paper aims to provide an alternative proposal for restorative treatment of compromised anterior teeth with a flared root, which is presenting itself as a suitable alternative to conventional cast metal post-and-cores with 16 years of long-term follow-up. Considerations regarding the restoration of flared incisor roots were also addressed based on the review of published references.

Key words: flared root, endodontically treated tooth, root canal therapy, fiber post, dental adhesive

Introduction

Patients who have suffered from large carious lesions or trauma to a front tooth during childhood and adolescence always end up having weakened roots with large canal space and poor remaining structure to ensure an adequate ferrule for the crown restoration[1-3]. Further, the tooth with a widely flared root canal and thin residual dentin wall makes the restoration more difficult, which can imply a poor prognosis for the restored tooth regarding its' long-term functionality[4,5].

In general, these teeth with poor restorability are considered and evaluated for removal and a more predictable prognosis like a fixed or removeable prosthesis is recommended for adult patients. However, in childhood and adolescent age patients, the treatment for these flared roots becomes more complicated and challenging. When teeth with flared roots are removed, some possible treatment options are offered to the young patients by the clinicians. For example, a dental flipper or a removable partial denture can be used to replace the missing tooth to meet the minimum esthetics and functions, which is an easy and economical way. However, the removable appliance is uncomfortable and should be relined or replaced occasionally following the patient's growth.

A 3-unit bridge could be another option, which is more comfortable for patients and provides certain functions in terms of esthetics and functions. Since the pulp tissue is relatively

large in young patients, a provisional bridge with under preparation of adjacent teeth is usually recommended to reduce the risk of pulp damage of the abutment teeth. Another alternative is, instead of a gross reduction for abutments, using an adhesive bridge to restore missing teeth with minimum tooth preparations. From the pro side, the minimum preparation ensures pulp vitality of abutment teeth. While on the con side, adhesive bridges are considered as semi-permanent restorations, and bridge loosening with secondary decay is not uncommon. Further, the clinical crown is relatively short in young patients, which could therefore hinder bridge retention and/or hygiene maintenance. Moreover, in recent years the patient's perceptions may change and lead to a greater demand for preservation of sound abutment tooth structure, which makes the treatment of flared roots more challenging.

Most of the time, an implant restoration is not an option for young patient, as early implant placement can stunt the growth of the surrounding teeth and jawbones, which could result in serious issues down the line. Therefore, the development of the patient should be carefully evaluated before any implant can be inserted, regardless of the general guidelines which suggest that female teenagers must be at least 15 years of age and male teenagers must be at least 17 years of age to receive dental implants[6,7]. To complement the implant replacement for the weakened tooth till the completeness of jawbone growth, how to restore the compromised flared root of anterior tooth becomes an important issue. Thus, this case report aims to propose an option for the treatment of an upper anterior weakened tooth using fiber posts with composite crown restorations, to discuss the important clinical steps involved in the success of this protocol, to report a case with 16 years of long-term follow-up, and to address the considerations in the treatment of flared anterior tooth.

Case report

The 11-year-old male student presented with a chief complaint of an ill-fitting Nance appliance in the mouth, which was inserted by his orthodontist 2 years ago in order to serve as a space maintainer to prevent upper molars from drifting forward (Fig. 1A). Clinical examination revealed that besides the presence of the appliance, upper right central incisor (tooth 11 in the FDI numbering system) was previously prepared and restored with a denture tooth. Apical radiograph showed that 11 had a previous root canal treatment, but the quality of root filling was quite poor, and a periapical radiolucency was noted (Fig. 1B). The denture tooth of 11 was utilized and assumed to protect the fractured tooth which might be caused by a traumatic injury when the patient was 9 years old.

The mission of the Nance appliance was considered accomplished as all the teeth in front of the first molars were in a good position, therefore the appliance was detached. The provisional crown of 11 was removed and the tooth was thoroughly evaluated. The tooth was sensitive to palpation and percussion but probing depths were within normal limits. The remaining clinical crown height was less than 2 mm at the labial side (Fig. 1C). While at the palatal side, marginal caries underneath the provisional crown was noted, and no coronal dentin existed (Fig. 2A). After removal of the carious dentin, the tooth ended up with a flared canal with a rather thin dentin wall surrounding it. The restorability of the tooth with conventional treatment for endodontically treated tooth was questioned since the remaining structure could not provide sufficient ferrule to protect the tooth.

The three-unit bridge or implant crown to replace 11 was also not suggested, because pulp size in the adjacent abutments was large, the patient was young, and the jawbone was still growing. Further, the patient preferred keeping the adjacent teeth intact, therefore the semi-permanent adhesive bridge was not acceptable. The treatment plan of using a removable partial denture to replace 11 was considered but not approved. Because the patient felt wearing a removable flipper was uncomfortable and inconvenient. Moreover, the edentulous ridge resorption under denture might complicate the consequent implant treatment, if the removal of the root is too early before jawbones are well developed for implant therapy. To keep the tooth in function as long as possible and to avoid early extraction of the tooth, the patient accepted the treatment plan of directly restoring the weakened tooth with fiber posts and composite crown restoration.

The tooth 11 was endodontically retreated under a modified rubber dam technique to isolate the operative field. At the follow-up appointment two weeks later, it was noted that the tooth sensitivity to palpation and percussion was remitted (Fig. 2B). During the following visit, No. 4 Gates-

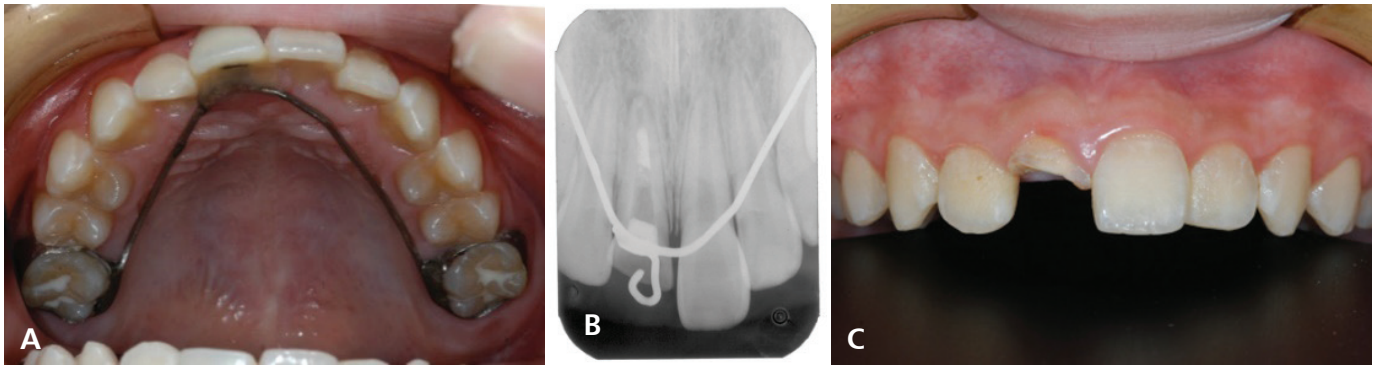

Figure 1. Initial visit.
(a) Nance appliance in the mouth.
(b) Radiograph showing apical rarefaction.
(c) short remaining tooth after crown removal.

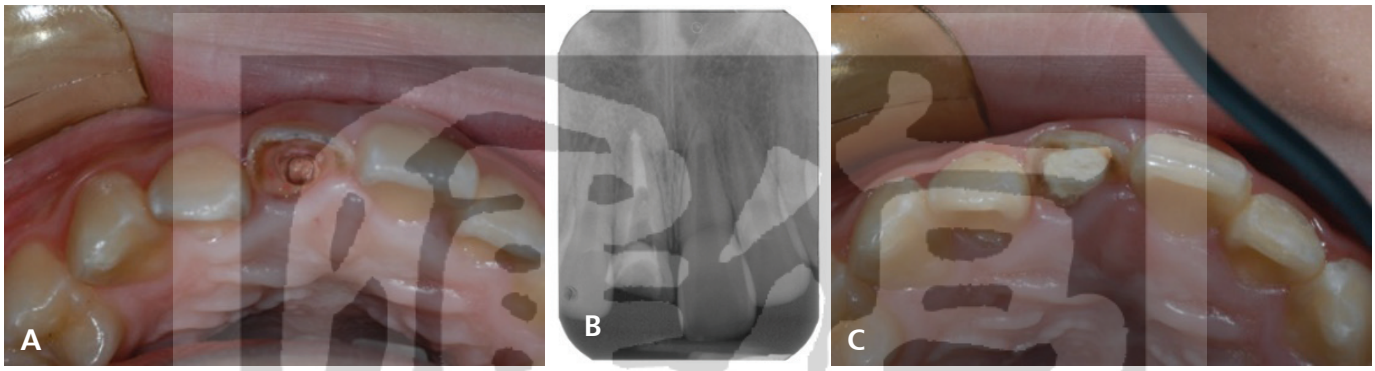

Figure 2. Endodontic retreatment.
(a) Large pulp chamber after instrumentation.
(b) Radiograph showing flared root canal.
(c) Thin dentin walls with poor ferrule.

Glidden drills (Maillefer, Ballaigues, Switzerland) were used for gutta-percha (GP) removal of the root canal until 5 mm of GP was left, then a series of fiber posts were checked for adaptation inside the root canal. Due to a mismatch between the post and the flared root canal space, modification of post fabrication was indicated. For this purpose, the number and sequence of fiber posts try-in was carefully evaluated.

Thereafter, the deep margin elevation protocol was conducted to isolate the subgingival palatal margin[8-10], followed by immediate dentin sealing and coronal elevation of the deep margin to a supragingival position using a direct bonded composite resin base. A curved Tofflemire matrix was modified by reducing matrix height to 2-3 mm at the palatal side for better matrix adaptation. Since the narrowed matrix will allow itself to slide into the subgingival sulcus easier and seal the margin more efficiently. The ideal matrix height was further adjusted to slightly higher than the desired elevation for better visibility of the subgingival margin. Prior to bonding, a Teflon strip was rolled and placed to improve deep isolation and reveal the true limits of the cavity, the margin was gently re-prepared using a fine diamond bur on a low-speed electric handpiece. The canal wall was also retouched since the freshly cut dentin is ideal for bonding. Following the manufacturer's instruction, the root canal and remaining dentin was conditioned, primed and bonded using the Optibond FL adhesive system (Kerr, Orange, CA, USA) in the presence of the matrix. Then, a flowable composite (Filtek Supreme XT, 3M ESPE, St. Paul, MN) was placed to get a better adaptation of margin, following by Z100 composite (3M ESPE) to build up a palatal wall for elevating the margin supragingivally.

Three fiber posts (RelyX size 1 tapered post, 3M ESPE) were placed into the flared root canal, to obtain better support for composite crown restoration (Figs. 3A & 3B). The lengths of fiber posts were reduced to allow at least 1 mm veneer space for the composite resin. The posts were cemented into the canal with a dual-cured resin cement (Nexus 2, Kerr) in apical third, and light-cured for 20 s. The remaining canal space was filled with flowable resin (Filtek Supreme XT),

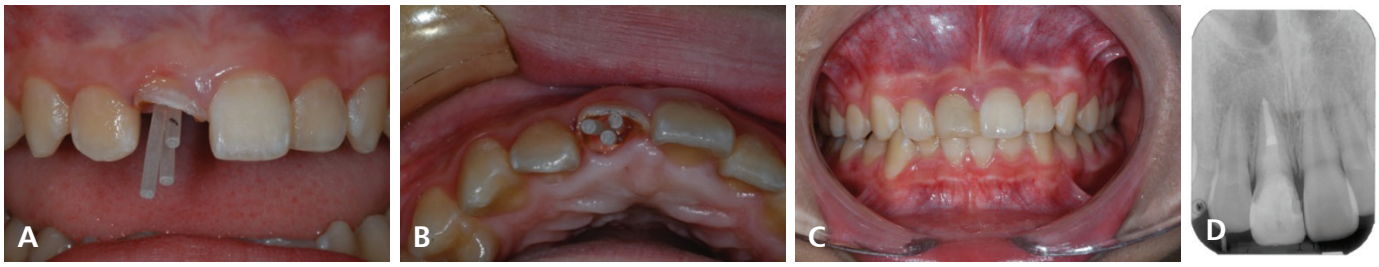

Figure 3. Post insertion and composite crown resonation.
(a) Try-in of three fiber posts.
(b) Occlusal view showing post position deep palatal wall.
(c) Crown build-up with composite resin.
(d) Radiograph showing smooth proximal walls.

Figure 4. Six years of follow-up.
(a) Generalized gingivitis with labial external stain of 11.
(b) Radiograph showing normal healthy apical tissue.
(c) One week after full mouth scaling and resin repair of 11.
(d) Close-up view of 11 after resin repair.

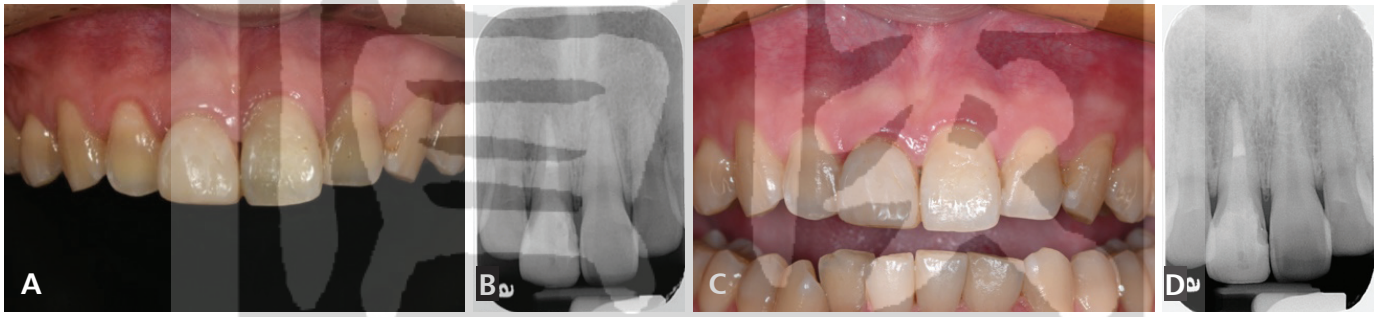

Figure 5. Twelve and sixteen years of follow-ups.
(a) Twelve years of follow-up of 11.
(b) Radiograph showing normal healthy apical tissue and alveolar bone.
(c) Sixteen years of follow-up of 11.
(d) Radiograph showing normal healthy apical tissue and alveolar bone.

and the crown portion was finished directly with regular composite (Z-100) incrementally. After completeness of crown build-up, a sharp explorer and interdental flossing were used to check for the absence of overhangs and flash (Fig. 3C). Further, an apical radiograph was taken to ensure that no excesses or gaps were present (Fig. 3D). Static and dynamic occlusions were checked to confirm that 11 was not subjected to occlusal force alone. At the end of the visit, the importance of avoiding biting on hard foods with this tooth and keeping good oral hygiene were addressed.

The tooth was functional and esthetically accepted by the patient, and had been scheduled for regular follow-up every year. At 6 years of follow-up, the young male student presented with a dark, unpleasant stain at 11 labial surface and generalized gingivitis, which could be due his neglecting dental hygiene when he was under heavy pressure from his schoolwork (Fig. 4A). Luckily, the apical film of 11 showed smooth proximal contours with normal apical tissue and periodontal bone profile (Fig. 4B). The patient received full-mouth ultrasonic scaling with intensive oral hygiene instruction, and 1 week later he had a composite resin replacement on 11 labial surface (Figs. 4C & 4D). From then to now, the 16 years of follow-up, the tooth 11 was still functional and

maintainable. Radiographic evaluation did not reveal any periapical and periodontal changes. The patient was satisfied with the treatment outcome, and had plenty of time to decide when and what types of restoration he wishes to use to replace the weakened tooth.

Discussion

The longevity of the presented flared tooth was beyond common expectations. During the 16 years of follow-up, the preservation of alveolar bone around the tooth had achieved the intended goal, and the tooth was still in function. The success of the treatment could be due to delicate procedures in restoring the tooth and regular follow-up for comprehensive maintenance. The regular maintenances focused on oral hygiene, soft tissue condition, initial or secondary caries, marginal integrity and especially occlusal prematurity. Usually, a follow-up apical radiograph is a routine to evaluate periodontal and periapical conditions. In restoring a flared incisor root, several concepts and related skills should be addressed, including preserving tooth structure, deep margin elevation, post selection and modification, adhesive approaches, and guided occlusion.

Decision making for a flared root

Treatment of an endodontically involved anterior tooth is really challenging for schoolchildren and their parents. In spite of a large pulp chamber, caries and trauma usually result in substantial loss of coronal tooth structure, which needs a post and core to retain the artificial crown. However, most of the time the remaining tooth structure is too weak to provide a good ferrule in these young patients. Although orthodontic extrusion and surgical crown lengthening procedures could be considered to partially solve the problems, the treatments cost time and money, and cause discomfort to patients. Further, it may compromise the crown and root ratio and result in unfavorable esthetic outcomes. What makes the matter worse is that these teeth usually combined with a flared root having rather thin dentin walls around the canal just like the presented case. Basically, the optimal treatment for the flared incisor root is to remove the weakened root and install an implant for the adult patient. However, implant treatment for growing children is contraindicated[11]. Therefore, the best treatment for this patient was to provide a provisional crown which is functional and esthetically acceptable, and more importantly, it should not only maintain the alveolar bone height but also not impede subsequent bone growth.

Preserving tooth structure

There is a consensus that the remaining tooth structure plays an important role in the survival of endodontically treated teeth[3,12]. Therefore, caries should be removed carefully, and remaining sound tooth structure should be kept as much as possible. Most of the time, healthy dentin and enamel are carelessly removed by air-driven turbines at high speed during caries removal. However, for the flared root remaining sound tooth structure is so precious that a high-torque electric handpiece at low speed is requested for precise caries removal. Because electric handpiece at low speed can provide a better tactile sensation in caries removal, which shall maximize preservation and conservation of remaining tooth structure.

Deep margin elevation

Subgingival margins were encountered at proximal and palatal surfaces of the case, which complicated the use of direct or indirect adhesive restorations. Because such cases cause significant challenges during isolation of the operatory field for adhesive bonding, impression taking, and adhesive luting. When these procedures are not properly executed, it can and may generate marginal leakage and thus affect the longevity of the restoration and the periodontal tissues. Clinically, there are two common approaches to handle deep subgingival caries[8]. One is Crown Lengthening procedure which relocates gingival margins apically by surgically removing supporting tissue and recreating the space necessary for deep restoration without violating biologic width. The other approach was suggested by Dietschi and Spreafico[10] for deep caries by relocating the restoration margin coronally, instead of relocating gingival margin apically by crown lengthening procedure. This procedure was named as deep margin elevation (DME) by Magne and Spreafico[9], which is based on the ability to get proper isolation after carious tissue removal, immediate dentin sealing (IDS)[13-15], and the bonding of several layers of composite onto the deep margin to create a new, more coronal restoration margin. In addition, a well-adapted matrix is indicated for building-up the subgingival restoration with an adequate emergence profile[9]. Thereafter, the indirect

restoration can be prepared and cemented on top of the elevated margin.

According to previous references, DME was considered a feasible noninvasive alternative to crown lengthening, which also facilitate the placement of large direct composite resin restorations. To reduce polymerization shrinkage stresses, incremental filling technique and compensatory techniques are commonly suggested. The later includes building up large restoration with various composite layering systems, incorporation of a composite resin or ceramic insert, or application of a glass-ionomer base, to minimize the stresses developed in adhesive interfaces. Frankly, the marginal seal is the prerequisite for DME[8-10]. Another concern is the long-term biocompatibility of restorative resin. Information on the gingival reaction to subgingival restoration is very controversial[16-18]. Some studies have shown a higher plaque index around composites compared to a healthy enamel surface, while others showed no significant differences in term of plaque accumulation and gingivitis. In general, resin materials seem to be tolerable subgingivally, if the restoration is carefully finished and polished, and plaque control is well taken of[18-20]. However, the presented patient did not take great care of his oral hygiene and it lead to gingivitis frequently but did not violate periodontal attachment, which might be inferred that gingival response to biofilm may vary between individuals[18,20].

Fiber post modification

Because of the improved physical properties and adhesion to root canal dentin, composite resin materials alone have been used for posts and cores if the teeth have a great amount of remaining tooth structure[3]. However, for teeth with a flared root and a weakened coronal structure, studies had shown that the post and core that were exclusively restored through the resin composite lacked sufficient strength[21-23]. For many years, cast metal posts and cores were regarded as the main option for the rehabilitation of endodontically treated teeth with flared roots. Because these customized metal posts provide a good fit to the canal wall, thus providing high retention with a thin cement layer[24]. However, because of the high elastic modulus and stiffness in comparison to tooth, metal posts potentially lead to catastrophic root fracture[25-27]. Furthermore, the wedging force from cast posts and cores would impose serious impacts on the weakened coronal portion. The risk is even higher for the flared root, since it has a stronger post and a weaker root having limited remaining dentin[28]. Considering stress distribution and incidence of catastrophic root fracture, fiber posts with a similar elastic modulus to dentin are highly recommended. Further, fiber posts could provide better optical translucency feature by the combined use of a resin core. However, the mismatch of the prefabricated fiber posts and flared root canals should be carefully justified. Merely luting fiber post with resin cement is not suggested, the strength of the cement can be questioned, moreover, the excessively thick cement favoring polymerization shrinkage and formation of bubbles which could thus weaken the restoration[4,29,30].

Up to date, several ways to fill the voids between the prefabricated fiber post and the flared root canal can be approached. Some authors suggested to reline the fiber post with composite resin to create an individual anatomic post, and/or fill in with accessory glass fiber posts to reduce the amount of cement[2,21,31-33]. However, Kubo et al[21] found that the use of a prefabricated glass fiber post in the center of the post space was ineffective in strengthening the composite resin post and core, while the use of glass fiber ribbon outside of the post space could provide stronger strength[21]. The elastic behavior of fiber posts is considered to benefit the stress distribution, however, too much flexibility could also generate higher cyclic bending during function, which could induce micro-gaps in crown/post/root interfaces. The similar finding of strengthening fiber posts was reported, where a fiber sleeve was used[34]. In this case, accessary fiber posts instead of fiber ribbon or sleeve were used for the reinforcement of the composite resin post and core.

Adhesive approaches

Fiber posts reinforced with ribbon, sleeve, or accessary posts could be done by relining with composite resin to form anatomical posts easily. Although the anatomical customization of the fiber post showed a more uniform cement layer[24], the customization procedure included the application of a water-soluble gel into the root canal to serve as a separating agent during relining, which could impede adhesive bonding if the gel was not completely removed. Further, root canal walls sometimes are over-prepared to remove undercuts to facilitate the relining procedure, which not only weakens the tooth

structure but also reduces the bonding potential.

It is crucial to get good and lasting bonding between the dentin, posts, and composite. During the cementation of fiber post, the compatibility between the luting agent and the adhesive system is important. In our case, the three-step Optibond FL adhesive was applied into a freshly-prepared root canal and coronal dentin, then light-cured to create optimal bonding. Based on the IDS concept, three fiber posts were cemented by the dual-cured cement at apical third, then glued together by injecting a light-cured flowable composite resin into the root canal directly. The light-cured resin system has a higher degree of conversion, comparing to the dual-cured system if light irradiation is sufficient. It is agreed that a polymer with a higher degree of conversion shall benefit the physical property and biocompatibility. Accordingly, flowable resins with good translucency are suggested. However, in this procedure, some issues need to be justified that injecting resin should not induce voids into the canal, and the thickness of light-cured flowable resin should keep within its curing depth suggested by the manufacturer[21].

Areas that need improvement

The treatment procedures of the presented case can be more efficient if the caries removal could be operated under a microscope or with adjunctive caries staining solution to keep sound tooth structure as much as possible. Further, an indirect resin veneer or customized index could enhance the labial profile which not only dominates the esthetic appearance but also provides adequate support for marginal gingiva[35,36]. The overcontoured profile of a restoration at the subgingival zone might cause gingival recession, while an undercontoured profile does not support marginal gingiva optimally, and thus the gingiva tends to form a roll around the tooth and is slightly inflamed as seen in this case. When the patient presented at the first visit, the tooth was not fully erupted and with a mesial-in rotation, which biased the judgment of the subgingival contour of the restoration. Fortunately, the mild gingival inflammation did not cause any periodontal bone loss during the 16 years of follow-up. On the contrary, the undercontoured profile of the restoration lead to a coronal shift of the gingival line in comparison with the adjacent teeth, which could be easily corrected when the patient requests a new provisional or definitive prosthesis. Another shortcoming of treatment was that the patient did not consistently maintain and take good care of his oral hygiene, which worsened the gingival inflammation.

Conclusion

The clinical challenges associated with the treatment of flared roots are not uncommon. Facing all compromised situations, a risk-benefit analysis must be done to determine whether procedures attempting to restore the tooth, even just for temporary use, will prolong the function of the tooth without sacrificing the alveolar bone which is the indispensable foundation for future implantation. A functional and tolerable temporary restoration of the flared root is even more important for the growing patient since it will buy time until an implant can be placed. The success of this 16 years of follow-up case was only possible with the application of optimal and reliable adhesion, followed by the installation of modified fiber posts to strengthen crown restoration. It should be emphasized that there is no consensus regarding the preferred type of post systems to reinforce crown restoration[37]. However, preserving tooth structure, immediate dentine sealing, deep margin elevation, post modification, adhesive approaches, and guided occlusion seem to take their roles in contributing to the success of this case. Meanwhile, it should be noticed that the presented treatment protocol is not a panacea for all the flared root cases, especially for patients with deep bite, lost posterior support, clenching, bruxism, or poor oral hygiene.

Acknowledgement and disclosure

The authors declare that they do not have any financial interest in the companies whose materials are included in this article.

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Introduction for authors

Types of article

All works related to basic or clinical prosthodontics, temporomandibular joints or masticatory function, dental implants, and technical science of dental prosthodontics are the objects of publication. There are five types of accepted manuscripts, please indicate the type of manuscript.

- Review article
- Original article
- Technical report
- Case report
- Letters to the Editor

General Format guide

- Articles must not have been published or will be accepted for publication in other journals.
- Please write your text in good English (American or British usage is accepted, but not a mixture of these) , and the content of the article is typed in double spacing, with font size 12 and above, with at least 2.5 cm margin on each side, and without any formatting.
- The total number of pages of the full text (including abstract, figures, tables, and references) is limited to eight pages, and can be extended to twelve pages if necessary.
- Please use electronic documents to submit manuscripts. IBM-Microsoft Word is recommended as the word processing program. The program used, the title of the manuscript, and the name of the first author must be marked. The electronic file should be emailed to: prosthor@ms48.hinet.net.
- Please also include a short letter to the Editor-in-Chief of the Journal stating that you would like to contribute to the Journal and stating that all authors have read and signed the consent form. If the research involves the use of human subjects, the manuscript must be accompanied by the consent of the appropriate institutional review board or ethics committee.

Review Articles Format Guide

These should aim to provide the reader with a balanced overview of an important and topical issue in prosthodontic field. They should cover aspects of a topic in which scientific consensus exists as well as aspects that remain controversial and are the subject of ongoing scientific research. All articles or data sources should be selected systematically for inclusion in the review and critically evaluated.

- Abstract: required, up to 400 words, unstructured (i.e., no subheadings)
- Keywords: up to 10
- Word limit: 3500 words
- References: up to 100
- Tables/Figures: 1 maximum

Original Articles Format Guide

Section headings should be: Abstract, Introduction, Materials and methods, Results, Discussion, Conclusion Conflicts of Interest Statement, Acknowledgments (if any), and References.

(1) ***The Introduction*** should provide a brief background to the subject of the paper, explain the importance of the study, and state a precise study question or purpose.

(2) ***The Materials and methods*** section should describe the study design and methods (including the study setting and dates, patients/participants with inclusion and exclusion criteria, patient samples or animal specimens used, the essential features of any interventions, the main outcome measures, the laboratory methods followed, or data sources and how these were selected for the study), and state the statistical procedures employed in the research.

(3) ***The Results*** section should comprise the study results presented in a logical sequence, supplemented by tables and/or figures. Take care that the text does not repeat data that are presented in tables and/or figures. Only emphasize and summarize the essential features of the main outcome measures, and the main results.

(4) ***The Discussion*** section should be used to emphasize the new and important aspects of the study, placing the results in context with published literature, the implications of the findings.

(5) The conclusion that follows from the study results.

- Abstract: required, up to 400 words
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Technique Reports/ Case Reports Format Guide

These are short discussions of a case / case series/ technique report with unique features not previously described that make an important teaching point or scientific observation. They may describe novel techniques or use of equipment, or new information on diseases of importance. Section headings should be: Abstract, Introduction, Case Report, Discussion, Conflicts of Interest Statement (if any), Acknowledgments (if any), and References.

Case reports should have no more than 6 authors. The maximum length is 2000 words, and the number of references should not exceed 10.

Letters to the Editor Format Guide

Brief letters of constructive comments in response to previously published JDS articles are welcome. Ensure that the corresponding author's mailing and e-mail addresses are included. Letters are edited, sometimes extensively, to sharpen their focus. They may be sent for peer review at the discretion of JDS Editors. Letters are selected based on clarity, significance, and space.

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Text should be typed double-spaced on one side of white A4 (297 × 210 mm) paper, with outer margins of 2.5 cm. A manuscript should include a title page, abstract, text, references, conflicts of interest statement (if any), acknowledgments (if any), and figures and tables as appropriate. Each section of the manuscript should begin on a new page. Pages should be numbered consecutively, beginning with the title page.

The detailed specifications of the manuscript content are as follows:

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The title page should contain the following information (in order, from the top to bottom of the page): article category article title names (spelled out in full) of all authors*, and the institutions with which they are affiliated†; indicate all affiliations with a superscripted lowercase letter after the author's name and in front of the matching affiliation corresponding author details (name, e-mail, mailing address, telephone and fax numbers). A running title must be within 40 characters. Please provide the detailed information of the corresponding author (name and address in English, telephone and fax numbers, email address).

➢ ***Abstract and keywords***

An abstract (no longer than 400 words) and relevant keywords (limited to 5) are required.

(1) Abstracts for **Review Articles, Case Reports and Technique report** should be *unstructured (in one single paragraph with no section headings),* and include information on the background/purpose of the report, methods, results (or case report), and conclusions.

(2) Abstracts for **Original Articles** should be structured into the following sections. **Aims:** briefly explain the importance of the study topic and state a precise study question or purpose. **Materials and Methods:** briefly introduce the methods used to perform the study; include information on the study design, setting, subjects, interventions, outcome measures and analyses as appropriate. **Results:** briefly present the significant results, with data and statistical details such as p values where appropriate; be sure that information in the abstract matches that in the main text. **Conclusion:** state the meaning of your findings, being careful to address the study question directly and to confine your conclusions to aspects covered in the abstract; give equal emphasis to positive and negative findings.

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(1) **Review article:** Review articles should be unstructured (no fixed format).

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- Introduction: Briefly explain the origin of the research.
- Materials and methods: Describe the research design, objects, and procedures.
- Results: The results are expressed in words, tables or illustrations.
- Discussion: Emphasize important results and arguments, and compare with previous studies.
- Conclusion: The conclusion should be concise and clear.
- Conflicts of interest statement
- Acknowledgments (if any)
- References

(3) **Technical report**

Sections for technical reports are Introduction, Methods, and Discussion, Conflicts of interest statement (if any), Acknowledgments (if any), and References. Each section should begin on a new page.

(4) **Case report**

Sections for case reports are Introduction, Case description, and Discussion, Conflicts of interest statement (if any), Acknowledgments (if any), and References. Each section should begin on a new page.

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Where a term/definition will be continually referred to, it must be written in full when it first appears in the text, followed by the subsequent abbreviation in parentheses. Thereafter, the abbreviation may be used. An abbreviation should not be first defined in any section heading; if an abbreviation has previously been defined in the text, then the abbreviation may be used in a subsequent section heading. Restrict the number of abbreviations to those that are absolutely necessary and ensure consistency of abbreviations throughout the article. Ensure that an abbreviation so defined does actually appear later in the text (excluding in figures/tables), otherwise, it should be deleted.

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Numbers that begin a sentence or those that are less than 10 should be spelled out using letters. Centuries and decades should be spelled out, e.g., the Eighties or nineteenth century. Laboratory parameters, time, temperature, length, area, mass, and volume should be expressed using digits.

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Système International (SI) units must be used, with the exception of blood pressure values which are to be reported in mmHg. Please use the metric system for the expression of length, area, mass, and volume. Temperatures are to be given in degrees Celsius.

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Use the Recommended International Nonproprietary Name (rINN) for medicinal substances, unless the specific trade name of a drug is directly relevant to the discussion. Generic drug names should appear in lowercase letters in the text. If a specific proprietary drug needs to be identified, the brand name may appear only once in the manuscript in parentheses following the generic name the first time the drug is mentioned in the text.

For devices and other products, the specific brand or trade name, the manufacturer and their location (city, state, country) should be provided the first time the device or product is mentioned in the text, for example, ""¡KSPSS version 11 was used (SPSS Inc., Chicago, IL, USA)"". Thereafter, the generic term (if appropriate) should be used.

➢ ***References***

References should be limited to those cited in the text and listed in numerical order (superscript). Please refer to Cumulated Index Medicus for the writing format. References should include, in order, all authors' names, article title, journal name, year, volume and inclusive page numbers.

Authors are responsible for the accuracy and completeness of their references and for correct in- text citation. If massive corrections to the references are found to be necessary in the event that your manuscript is accepted, JPI Editors reserve the right to rescind the accept decision and reject the article.

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Examples of the common reference types are provided below.

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- **Book chapter in book with editor and edition:** Moore BK, Avery DR. Dental materials. In: McDonald RE, Avery DR. Dentistry for child and adolescent. 6th ed., Mosby Co., St. Louis, 1994; pp349-72.
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- Illustrations should not be included in the main text or edited, but should be stored in a separate folder. Image files should be archived in JPG, EPS or TIF format and submitted electronically via e-mail.
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The title and detailed description of each table must be typed double-spaced on separate pages, and numbered in Arabic numerals.

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➢ ***Acknowledgments***

After the Conflicts of Interest Statement and/or Funding/Support Statement, general acknowledgments for consultations and statistical analyses should be listed concisely, including the names of the individuals who were directly involved. Consent should be obtained from those individuals before their names are listed in this section. Those acknowledged should not include secretarial, clerical or technical staff whose participation was limited to the performance of their normal duties.

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- Keywords (limited to 5) and a running title within 40 characters.
- Confirm that the format, content, and order of citation of all references are complete and correct.
- Confirm titles and footnotes for all tables, and detailed titles and descriptions for figures. Type them double-spaced on separate pages.
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