

# Interimplant Papilla Reconstruction Using a Tunneled Palatal Pediculated Connective Tissue Graft After Severe Anterior Maxillary Trauma: A Case Report

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## Abstract

**Background:** Reconstruction of the interimplant papilla in the anterior maxilla remains one of the most demanding procedures in implant dentistry. The challenge is amplified when traumatic tooth avulsion is associated with buccal plate fracture, interproximal bone loss and collapse of the peri-implant soft-tissue scaffold. These defects may lead to persistent open embrasures or “black triangles” between adjacent implant-supported crowns, even after osseointegration, guided bone regeneration and provisional tissue conditioning.

**Case presentation:** A 38-year-and-7-month-old male patient presented after a bicycle accident that caused complicated crown fractures with pulpal exposure of teeth 21 and 22, avulsion of teeth 11 and 12 and fracture of the buccal bone plate. Initial emergency care had included wound cleansing, facial suturing, debris removal and splinting from teeth 13 to 23. Definitive treatment was performed in stages and included endodontic treatment of teeth 21 and 22, fiber-post reconstruction, digital prosthetic planning using intraoral scanning and Exocad software, tooth-supported provisionalization, prosthetically guided implant planning for positions 11 and 12, intraoperative manual adjustment of the final implant trajectories because of severe post-traumatic bone limitations, guided bone regeneration, implant-supported provisional crowns for soft-tissue conditioning, definitive ceramic crowns with intentionally narrowed transmucosal profiles and a combined soft-tissue reconstruction procedure.

**Surgical technique:** Persistent papilla deficiency remained between adjacent implants 11 and 12 after delivery of the definitive crowns. A palatal connective tissue segment was de-epithelialized from the region of tooth 16 to tooth 13 and maintained on a mesial pedicle. A recipient tunnel was prepared from the vestibular aspect through the

conditioned peri-implant tissues toward the palatal donor region, preserving the external papillary envelope. The pediculated connective tissue was rotated internally through the tunnel and positioned to increase the three-dimensional volume of the interimplant papilla. A second free connective tissue graft harvested from the contralateral palate was used to augment the buccal soft-tissue contour.

**Results:** At the latest follow-up on 26 March 2026, the rehabilitation remained clinically stable. The peri-implant tissues were healthy, the augmented buccal contour was maintained and the interimplant papilla between implants 11 and 12 showed substantial reconstruction. The pre-grafting black triangle was markedly reduced, producing a harmonious anterior aesthetic outcome.

**Conclusion:** This case illustrates a staged, prosthetically guided surgical approach for reconstructing an interimplant papilla after severe anterior maxillary trauma. Within the limitations of a single case report, the combined use of narrowed definitive emergence profiles, tunneled access, a palatal pediculated connective tissue graft and additional buccal connective tissue augmentation may be a useful option when papillary deficiency persists between adjacent implants after traumatic tissue loss.

**Keywords:** Interimplant Papilla; Connective Tissue Graft; Pediculated Graft; Anterior Maxilla; Dental Trauma; Implant Aesthetics; Guided Bone Regeneration; Emergence Profile; Black Triangle; Digital Dentistry

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## Introduction

Aesthetic rehabilitation of the anterior maxilla after traumatic tooth loss is clinically complex because success depends not only on osseointegration and restoration of missing teeth, but also on reconstruction of gingival architecture, papillary form, buccal convexity and natural emergence profiles. In the present case, traumatic avulsion of two adjacent maxillary incisors was associated with buccal plate fracture and loss of the soft-tissue scaffold. This combination produced a high-risk aesthetic scenario, as the papilla between adjacent implants lacks periodontal ligament support and natural supracrestal fiber insertion into cementum.

The presence of an interdental papilla is strongly related to the distance between the interproximal contact point and the crest of bone. Tarnow and colleagues demonstrated that papillary fill becomes less predictable as this distance increases [1]. In implant-supported restorations, the problem is intensified by the remodeling of the interimplant bone peak. Tarnow, Cho and Wallace reported that interimplant bone height is influenced by the horizontal distance between adjacent implants, with reduced spacing associated with greater crestal bone loss [2]. These observations are consistent with treatment-planning concepts that use interproximal bone height as a guidepost for predictable anterior aesthetic reconstruction [3].

Soft-tissue conditioning and augmentation are therefore central to aesthetic implant rehabilitation. Jemt described papilla regeneration after single-implant treatment, while subsequent implant literature has emphasized the importance of surgical positioning, bone volume, soft-tissue thickness, provisional restoration contour and final emergence profile [4,5]. Systematic reviews have also shown that immediate and early implant therapy in the anterior maxilla requires careful case selection because aesthetic outcomes are affected by hard- and soft-tissue stability [6]. Following extraction or trauma, three-dimensional ridge alterations are common in the aesthetic zone and ridge preservation or guided bone regeneration may reduce but cannot always eliminate dimensional collapse [7,8].

Connective tissue grafting has become a core technique for modifying peri-implant soft-tissue phenotype and improving buccal contour. Evidence suggests that connective tissue grafting can improve mucosal thickness and aesthetic stability around implants, particularly in the anterior maxilla [9-14]. Surgical-prosthetic strategies, including modification of the prosthetic contour, have also been proposed for correcting implant-related soft-tissue deficiencies [10]. However, predictable reconstruction of the papilla between two adjacent implants remains difficult and recent reviews continue to highlight the limited quality and heterogeneity of available evidence for black-triangle management and papilla reconstruction [15].

This case report describes a staged rehabilitation after severe anterior maxillary trauma. The principal focus is the reconstruction of the interimplant papilla between implants placed in positions 11 and 12 using a narrowed definitive emergence profile, tunnel preparation, a palatal pediculated connective tissue graft and additional buccal connective tissue augmentation. The manuscript is structured in accordance with the principles of CARE case-report guidance [18,19].

## Case Presentation

A 38-year-and-7-month-old male patient presented to Unique Dental, Dublin, Ireland, after sustaining severe anterior maxillary trauma in a motor vehicle accident. The initial emergency management was performed in a hospital setting and included cleaning of facial wounds, removal of debris, facial suturing and splinting from tooth 13 to tooth 23 to stabilize the remaining anterior teeth.

Clinical and radiographic assessment revealed complicated crown fractures of teeth 21 and 22, both with pulpal exposure. Teeth 11 and 12 had been avulsed during the accident. The avulsion was associated with fracture of the buccal bone plate and reimplantation of the avulsed teeth was therefore not considered feasible. The patient reported sensitivity and discomfort in the remaining fractured teeth. The initial treatment objectives were to control pulpal inflammation and infection, restore the fractured teeth, provide an immediate aesthetic provisional solution, replace the missing incisors and subsequently address the traumatic hard- and soft-tissue deficiency (Table 1, Fig. 1-26).

| Treatment Stage                                | Date             | Main Clinical Objective  |
|--|------------------|--|
| Emergency stabilization                        | Before referral  | Wound cleansing, debris removal, facial suturing and splinting from 13 to 23   |
| Endodontic treatment                           | 23 April 2024    | Root canal treatment of teeth 21 and 22  |
| Provisional prosthetic rehabilitation          | 02 May 2024      | Fiber posts in teeth 21 and 22 and fixed provisional restoration replacing 11 and 12   |
| Implant placement and guided bone regeneration | 22 August 2024   | Prosthetically guided implant planning, intraoperative manual adjustment of implant positioning to achieve primary stability and buccal ridge augmentation |
| Reopening and provisional implant crowns       | 21 November 2024 | Implant impression and peri-implant soft-tissue conditioning   |
| Definitive prosthetic phase                    | 4 March 2025     | Definitive ceramic crowns with narrowed transmucosal contours  |
| Soft-tissue reconstruction                     | 13 May 2025      | Pediculated palatal connective tissue graft and buccal connective tissue augmentation  |
| Latest documented follow-up                    | 26 March 2026    | Evaluation of stability, papilla reconstruction and anterior aesthetic integration   |

**Table 1:** Clinical and radiographic assessment.

#### *Initial Endodontic and Prosthetic Management*

Root canal treatment of teeth 21 and 22 was performed on 23 April 2024 in a single session. Both canals were irrigated with sodium hypochlorite and EDTA. Tooth 21 was prepared to a working length of 23 mm using the ProTaper Gold system with a final F2 file and obturated with an F2 gutta-percha cone and Sealapex sealer. Tooth 22 was prepared with the same system to a working length of 21 mm and obturated using the same protocol.

Following endodontic treatment, digital prosthetic planning was performed. An intraoral scan was exported to Exocad software and the ideal morphology of teeth 22 to 12 was digitally designed using pre-trauma photographic information as an aesthetic reference. The objective was to reproduce the original tooth proportions, incisal edge position, anterior curvature and smile harmony as closely as possible.

On 2<sup>nd</sup> of May 2024, fiber posts were placed in teeth 21 and 22, followed by tooth preparation and adjustment of a provisional fixed prosthesis. The provisional restoration was cemented on teeth 21 and 22 and replaced teeth 11 and 12 as cantilever pontics. This restoration provided immediate aesthetic rehabilitation and served as a reference for subsequent implant and prosthetic planning.

#### *Implant Placement and Guided Bone Regeneration*

On 22 August 2024, implant surgery was performed in the regions of teeth 11 and 12. Implant positioning was planned prosthetically using the digital restorative plan and a surgical guide was used to initiate the osteotomy sequence. However, because the traumatic injury had produced severe buccal and interproximal bone loss, the available residual bone did not permit complete execution of the digitally planned implant trajectories. During surgery, the final implant positioning had to be adjusted manually in order to engage the remaining native bone and achieve adequate primary stability. Two tapered implants measuring 3.75 × 13 mm were ultimately placed in positions 11 and 12. Because the trauma had caused significant buccal bone loss, guided bone regeneration was performed during the same surgical appointment. Buccal augmentation was carried out to increase vestibular volume, improve implant coverage and reconstruct the anterior ridge contour. A QualyBone particulate graft material and a QualyLive membrane were used according to the clinical protocol. The aim was to create a more favorable foundation for subsequent peri-implant tissue conditioning and aesthetic rehabilitation.

### *Reopening, Impression and Provisional Tissue Conditioning*

After approximately three months of healing, the implants were reopened. On 21 November 2024, impression procedures were performed. The original provisional fixed prosthesis was replaced and new individual provisional crowns were fabricated for teeth 21 and 22. Two screw-retained provisional crowns were fabricated over the implants in positions 11 and 12.

The screw-retained implant provisional crowns were used to condition the peri-implant mucosa and guide the emergence profiles. Provisional restoration contour is a recognized method for shaping peri-implant soft tissues in the aesthetic zone [12,13]. In this case, soft-tissue conditioning was continued for approximately two months, during which the general gingival architecture improved and the peri-implant tissues adapted favorably around the implant-supported provisional crowns.

Despite this favorable maturation around the individual implants, the interproximal region between implants 11 and 12 remained aesthetically compromised. Because the initial trauma had destroyed both interproximal and buccal tissue support, the papilla between the adjacent implant-supported crowns did not develop adequately. A visible black triangle remained between the implant crowns.

### *Definitive Prosthetic Phase Before Soft-Tissue Grafting*

The definitive ceramic crowns were delivered on 4 March 2025. A key prosthetic decision was made during the design of the implant-supported crowns in positions 11 and 12: the cervical and transmucosal portions were intentionally designed to be as narrow as possible. This design reduced compression of the peri-implant mucosa and created additional biological space for soft-tissue augmentation.

This strategy followed the principle that implant aesthetics are not determined by surgery alone. The prosthetic emergence profile can either compress and flatten the mucosa or create a protected space into which augmented soft tissue may mature. Surgical-prosthetic approaches have previously been described for peri-implant soft-tissue dehiscence and aesthetic correction [10]. In the present case, the definitive restorations were used actively as part of the papilla reconstruction plan: first, by creating space and second, by allowing the subsequent graft to occupy that space biologically.

### *Surgical Technique for Interimplant Papilla Reconstruction*

The soft-tissue grafting procedure was performed on 13 May 2025. The primary objective was to reconstruct the papilla between the adjacent implants in positions 11 and 12 and to improve the buccal soft-tissue volume of the anterior maxilla.

A palatal donor area was prepared from the mesial region of tooth 16 to the mesial region of tooth 13. A continuous palatal connective tissue segment approximately 1.5 mm wide was de-epithelialized. The segment was sectioned while maintaining its mesial attachment, thereby preserving a pediculated vascular supply. The purpose of maintaining a pedicle was to avoid complete graft disconnection and to support vascular stability during early healing. Contemporary reviews of peri-implant soft-tissue management emphasize the biological relevance of soft-tissue phenotype, vascularity, minimally invasive flap design and autogenous grafting in aesthetic-zone implant care [16,17].

The implant-supported crowns were removed to access the conditioned peri-implant soft-tissue profile. A tunnel was prepared internally through the soft tissue shaped by the implant crowns. The incision was made from the internal aspect of the gingival profile, without external vertical releasing incisions and without splitting or segmenting the external papillary tissue. The papillary region was carefully released at its connective tissue base while preserving the external papillary envelope. The tunnel was extended from the vestibular aspect toward the palatal donor region to create communication between the recipient papilla area and the pediculated palatal graft. The de-epithelialized pediculated connective tissue segment was rotated internally through the tunnel and positioned toward the vestibular interimplant papilla region. This maneuver increased the three-dimensional connective tissue volume between implants 11 and 12 and provided internal support for papilla reconstruction.

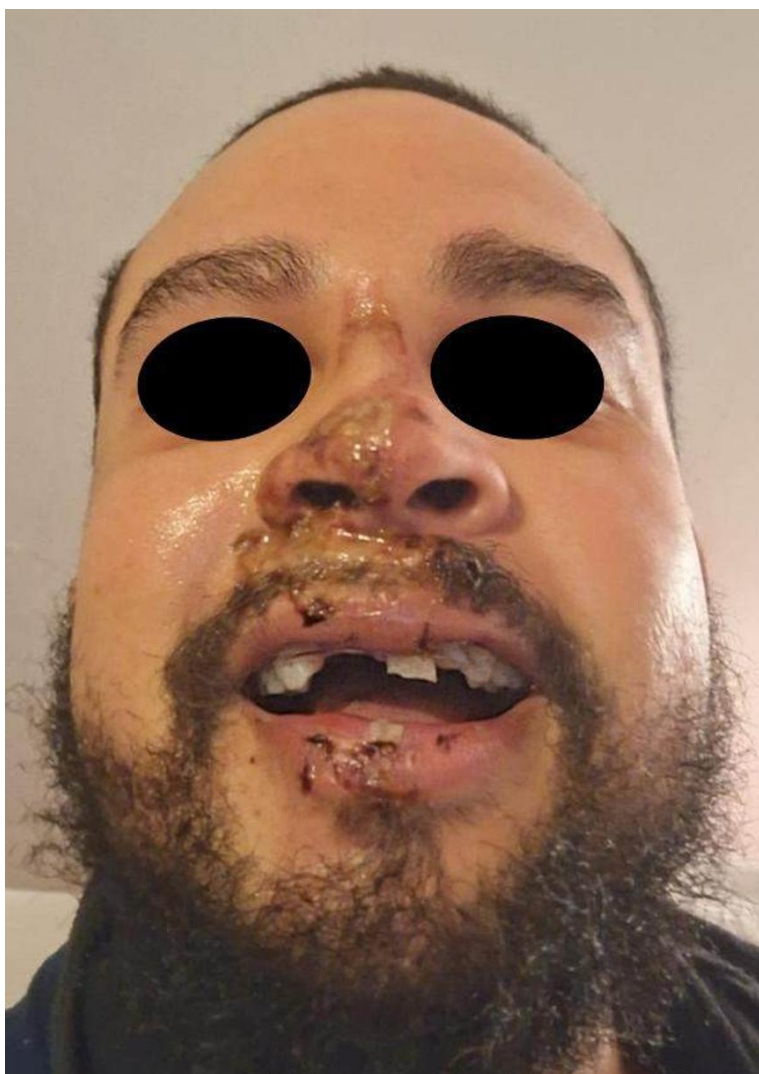
A second connective tissue graft was harvested from the contralateral palatal region, extending from tooth 23 to the mesial region of tooth 26. This graft was completely removed after de-epithelialization and used as a free connective tissue graft to augment the buccal contour. The graft was positioned to increase vestibular tissue thickness across the anterior region, extending approximately from the central aspect of tooth 13 to the central aspect of tooth 21, with particular focus on implants 11 and 12.

The combined procedure therefore included two complementary components: a pediculated palatal connective tissue graft rotated through a tunnel to reconstruct the interimplant papilla and an additional free connective tissue graft to increase buccal soft-tissue volume. This combination addressed both the papillary deficiency and the broader vestibular collapse that had resulted from the original trauma.

#### *Follow-Up and Clinical Outcome*

The patient was followed until 26 March 2026. At the latest documented follow-up, the anterior rehabilitation remained clinically stable. The implant-supported crowns and tooth-supported crowns demonstrated satisfactory aesthetic integration. The peri-implant tissues appeared healthy, the augmented vestibular contour was maintained and the interimplant papilla between implants 11 and 12 showed substantial reconstruction compared with the pre-grafting condition.

The black triangle that had persisted after provisional tissue conditioning and definitive crown delivery was markedly reduced. The final result demonstrated improved papillary fill, better soft-tissue continuity and a more harmonious anterior aesthetic outcome. No clinical signs of soft-tissue necrosis, graft exposure, peri-implant inflammation, prosthetic instability or loss of reconstructed papillary volume were observed at the documented follow-up.



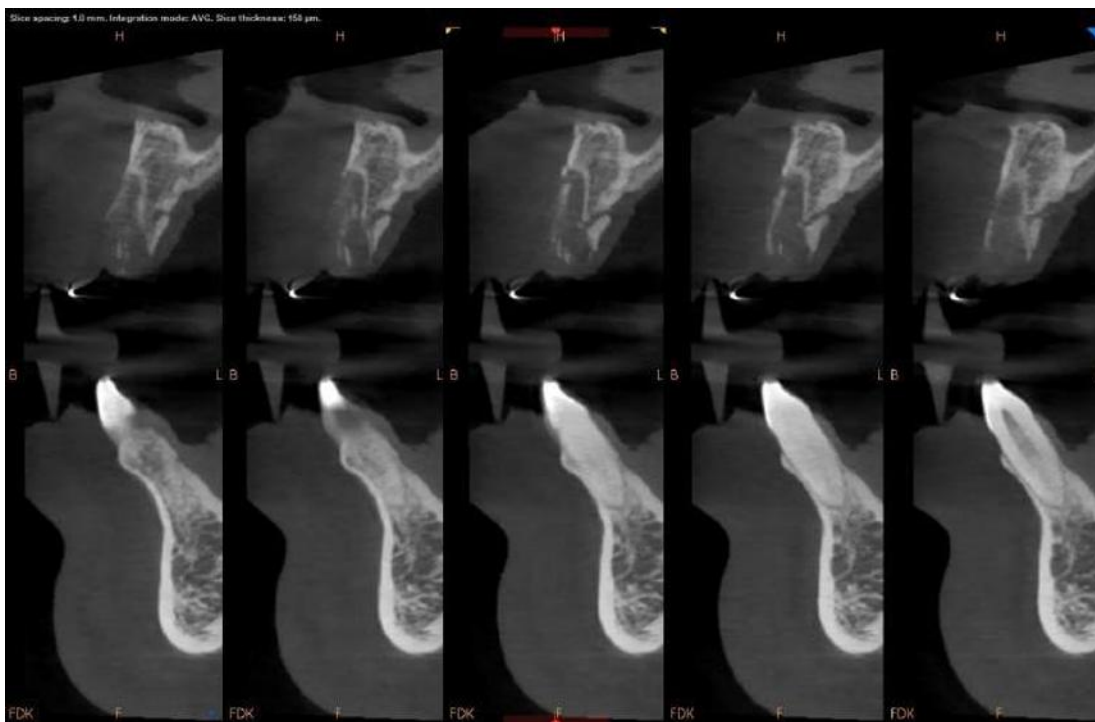
**Figure 1:** Initial clinical presentation after anterior maxillary trauma, showing the pre-operative intraoral aspect with fracture of teeth 21 and 22 and absence of teeth 11 and 12 following traumatic avulsion.



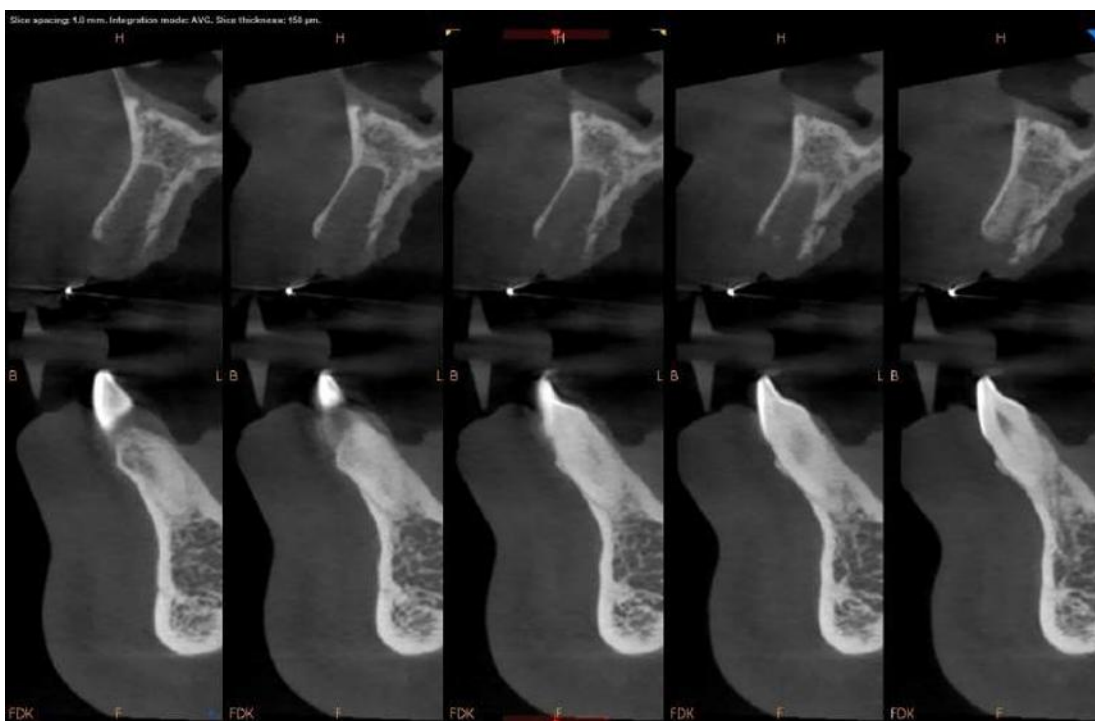
**Figure 2:** Profile photograph used as an aesthetic reference for digital restorative planning. Publication requires explicit patient consent and appropriate facial anonymization if requested by the target journal.



**Figure 3:** Pre-operative CBCT view demonstrating the traumatic defect in the anterior maxilla.



**Figure 4:** Pre-operative CBCT view showing the extent of hard-tissue compromise after avulsion of teeth 11 and 12.



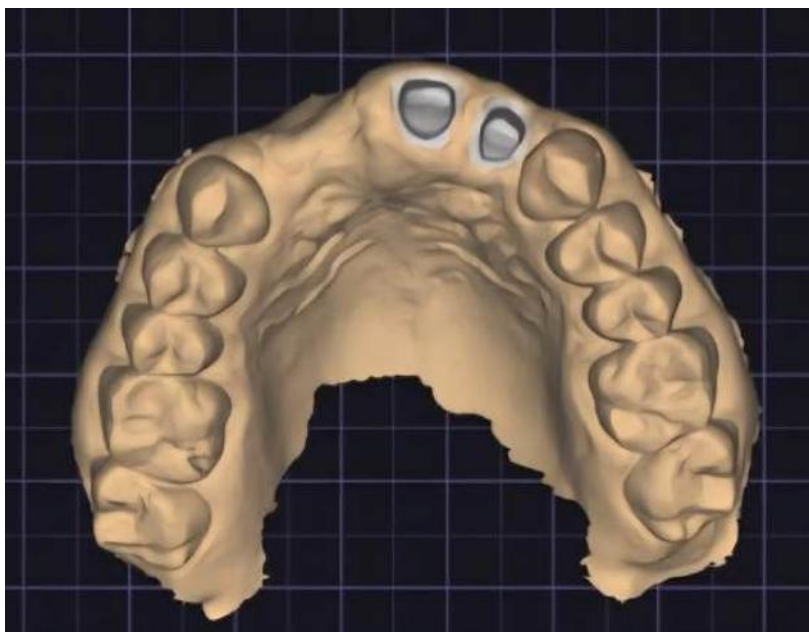
**Figure 5:** Additional pre-operative CBCT view documenting the buccal bone plate deficiency relevant to implant planning.



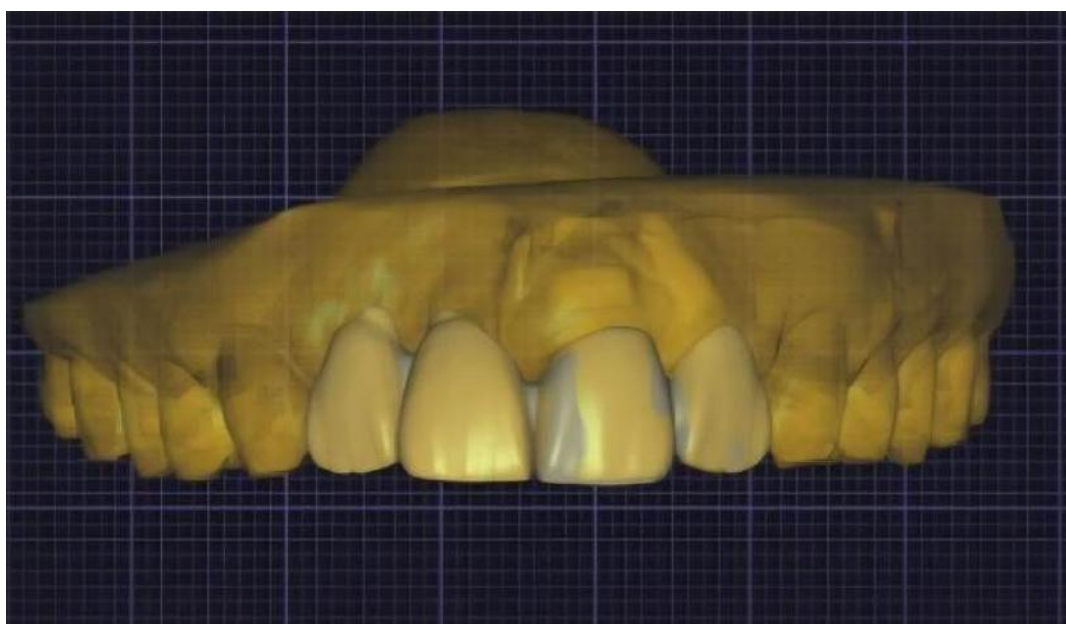
**Figure 6:** Endodontic treatment of teeth 21 and 22, fiber-post reconstruction and fixed provisional restoration replacing teeth 11 and 12.



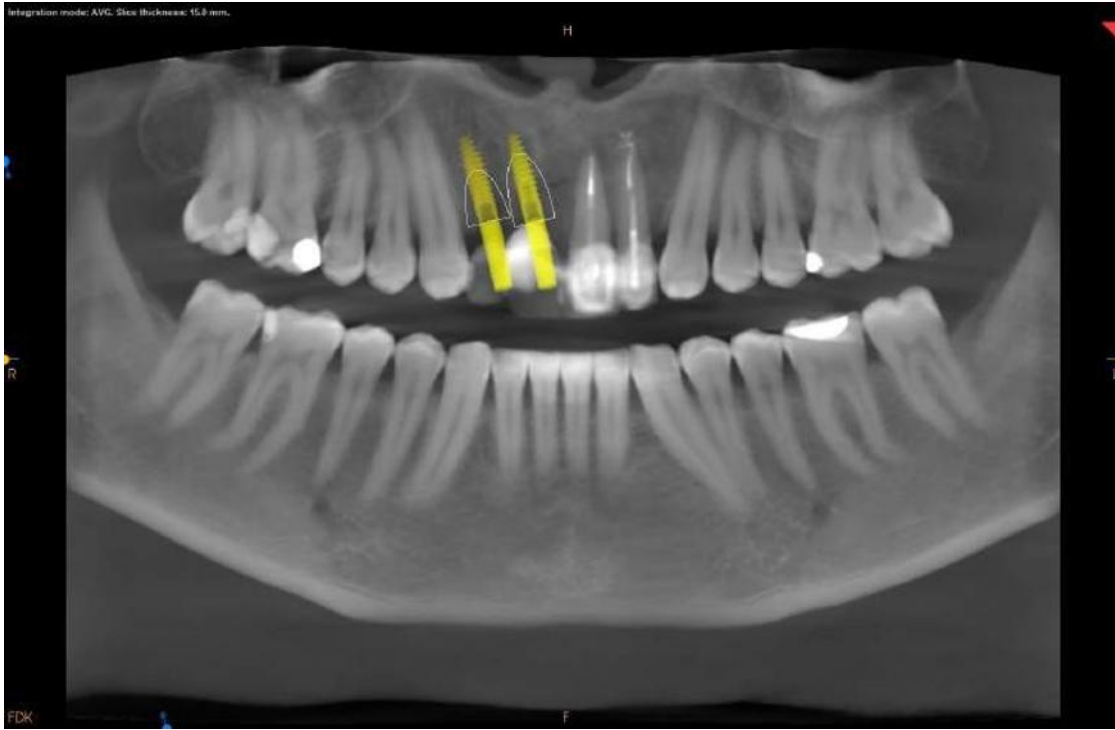
**Figure 7:** Digital planning of the anterior maxillary reconstruction based on intraoral scanning and pre-trauma aesthetic reference data.



**Figure 8:** Digital planning view highlighting loss of volume on the buccal aspect of the anterior ridge.



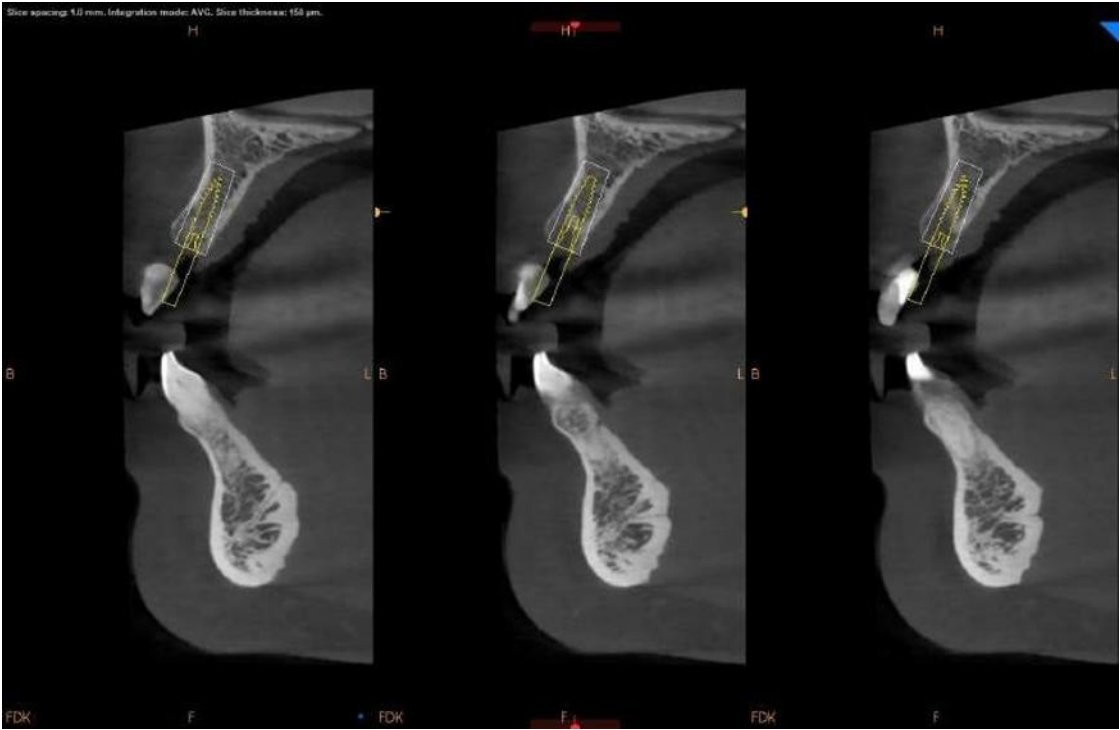
**Figure 9:** Digital restorative planning of tooth morphology and anterior maxillary contours.



**Figure 10:** Prosthetically guided implant planning for positions 11 and 12.



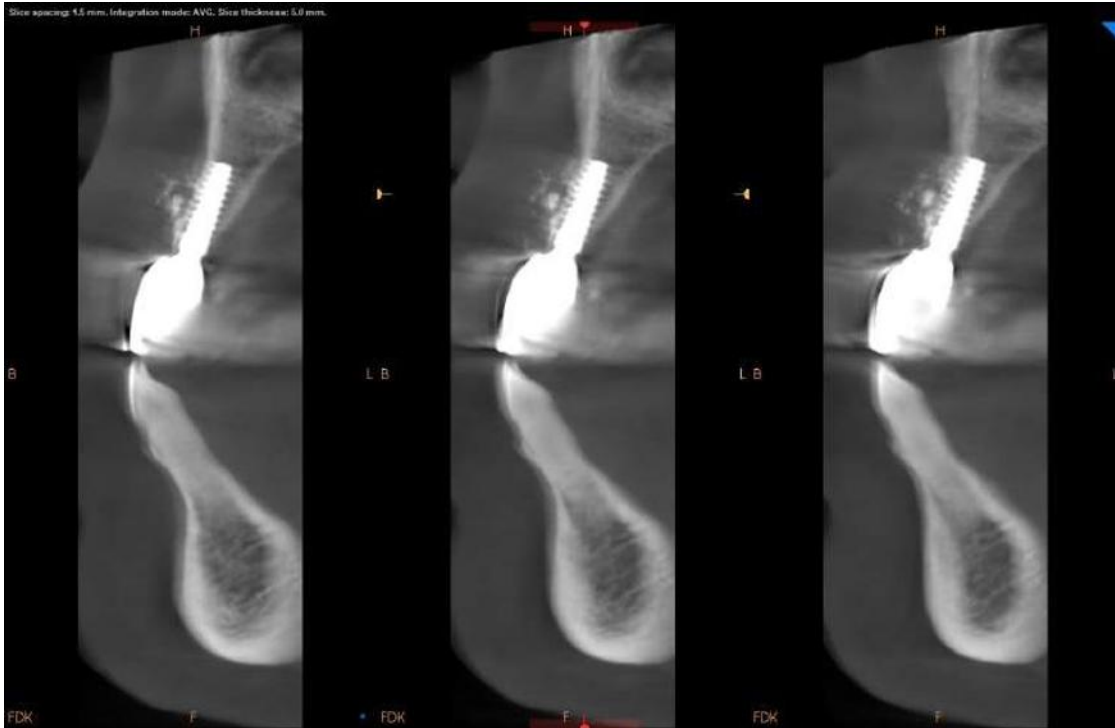
**Figure 11:** Prosthetically guided implant planning showing the relationship between planned implant position and restorative emergence.



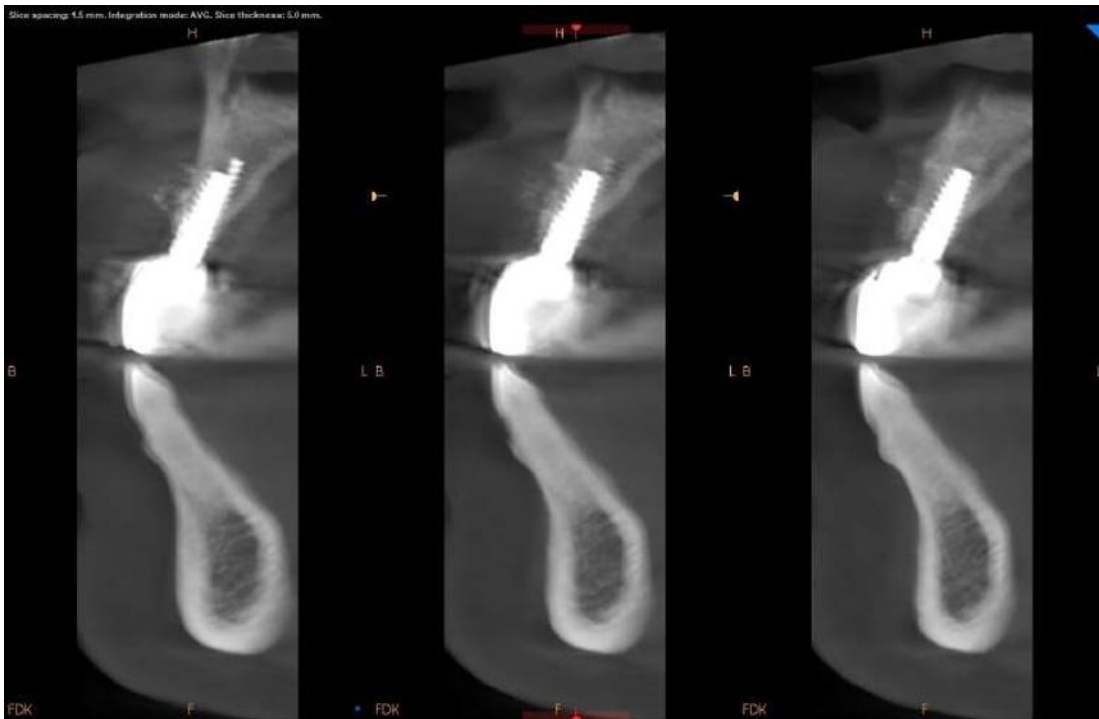
**Figure 12:** Final prosthetically guided implant plan for adjacent implants in positions 11 and 12.



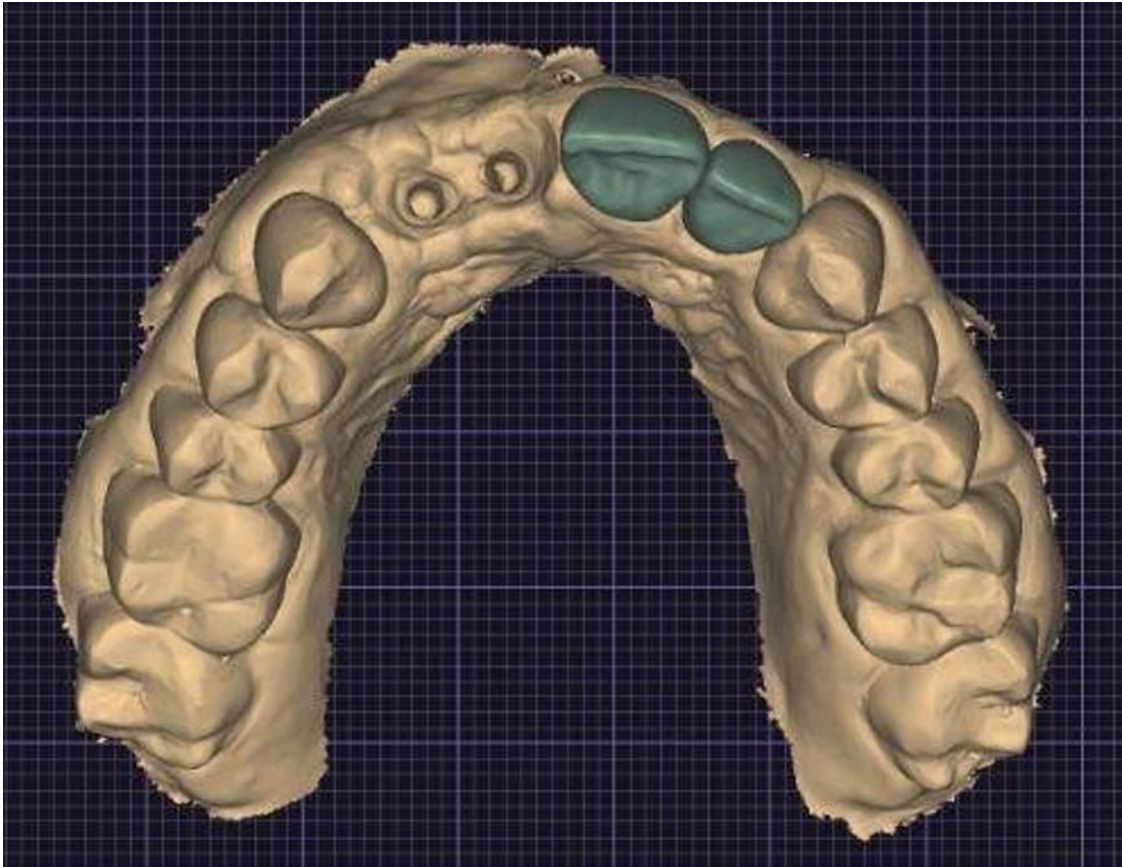
**Figure 13:** Clinical view after implant placement in positions 11 and 12.



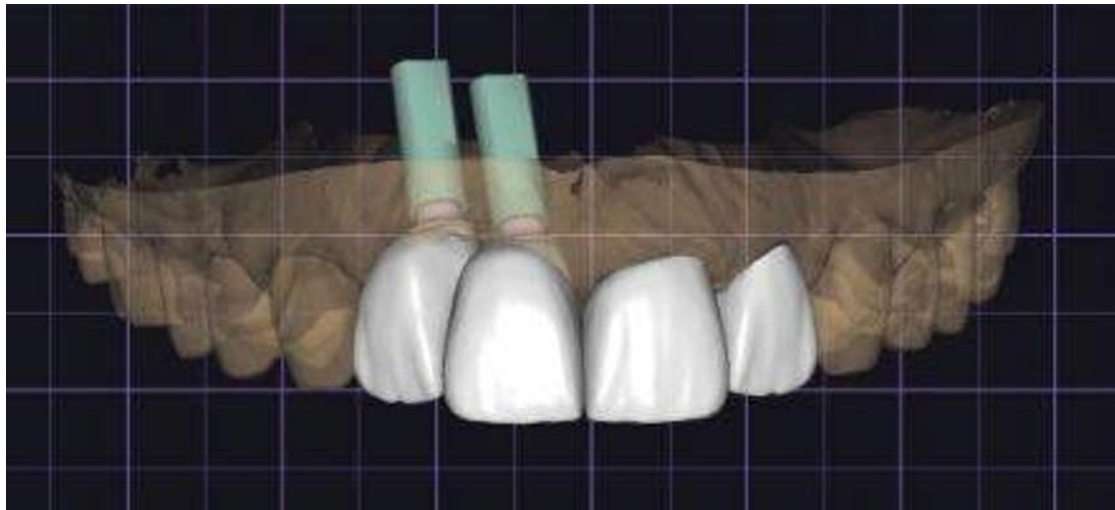
**Figure 14:** Additional clinical documentation after implant placement and guided bone regeneration.



**Figure 15:** Clinical view showing implant placement and regenerated anterior ridge contour.



**Figure 16:** Digital planning of the definitive restoration showing improvement in buccal volume after staged hard- and soft-tissue management.



**Figure 17:** Digital planning of the definitive crown contours, including cervical profile design.



**Figure 18:** Definitive crowns fitted; lateral aspect showing residual dark triangle between implant-supported crowns 12 and 11 before soft-tissue grafting.



**Figure 19:** Definitive crowns fitted; frontal aspect showing residual interimplant papilla deficiency between 12 and 11 before grafting.



**Figure 20:** Pediculated palatal connective tissue graft with verification of position and extension before tunneling into the recipient area.



**Figure 21:** Verification of the buccal connective tissue graft position for anterior soft-tissue volume augmentation.



**Figure 22:** Recipient area sutured with suspensory stitches to reduce tension and stabilize the grafted tissues.



**Figure 23:** Three-week follow-up after soft-tissue grafting, frontal aspect.



**Figure 24:** Three-week follow-up after soft-tissue grafting, lateral aspect.



**Figure 25:** Two-month follow-up after soft-tissue grafting, lateral aspect, showing maturation of the augmented soft tissues.



**Figure 26:** Final clinical result showing stable anterior rehabilitation, improved buccal contour and reconstruction of the interimplant papilla between implants 11 and 12.

### Discussion

Reconstruction of the interimplant papilla is one of the most difficult aesthetic challenges in implant dentistry. Buccal soft-tissue deficiencies may often be improved with connective tissue grafts, roll flaps and other augmentation procedures [11,14]. By contrast, the papilla between two adjacent implants is less predictable because it depends heavily on the height and stability of the interimplant bone crest, which may be reduced after extraction, traumatic avulsion, implant placement or physiologic remodeling [2,3].

In the present case, the difficulty was magnified by the mechanism of injury. The case also demonstrates that, in severe post-traumatic defects, prosthetically guided implant planning may provide an essential restorative reference, but the final implant position may still require intraoperative modification when residual bone availability prevents full execution of the digital plan. The patient did not present with intact sockets or a controlled extraction-site defect. Instead, the trauma caused avulsion of teeth

11 and 12 and fracture of the buccal bone plate. This compromised both the hard-tissue foundation and the soft-tissue scaffold required for papilla support. Even after guided bone regeneration, implant placement, provisional tissue conditioning and definitive ceramic crown delivery, the interimplant papilla remained deficient.

A central feature of this case was the intentional narrowing of the definitive crown emergence profiles before soft-tissue grafting. Excessive prosthetic contour may compress the peri-implant mucosa and leave insufficient biological space for papilla formation. In contrast, the strategy used here reduced the transmucosal prosthetic volume and created a protected space for graft maturation. The definitive prosthesis therefore became an active component of the reconstructive plan rather than a passive final restoration.

The surgical design also emphasized vascular preservation. A tunnel approach avoided vertical releasing incisions and preserved the external papillary envelope. The pediculated palatal connective tissue graft maintained a vascular attachment, which may offer a biological advantage in a compromised interimplant region compared with a fully detached graft. The use of an additional free connective tissue graft addressed a related but distinct problem: the need to restore buccal convexity and soft-tissue thickness across the anterior implant region. Papilla reconstruction is unlikely to appear aesthetic if the surrounding buccal tissues remain collapsed. The case further illustrates the value of staged rehabilitation. Emergency stabilization, endodontic therapy, digital planning, provisionalization, prosthetically guided implant placement, guided bone regeneration, implant provisional tissue conditioning, definitive contour modification and soft-tissue grafting were performed sequentially. Each stage contributed to the final outcome and none would likely have been sufficient in isolation.

The main limitation of this report is its single-case design. No histological evaluation was performed and the degree of papilla fill was not quantified using a formal papilla index, pink aesthetic score or three-dimensional volumetric analysis. Follow-up is clinically relevant but remains limited because peri-implant soft tissues may continue to remodel over time. Future documentation should include standardized photographs, radiographic follow-up, peri-implant probing after appropriate healing, pink aesthetic score assessment, papilla index scoring and digital volumetric comparison before and after grafting.

Within these limitations, the case suggests that interimplant papilla reconstruction may be improved when soft-tissue augmentation is combined with intentional prosthetic creation of space. This strategy may be particularly useful in traumatic cases where papillary deficiency is caused not only by prosthetic contour problems but also by true hard- and soft-tissue destruction.

## **Conclusion**

This case report presents a prosthetically guided surgical approach for reconstruction of an interimplant papilla after severe anterior maxillary trauma. The patient presented with avulsion of teeth 11 and 12, complicated crown fractures of teeth 21 and 22 and fracture of the buccal bone plate. Rehabilitation required endodontic treatment, fiber-post reconstruction, digital prosthetic planning, prosthetically guided implant placement, guided bone regeneration, provisional soft-tissue conditioning, definitive ceramic crowns and surgical soft-tissue reconstruction.

The principal clinical innovation was the combined use of intentionally narrowed definitive emergence profiles, tunneled access, a pediculated palatal connective tissue graft for interimplant papilla reconstruction and an additional buccal connective tissue graft for vestibular contour augmentation. At the latest follow-up, the anterior rehabilitation remained stable and the interimplant papilla showed substantial aesthetic reconstruction. Further cases, longer follow-up and objective volumetric outcome measures are required before predictable conclusions can be established.

## *Clinical Significance*

Interimplant papilla reconstruction is difficult, particularly after traumatic loss of teeth and buccal or interproximal bone. This case suggests that papillary reconstruction may be enhanced by combining three principles: prosthetic creation of space through a narrowed definitive emergence profile, preservation of vascularity through a tunnel approach and volume enhancement through a palatal pediculated connective tissue graft. The addition of buccal connective tissue augmentation may further improve the overall anterior aesthetic contour.

### *Patient Perspective*

The patient sought treatment after a severe traumatic injury that compromised the function and appearance of the anterior maxilla. The staged treatment restored the missing anterior teeth, stabilized and restored the fractured teeth, improved the gingival architecture and provided stable aesthetic rehabilitation.

### **Conflict of Interest**

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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### **Acknowledgement**

The authors have no acknowledgments to declare.

### **Data Availability Statement**

Clinical photographs, radiographic images, intraoral scans and supporting documentation are available from the corresponding author upon reasonable request, subject to patient confidentiality, written consent and applicable data protection regulations.

### **Ethical Statement**

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore was exempt.

### **Informed Consent Statement**

Written informed consent was obtained from the treated patient for treatment and for publication of anonymized clinical information, radiographic documentation and clinical photographs. The illustrative comparison image from another healed implant site should be included only if separate consent for anonymized publication has been obtained from that patient or if institutional/publication policy confirms that consent is not required for the anonymized comparator image.

### **Authors' Contributions**

Bruno Viana Reis was responsible for conceptualization, diagnosis, treatment planning, surgical planning for implant placement and guided bone regeneration, endodontic treatment of teeth 21 and 22, fiber-post reconstruction, tooth preparation, prosthetic planning and clinical prosthetic execution for both tooth-supported and implant-supported restorations, case supervision, clinical documentation, manuscript drafting and final manuscript review.

Victor Vidigal was responsible for the periodontal surgical procedure for interimplant papilla reconstruction, including soft tissue graft planning, tunnel preparation, pediculated connective tissue graft rotation, buccal soft tissue augmentation, clinical documentation, manuscript review and approval of the final manuscript.

Fillipe Marconi dos Santos Dutra was responsible for the digital prosthetic planning, CAD/CAM laboratory workflow, design and fabrication of the provisional restorations and fabrication of the definitive zirconia implant-supported crowns. He also contributed to technical documentation, manuscript review and approval of the final manuscript.

Renan Lana Devita contributed to case documentation organization, manuscript structuring, critical manuscript review, intellectual revision of the final text and approval of the final manuscript.

All authors reviewed and approved the final version of the manuscript before submission.

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