MEDICAL SCIENCE

To Cite:
Alqudaihi F, Al-Qudaihi W, Cook NB. Aesthetic and functional enhancement using anterior implant supported Cantilever Partial Fixed Dental Prostheses: A 5-year case report. *Medical Science* 2023; 27: e372ms3203
doi: https://doi.org/10.54905/dissi.v27i141.e372ms3203

Authors' Affiliation:
[1]Fatema Alqudaihi, BDS, AEGD, MSD, ABOD; Diplomate of the American Board of Operative Dentistry, Implant Dentistry Fellowship from Indiana University School of Dentistry, Indianapolis, IN, United States of America. Consultant Restorative Dentist with a subspeciality in Implant Dentistry, Head of Dental Professional Development at Al Khobar Health Network, First Health Cluster at Eastern Province, Ministry of Health, Kingdom of Saudi Arabia.
[2]Walla Al Qudaihi, BDS, MSD; Clinical training in Orthodontics and master's degree in dental science from Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia. Orthodontist, Riyadh Third Health Cluster, Ministry of Health, Kingdom of Saudi Arabia.
[3]Norman Blaine Cook, DDS, MSD, ABOD; Diplomate of the American Board of Operative Dentistry, Clinical Associate Professor and Director, Graduate Cariology and Operative Dentistry, Department of Cariology, Operative Dentistry and Dental Public Health, Division of Operative Dentistry, Indiana University School of Dentistry, Indianapolis, IN, United States of America.

[*]**Corresponding author**
Fatema Alqudaihi, BDS, AEGD, MSD, ABOD; Diplomate of the American Board of Operative Dentistry, Implant Dentistry Fellowship from Indiana University School of Dentistry, Indianapolis, IN, United States of America. Consultant Restorative Dentist with a subspeciality in Implant Dentistry, Head of Dental Professional Development at Al Khobar Health Network, First Health Cluster at Eastern Province, Ministry of Health, Kingdom of Saudi Arabia.
Email: fatema.sabri@hotmail.com

Peer-Review History
Received: 17 June 2023
Reviewed & Revised: 21/June/2023 to 23/October/2023
Accepted: 26 October 2023
Published: 3 November 2023

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

DISCOVERY
SCIENTIFIC SOCIETY

Aesthetic and functional enhancement using anterior implant supported Cantilever Partial Fixed Dental Prostheses: A 5-year case report

Fatema Alqudaihi[1*], **Walla Al Qudaihi**[2], **Norman Blaine Cook**[3]

ABSTRACT

Restoring two adjacent maxillary anterior teeth with implants remains challenging, especially with limited mesiodistal space. It can result in implants being positioned relatively close which may affect the final appearance of the surrounding soft tissues. Our clinical case study describes a treatment approach to restore bilateral congenitally missing maxillary canines and lateral incisors utilizing implant-supported cantilever prostheses to achieve good aesthetic and functional outcomes. After 5-year follow-up the case showed favorable results.

Keywords: Restoration, esthetic, smile, resin composite, dentistry.

1. INTRODUCTION

Restoring missing teeth in the anterior maxilla often poses a challenge for implant placement, especially when replacing two adjacent missing teeth. When restoring a single missing tooth with a dental implant, the bone levels of the adjacent teeth determine the tooth-implant papilla fill (Roccuzzo et al., 2018). However, with two adjacent implants, the distance between proximal contact and the interdental bone level determines the papilla fill (Ramanauskaite et al., 2018). A minimum distance of 1.5mm between the natural tooth (root) and the implant is recommended to maintain the interdental bone level and avoid bone resorption (Tarnow et al., 2000). Ensure a distance of 3-4 mm between two adjacent implants to form and maintain inter-implant papilla (Jung et al., 2018). In such situations, using a single implant supporting a 2-unit cantilever fixed dental prosthesis (PFDP) could be advantageous (Becker and Kaiser, 2000).

However, the success of a cantilever prosthesis with an implant is controversial due to limited data on the long-term survival of implants, marginal bone loss, and unequal distribution of masticatory load affecting the implant-bone interface (Roccuzzo et al., 2020; Rangert et al., 1995; Misch, 2014;

Buser et al., 1998). Meanwhile, mesial cantilever prostheses are more favorable than distal extensions as they induce minimal stress in the bone (Misch, 2014; Buser et al., 1998; English, 1993). As per a systematic review, the 5-year survival rates of the implant-supported partial fixed dental prostheses (PFDPs) with cantilever were high (91.9%) and comparable with non-cantilever prostheses (95.8%) (Zurdo et al., 2009). This clinical report describes treatment utilizing implant-supported short cantilever prostheses to replace congenitally missing maxillary canines and lateral incisors to achieve an aesthetic and functional outcome.

2. CASE REPORT

A 44-year-old female with no significant medical history reported to our dental clinic with a chief complaint of fractured and loose provisional maxillary anterior PFDPs (Figure 1). We reviewed her medical and dental records, made a full-mouth intraoral radiographic series and completed extra- and intraoral examination. Our patient's oral hygiene was fair, with generalized gingival redness, swelling, blunting of interdental papilla, and bleeding upon gentle probing of the maxillary anterior area with apparent facial gingival hypertrophy in the maxillary canine regions. Our patient had a history of congenitally missing maxillary lateral incisors and canines. Two single implants had been placed bilaterally in the maxillary canine sites six years previously. Gingival inflammation was evident on the facial aspect of the maxillary anterior area, along with loose, stained, and chipped 3-unit acrylic-based provisional PFDPs (canine implants to central incisors). Our patient was dissatisfied with the aesthetics of her teeth; however, she had not continued treatment due to financial issues.

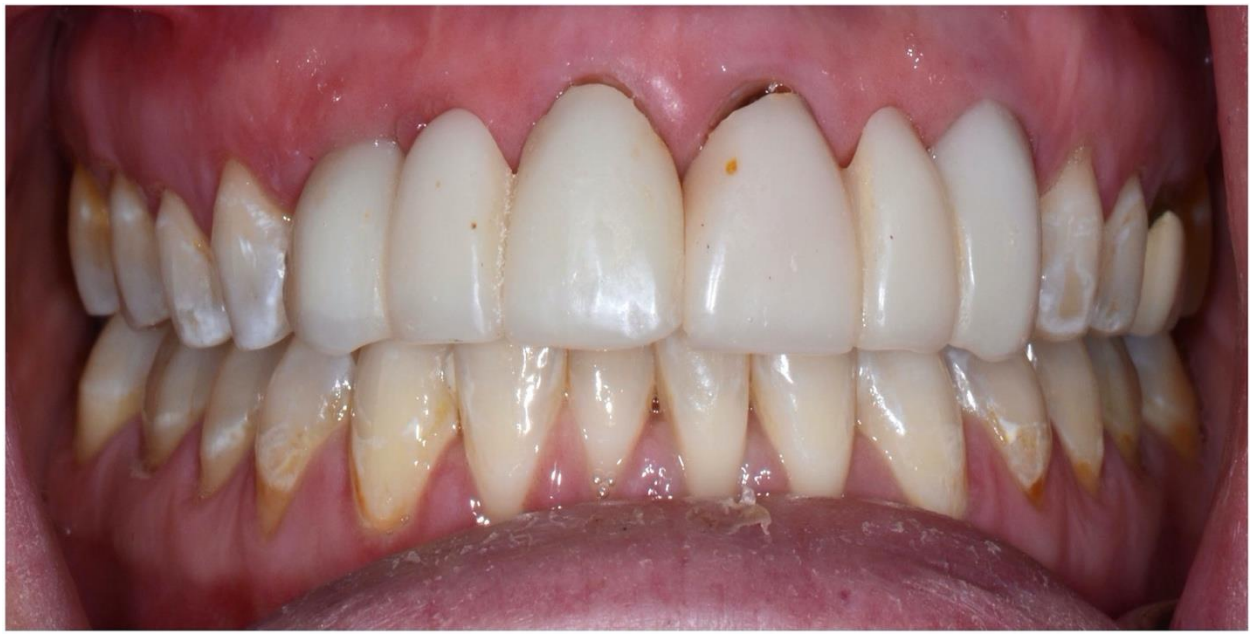
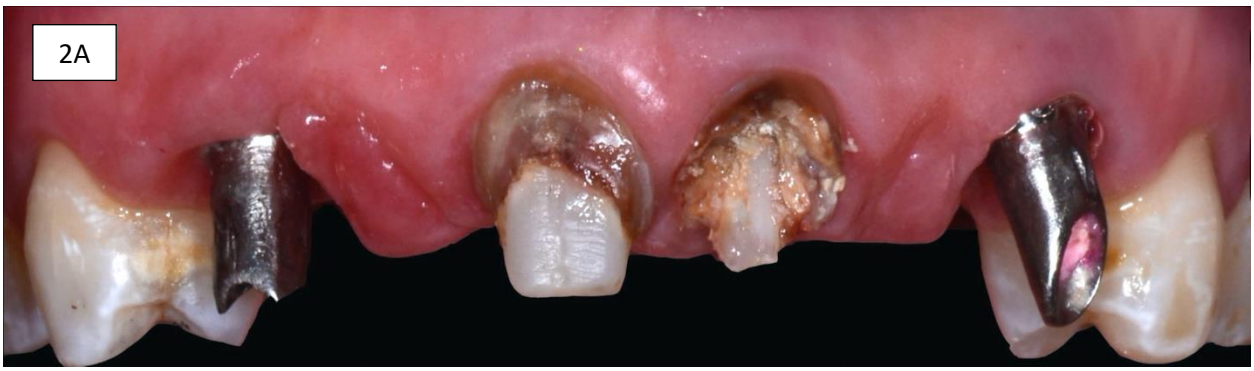


Figure 1 Pre-operative frontal view.

During the first visit, the provisional PFDPs were removed, and decay was detected on the maxillary right central incisor, along with a fractured post on the maxillary left central incisor (Figures 2A, 2B). Both maxillary central incisors were previously endodontically treated. We planned prefabricated non-metallic posts and resin composite cores for these teeth (Figure 3).



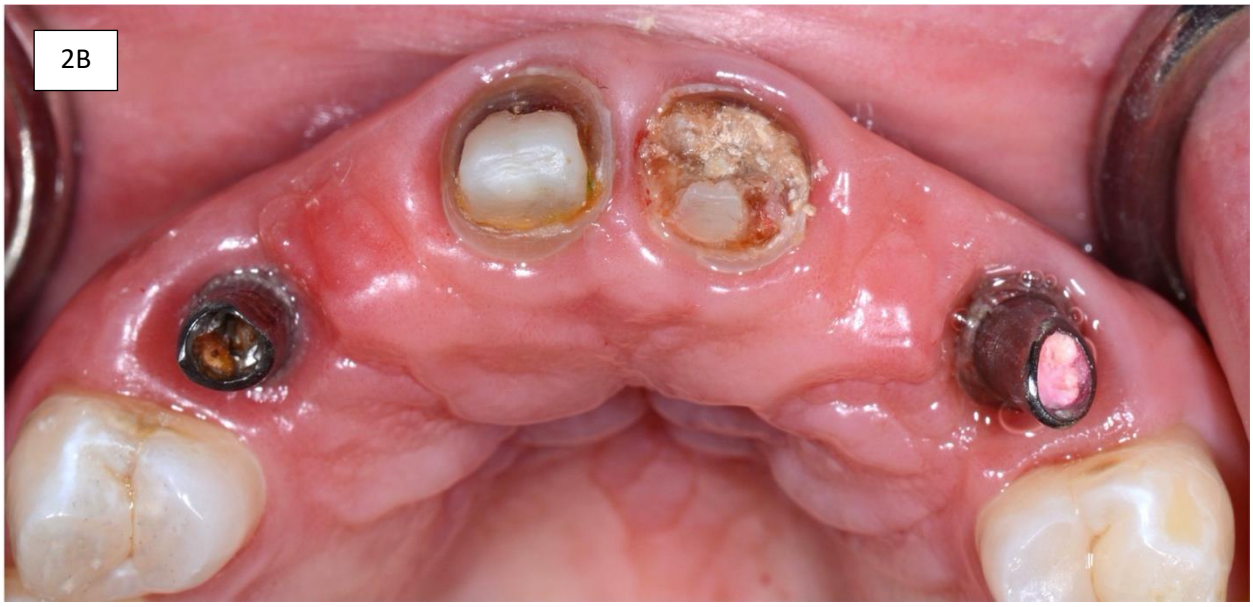


Figure 2 Maxillary anterior close-up view (Figure 2A) and occlusal view (Figure 2B) after removing the provisional PFDPs.

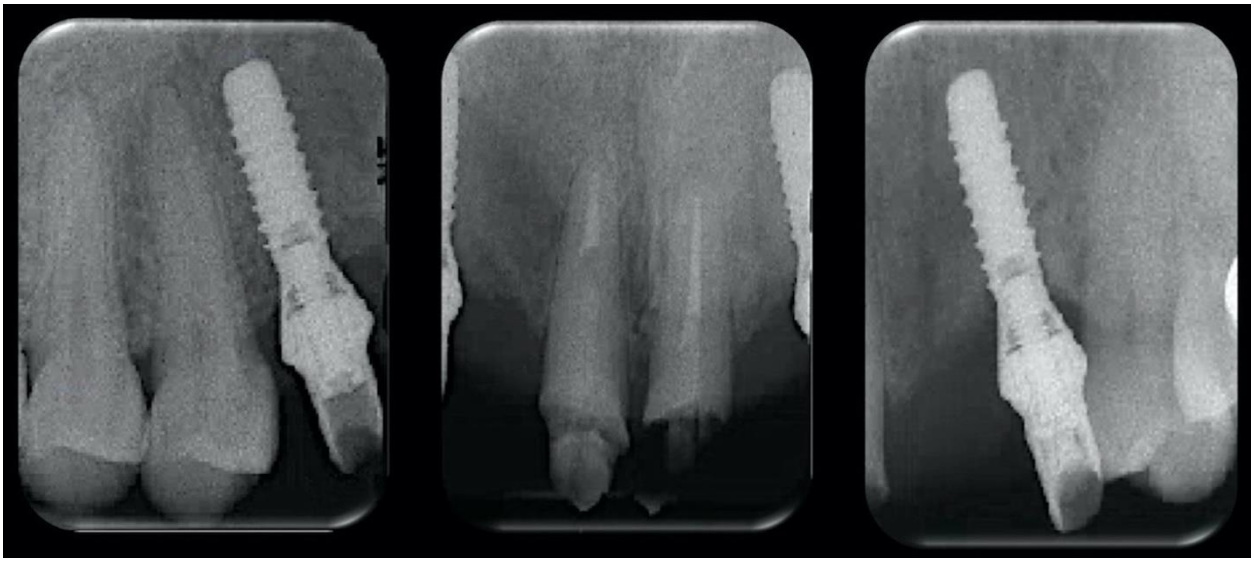


Figure 3 Pre-operative periapical radiographs.

We removed and cleaned the stock abutments from the existing implants and identified the implants as SLActive Standard Plus RN 4.1×14 mm (Straumann USA LLC) from radiographs. We confirmed implant identity with new radiographs made when checking the fit of implant impression posts. We reseated the original implant abutments onto the implants and torqued to 15 N/cm2, and then made preliminary impressions using irreversible hydrocolloid (Accu-Dent System 1; Ivoclar Vivadent AG). Provisional PFDPs were recemented with Temp Bond (Kerr, Orange, CA, USA). We mounted diagnostic casts on a semi-adjustable articulator (Whip Mix series 2240Q) using a quick-mount indirect facebow (Whip Mix) and centric relation record, and then completed a diagnostic wax-up. Afterward, we duplicated the maxillary cast with the diagnostic wax-up and fabricated a thermoplastic polyethylene mold using a vacuum former machine.

At the second visit, we removed the broken post from the maxillary left central incisor, evaluated the endodontic apical seal, prepared a post-space 7.5 mm in length while maintaining 5.5 mm of gutta-percha seal apically, and cemented a fiber post of 1.14 mm diameter (ParaPost Fiber Lux; Coltene/Whaledent Inc.) using resin cement (RelyX Unicem 2 Clicker; 3M ESPE). We excavated the decay from the maxillary right central incisor; then the remaining resin composite was air-abraded using 50μ aluminum oxide particles (MicroEtcher TM II Intraoral Sandblaster; Danville Materials). We etched the maxillary central incisors with 37.5% phosphoric acid for 15 seconds, rinsed thoroughly with water, and lightly dried. Then we applied bonding agent (Optibond Solo Plus; Kerr) for 15 seconds using a micro brush, air-dried for 3 seconds, and light polymerized for 20 seconds. We then completed

resin core build-ups with resin composite (shade A2) placed incrementally (Premise; Kerr). Every 2 mm increment was light polymerized for 40 seconds.

Next, we prepared the central incisors for single-unit porcelain fused metal (PFM) crowns and placed polytetrafluoroethylene (Teflon) tape in the screw-access channels covering the retention screws of the implant abutments. We created provisional restorations based on the diagnostic wax-up by filling the previously fabricated polyethylene stent with auto-polymerizing bisacryl resin (Protemp™ Plus; 3M ESPE) and seating over the prepared teeth and implant abutments. Once set, we removed the provisional restorations and adjusted, finished, and polished them. We cemented the provisional restorations using Temp Bond (Kerr). We ensured the restorations followed the existing soft tissue form as desired by the patient. The patient returned after two weeks and confirmed her satisfaction with the current restorations. We made a new maxillary irreversible hydrocolloid impression of the provisional prostheses and poured it in stone; the resulting cast acting as a guide to the dental laboratory for definitive prostheses fabrication.

We removed the provisional prostheses and cleaned the prepared teeth using a disposable prophylaxis polishing cup and pumice flour. Using a two-cord technique, we placed retraction cords in the gingival sulcus of the central incisors. We removed the stock abutments from implants 6 and 11, and attached impression copings. We made a definitive impression using an open tray full-arch technique using light and heavy body vinyl polysiloxane (VPS) impression material (3M ESPE) and sent the case to the dental laboratory. We requested individual PFM crowns for the maxillary central incisors, custom titanium implant abutments for implants 6 and 11, and cement-retained implant-supported 2-unit PFM cantilever PFDPs with modified ridge-lap pontics extending from implants 6 and 11 replacing the lateral incisors 7 and 10, respectively (Figure 4).

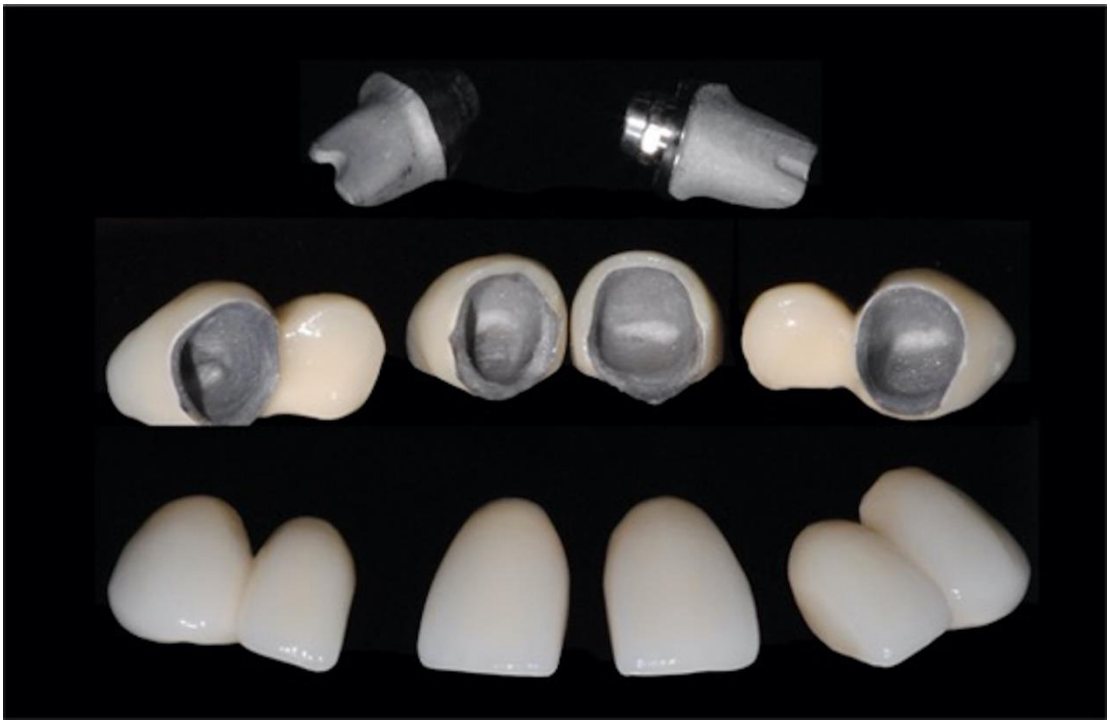


Figure 4 Extra-oral view of the definitive prosthesis.

At the delivery visit, we removed the provisional restorations and cleaned teeth 8 and 9 with a pumice slurry. We seated custom abutments on implants 6 and 11 and hand-tightened the retaining screws; then tried in and adjusted the PFM crowns and the cantilever prostheses. We torqued implant abutment screws to 35 N/cm2 per manufacturer instructions, then covered the screw heads with Teflon tape. We filled the remaining space in the access channels of the custom abutments with light-body VPS material (Figure 5).

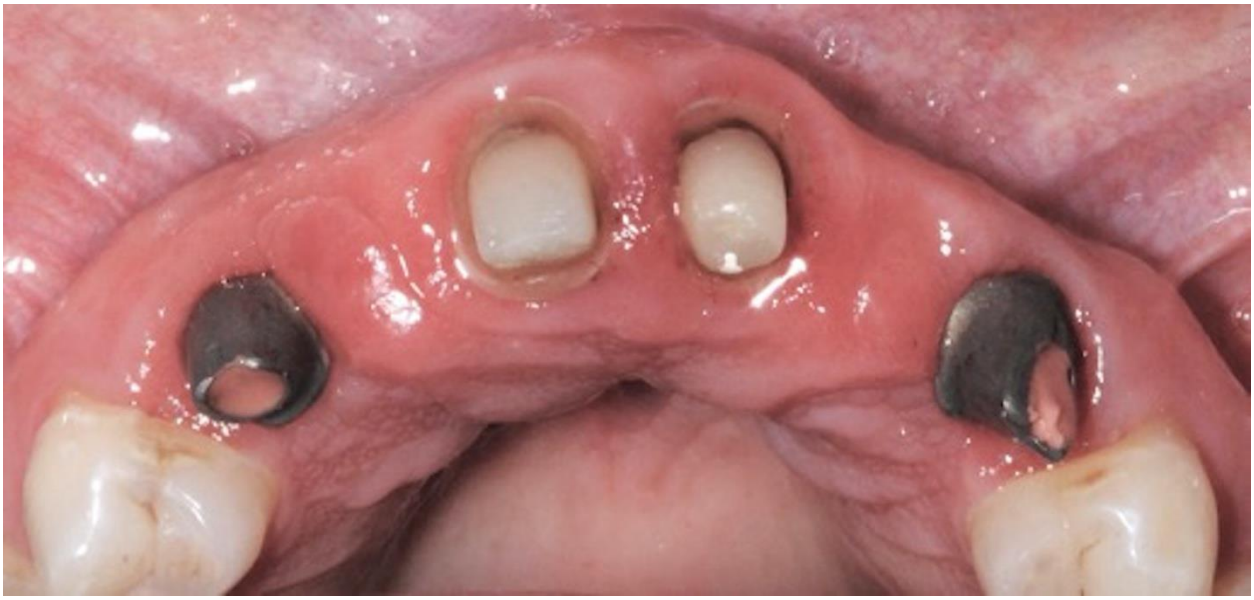


Figure 5 Occlusal view of maxillary central incisors buildups and placing custom implant abutments.

We lightly coated the intaglio surfaces of the PFM crowns and prosthesis abutments with glass ionomer luting cement (Ketac Cem; 3M ESPE), seated the restorations and held them in place for 5 minutes, and then cleaned away the excess cement (Figure 6). We recalled the patient after six months. The patient reported no complications (Figure 7), and we observed a decrease in gingival inflammation and hypertrophy that was initially present on the facial aspect of implant #6.

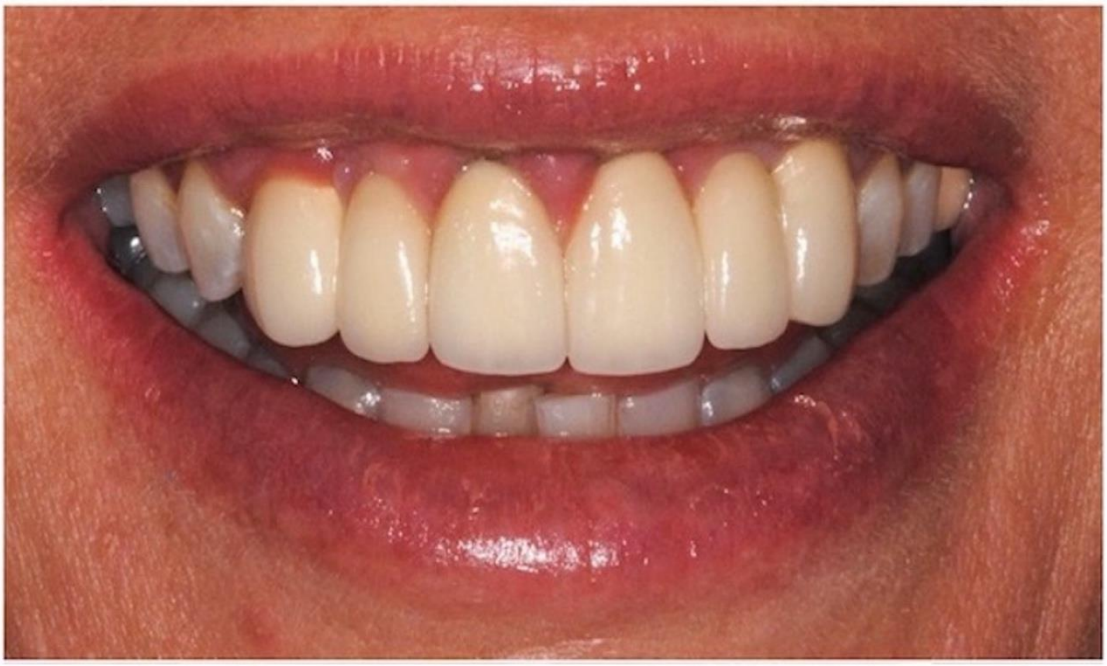


Figure 6 Post-cementation smile view.

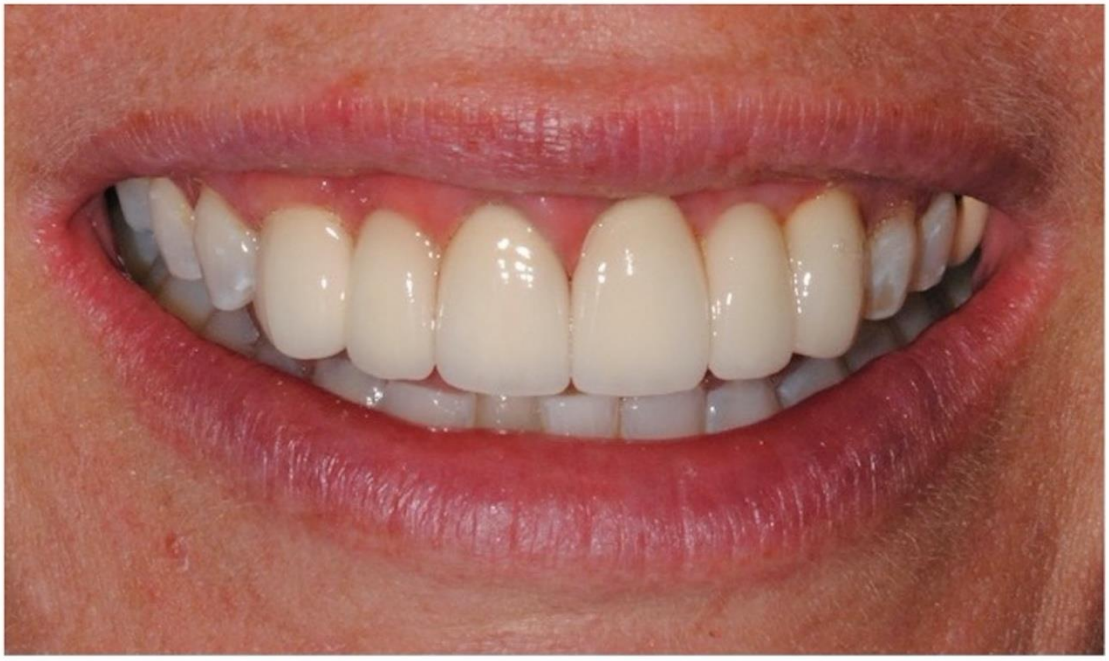
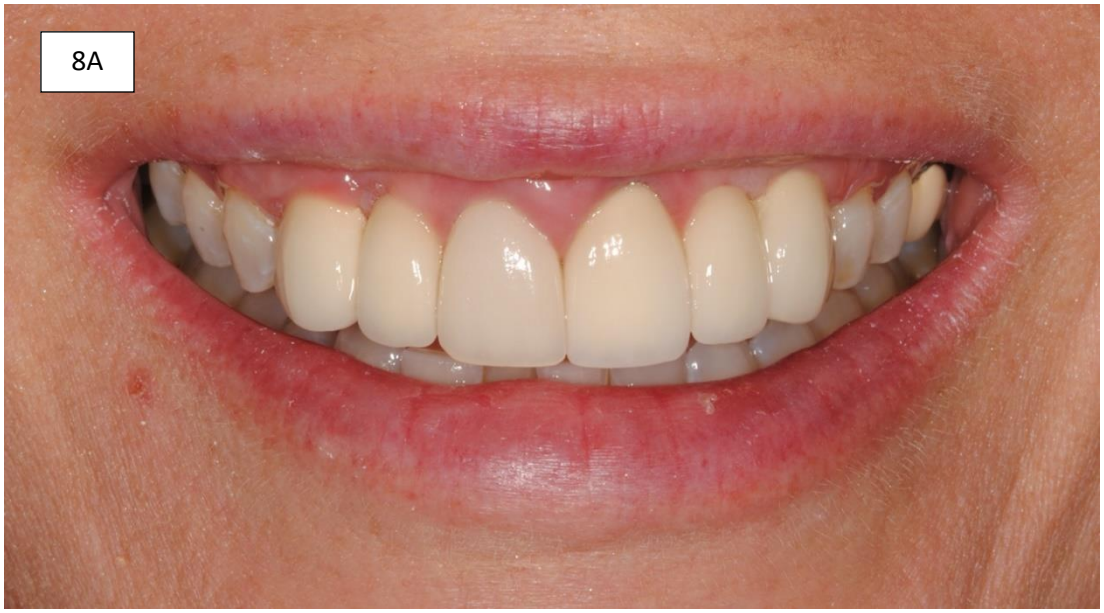


Figure 7 Six months follow-up smile view.

We recalled the patient again after 5 years. The patient reported a minor porcelain chipping of the maxillary right central incisor crown that occurred a few months earlier. Due to the extended distance from our dental office, the patient elected to see a dentist in her hometown who replaced her crown. We evaluated periodontal and peri-implant sulcus depths using a periodontal probe (Hu-Friedy Diagnostic Probe UNC, UNC15 Qulix; Hu-Friedy Mfg Co Inc); and took new intraoral photographs (Figure 8A, 8B), and periapical radiographs (Figure 9). We measured the marginal bone loss by calculating the distance between the marginal bone and the marginal edge of the implants. We then calculated and recorded the mean value of bone resorption for both the mesial and distal aspects of each implant. We evaluated these parameters at the initial visit (baseline), at six months, and at five years after delivery of the definitive prosthesis.



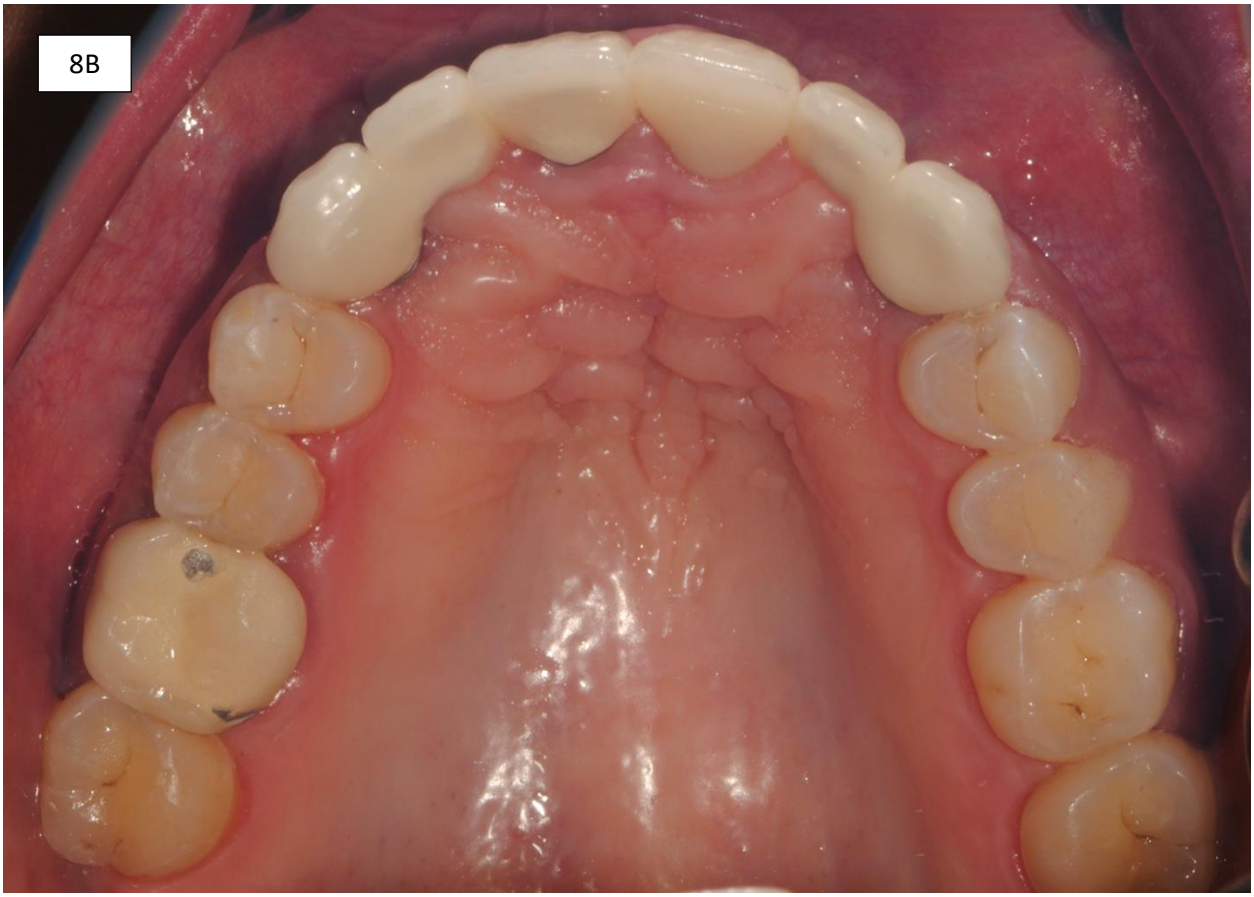


Figure 8 5-year follow-up smile view (Figure 8A) and occlusal view (Figure 8B).

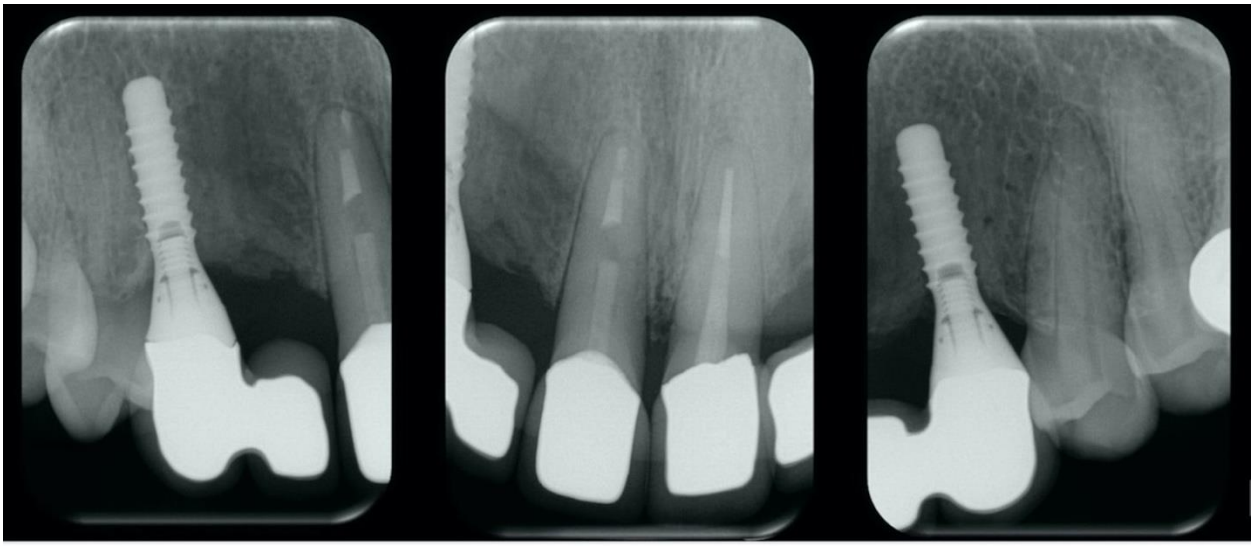


Figure 9 5-year follow-up periapical radiographs.

3. DISCUSSION

This treatment option eliminated the need for surgical intervention to restore maxillary lateral incisors with dental implants, and implant-borne cantilever prostheses are known to have a high survival rate (English, 1993). Several studies suggest no significant effect on the amount of peri-implant marginal bone loss, either at the prosthesis or implant level next to the cantilever (Wennström et al., 2004; Hälg et al., 2008; Kim et al., 2014). This finding is consistent with our results. Bone integrity is crucial for implant success, and marginal bone is an important criterion to consider. Average marginal bone loss of 1.0 to 1.5 mm, up to the first

implant thread in the first year of loading, is considered stable (Hall et al., 2019). In our case, we observed no significant marginal bone loss at 6-month or 5-year follow-ups.

The main disadvantages of this treatment include the possibility of porcelain chipping and implant fracture (Wennström et al., 2004; Hälg et al., 2008). In a retrospective clinical study, Roccuzzo et al., (2020), concluded that using a single implant-supported 2-unit cantilever PFDP in anterior sites is a credible treatment alternative, especially when the available mesiodistal space is limited. These findings are consistent with our results, as we detected no technical or aesthetic complications. On the other hand, other studies Palmer et al., (2005), Taha et al., (2020) showed an increase in peri-implant sulcus depth around the implant near the cantilever that was often associated with screw loosening, indicating mechanical complications of the cantilever design. We did not observe this as we used cement-retained definitive prosthesis (Palmer et al., 2012).

For this case, we chose custom abutments designed to improve the final prosthesis alignment over the existing stock abutments. This resulted in enhanced anatomical and aesthetic outcomes, and the design supports the surrounding soft tissue and allows easier removal of excess luting cement, which is considered one of the significant factors for implant failure (Korsch et al., 2015). Alternative and satisfactory approaches to this treatment include restoring the congenitally missing maxillary lateral incisors with implants or extracting the maxillary central incisors, replacing them with two implants, and restoring with two implant-supported FPDPs. Our chosen treatment option best fit the patient's aesthetic demands and financial limitations.

4. CONCLUSION

The treatment outcome met the patient's aesthetic expectations and our functional goals. An alternative to surgical intervention, implant-supported cantilever prostheses can be an appropriate treatment option for many cases, provided there is a correct case diagnosis and treatment planning to ensure biological and functional viability.

Author's Contributions

Dr Fatema Sabri Alqudaihi: Conceptualization, Methodology, Examination and Treating the Patient, Resources, Data Collection, Writing and Formal analysis, literature Review

Dr Walla Al Qudaihi: Resources, Data Analysis, Review and Editing

Dr Norman Blaine Cook: Methodology, Supervising, Writing, Investigation, Analysis, Review and Editing

All authors have read and agreed to submit the manuscript.

Informed consent

Written & Oral informed consent was obtained from the individual participant included in this manuscript.

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES AND NOTES

1. Becker CM, Kaiser DA. Implant-retained cantilever fixed prosthesis: where and when. J Prosthet Dent 2000; 84(4):432-5. doi: 10.1067/mpr.2000.110259
2. Buser D, Belser UC, Lang NP. The original one-stage dental implant system and its clinical application. Periodontol 2000 1998; 17:106-18. doi: 10.1111/j.1600-0757.1998.tb00128.x
3. English CE. Biomechanical concerns with fixed partial dentures involving implants. Implant dent 1993; 2(4):221-42. doi: 10.1097/00008505-199312000-00002
4. Hälg GA, Schmid J, Hämmerle CH. Bone level changes at implants supporting crowns or fixed partial dentures with or without cantilevers. Clin Oral Implant Res 2008; 19(10):983-90. doi: 10.1111/j.1600-0501.2008.01556.x
5. Hall J, Neilands J, Davies JR, Ekestubbe A, Friberg B. A randomized, controlled, clinical study on a new titanium oxide abutment surface for improved healing and soft tissue health. Clin Implant Dent Relat Res 2019; 21 Suppl 1:55-68. doi: 10.1111/cid.12749

6. Jung RE, Heitz-Mayfield L, Schwarz F, Groups of the 2nd Osteology Foundation Consensus Meeting. Evidence-based knowledge on the aesthetics and maintenance of peri-implant soft tissues: Osteology Foundation Consensus Report Part 3—Aesthetics of peri-implant soft tissues. Clin Oral Implants Res 2018; 29 Suppl 15:14-17. doi: 10.1111/clr.13113
7. Kim P, Ivanovski S, Latcham N, Mattheos N. The impact of cantilevers on biological and technical success outcomes of implant-supported fixed partial dentures. A retrospective cohort study. Clin Oral Implants Res 2014; 25(2):175-184. doi: 10.1111/clr.12102
8. Korsch M, Robra BP, Walther W. Predictors of excess cement and tissue response to fixed implant-supported dentures after cementation. Clin Implant Dent Relat Res 2015; 17e:45-53.
9. Misch CE. Rationale for dental implants. Dental implant prosthetics 2014; 2:1-25. doi: 10.1016/B978-0-323-07845-0.00001-4
10. Palmer RM, Howe LC, Palmer PJ, Wilson R. A prospective clinical trial of single Astra Tech 4.0 or 5.0 diameter implants used to support two-unit cantilever bridges: results after 3 years. Clin Oral Implants Res 2012; 23(1):35-40. doi: 10.1111/j.1600-0501.2011.02160.x
11. Palmer RM, Howe LC, Palmer PJ. A prospective 3-year study of fixed bridges linking Astra Tech ST implants to natural teeth. Clin Oral Implants Res 2005; 16(3):302-7. doi: 10.1111/j.1600-0501.2005.01110.x
12. Ramanauskaite A, Roccuzzo A, Schwarz F. A systematic review on the influence of the horizontal distance between two adjacent implants inserted in the anterior maxilla on the inter-implant mucosa fill. Clin Oral Implants Res 2018; 29 Suppl 15:62-70. doi: 10.1111/clr.13103
13. Rangert BO, Krogh PH, Langer B, Van-Roekel N. Bending overload and implant fracture: a retrospective clinical analysis. Int J Oral Maxillofac Implants 1995; 10(3):326-34.
14. Roccuzzo A, Jensen SS, Worsaae N, Gotfredsen K. Implant-supported 2-unit cantilevers compared with single crowns on adjacent implants: a comparative retrospective case series. J Prosthet Dent 2020; 123(5):717-723. doi: 10.1016/j.prosdent.2019.04.024
15. Roccuzzo M, Roccuzzo A, Ramanuskaite A. Papilla height in relation to the distance between bone crest and interproximal contact point at single-tooth implants: A systematic review. Clin Oral Implants Res 2018; 29 Suppl 15:50-61. doi: 10.1111/clr.13116
16. Taha A, Al-Shahat MA, Ghazy M. Clinical and radiographic evaluations of implant-supported cantilever fixed partial dentures replacing maxillary anterior teeth: A randomized clinical trial. J Prosthet Dent 2020; 124(6):659-666. doi: 10.1016/j.prosdent.2019.08.004
17. Tarnow D, Cho SC, Wallace SS. The effect of inter-implant distance on the height of inter-implant bone crest. J Periodontol 2000; 71(4): 546-9. doi: 10.1902/jop.2000.71.4.546
18. Wennström J, Zurdo J, Karlsson S, Ekestubbe A, Gröndahl K, Lindhe J. Bone level change at implant-supported fixed partial dentures with and without cantilever extension after 5 years in function. J Clin Periodontol 2004; 31(12):1077-1083. doi: 10.1111/j.1600-051X.2004.00603.x
19. Zurdo J, Romao C, Wennström JL. Survival and complication rates of implant-supported fixed partial dentures with cantilevers: a systematic review. Clin Oral Implants Res 2009; 20 Suppl 4:59-66. doi: 10.1111/j.1600-0501.2009.01773.x