Rehabilitation of a failing central incisor

A periodontal and restorative success formula

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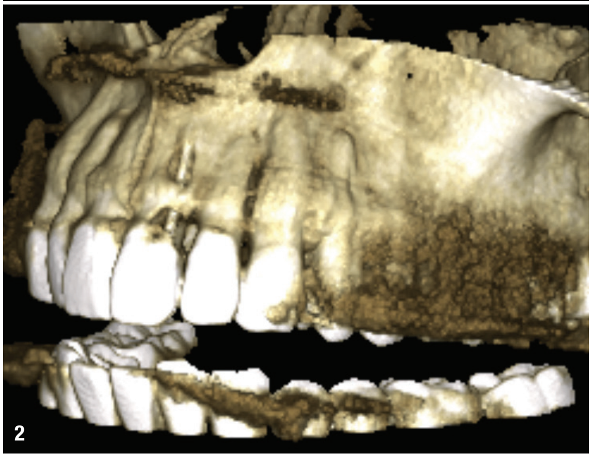


Fig. 1: Pre-op clinical image showing the affected teeth #11 and 21. **Fig. 2:** CBCT evaluation showing fenestration at tooth #21.

Introduction

Rehabilitation in the anterior zone with implant-supported restorations is a daunting task. Implant-supported rehabilitation in the anterior maxilla requires seamless merging of the restoration with the existing gingival architecture. Therefore, prosthetically driven implant placement is of utmost importance in achieving the aesthetic goal. Implant success is not limited to osseointegration alone but is mainly dependent on the aesthetic outcome. Another important factor influencing success of the procedure is the quality of hard and soft tissue available at the time of treatment planning. This periodontal assessment is the crux of aesthetic zone management in cases which require augmentation procedures with immediate implantation. The hard and soft tissue form the peri-implant seal which is crucial for the long-term success of the implant restoration. Immediate implantation has become the preferred option for cases in the anterior zone, as it prevents post-extraction ridge collapse and hence maintains optimum bone and soft-tissue quantity and quality for favourable outcomes. Immediate provisionalisation of the implant maintains acceptable function and aesthetic appearance simultaneously, providing a template for soft-tissue contouring and maturation until a definitive restoration can be integrated. The implant also serves as a placeholder to prevent migration of neighbouring teeth and extrusion of opposing teeth. Favourable implant success, peri-implant tissue response and aesthetic outcomes can be achieved with immediately placed and provisionalised maxillary anterior single implants.[1] A favourable visual result is a combination of a well-planned and executed surgical technique along with good prosthetic choices and operator skill. The following case report showcases the complete rehabilitation of an ailing maxillary central incisor with an implant-supported restoration.

Case report

The patient presented with the chief complaint of discomfort and mild mobility of the maxillary left central incisor and gave a history of trauma to the same jaw region about ten to twelve years before. This had led to avulsion of the same tooth, following which the tooth was replanted. The right central incisor showed purple discoloration and required endodontic retreatment (Fig. 1).

Radiographic investigations

A CBCT scan was done for planning the treatment. Tooth #21 revealed a fenestration in the middle third of the root (Fig. 2). Based on the clinical and radiographic findings, extraction of tooth #21 with immediate implant placement and loading was decided on. A putty index was made to record the existing morphology of tooth #21. Guided bone regeneration and soft-tissue surgery were planned for the fenestration defect and augmentation of the thin gingival tissue to ensure a good peri-implant seal.

Procedure

The procedure was flapless in order to minimise hard- and soft-tissue trauma. The fractured portion of the tooth was gently removed with a tweezer and the remaining root was atraumatically luxated (Fig. 3). Thorough curettage was done to ensure the total removal of the granulation tissue (Figs. 4a & b). To ensure complete disinfection of the site, antimicrobial photodynamic therapy was done using the HELBO laser (bredent medical). Blue photosensitiser (methylene blue) was applied inside the socket and left *in situ* for 60 seconds to stain the bacteria. After the dye had been rinsed off, the socket was then exposed to the HELBO TheraLite diode laser for 1 minute (Fig. 5). This ensures focused antibacterial action by singlet oxygen molecules, destroying bacteria in the biofilm.

The implant osteotomy site was prepared with sequential drills, and 3D position verified with paralleling tools (Fig. 6). The implant (copaSKY, 4 × 12 mm; bredent medical) was placed with sufficient primary stability (torque of 45 Ncm), facilitating predictable immediate loading of the implant. The implant was placed 4 mm below the gingival margin to accommodate biologic width (Fig. 7).

A free gingival graft was harvested from the palate, de-epithelialised and stabilised under the labial gingiva, as the existing labial tissue appeared thin (Fig. 8). The connective tissue graft was then stabilised with a sling suture using #6/0 DemeDIOX polydioxanone resorbable monofilament thread (DemeTECH; Fig. 9).

The extracted tooth was relined with flowable composite and used for the provisionalisation on an copaSKY exso abutment using the previously fabricated putty index (Figs. 10a & b). The screw-retained provisional restoration was polished extra-orally and the abutment screw torqued to 15 Ncm (Fig. 11). The screw access channel was plugged with PTFE and composite and kept out of occlusal contact.

Guided bone regeneration was done at the site of the fenestration to ensure bone filling of the defect. Guided bone regeneration provides an environment conducive to bone formation. A membrane is applied to exclude non-

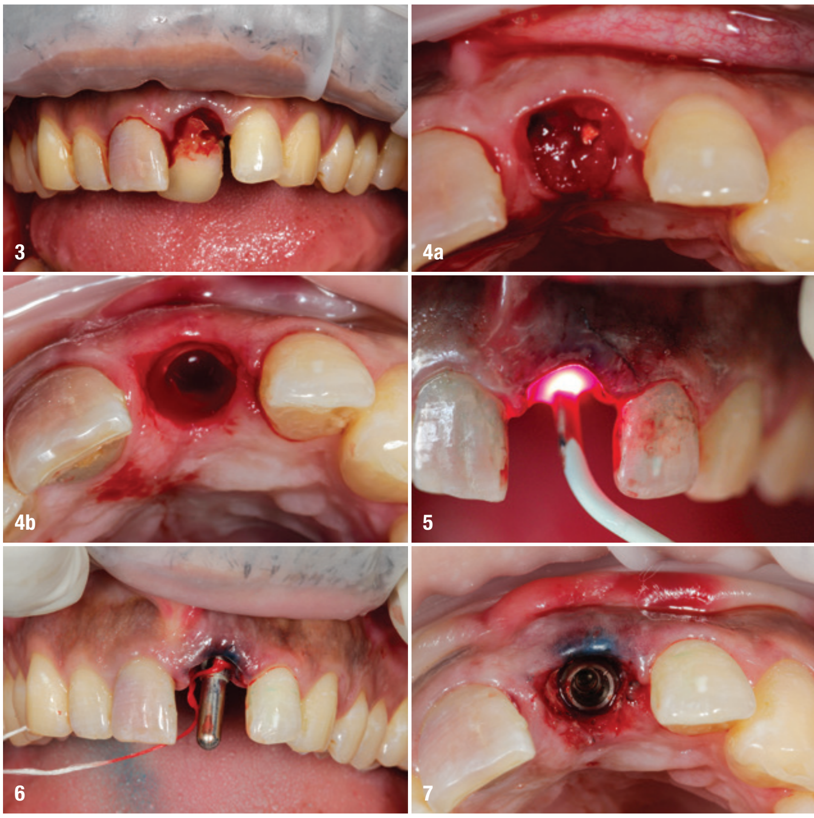


Fig. 3: Fractured cervical portion of tooth #21. **Fig. 4a:** Granulation tissue after extraction. **Fig. 4b:** Extraction socket after mechanical debridement. **Fig. 5:** HELBO antimicrobial photodynamic therapy. **Fig. 6:** Verifying implant position and angulation. **Fig. 7:** Implant placement 4 mm below the gingival margin, respecting the biologic width.

osteogenic tissue from interfering with bone regeneration. A semilunar incision was made on the mucogingival junction to expose the area of fenestration (Fig. 12). After debridement, 50/50 NonDemin mineralised cortical and cancellous human allograft (0.5 cm^3; Impladent), along with autogenous

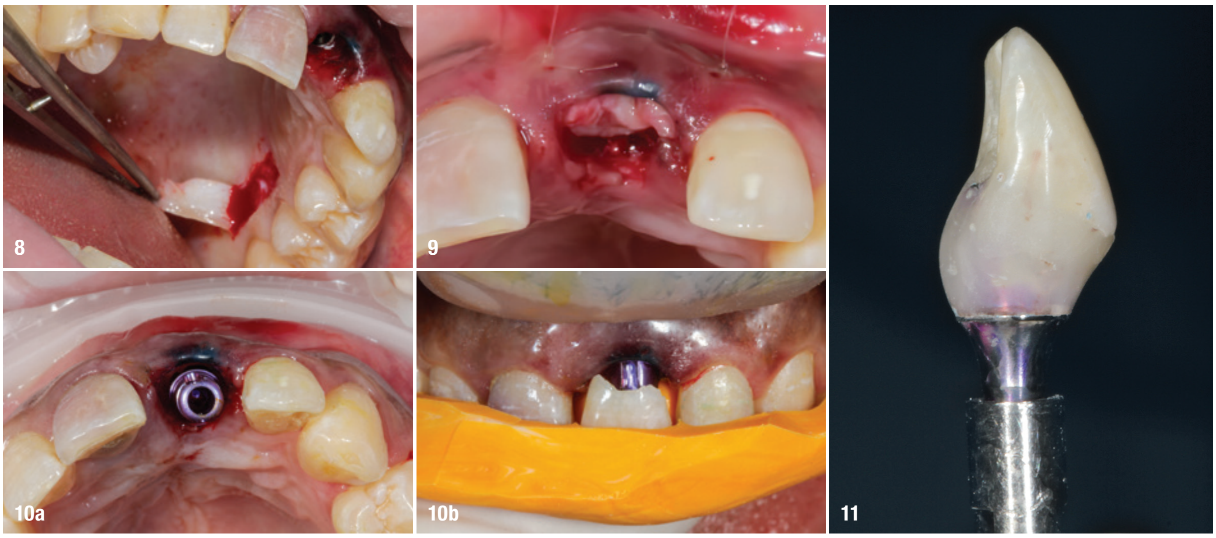


Fig. 8: Free gingival graft obtained from the palate. **Fig. 9:** De-epithelialised free gingival graft (connective tissue) stabilised in a pouch. **Fig. 10a:** CopaSKY exso abutment placed for provisionalisation. **Fig. 10b:** Putty index with extracted tooth for relining over the abutment. **Fig. 11:** Provisional crown highly polished extra-orally.

Fig. 12: Fenestration exposed with semilunar incision. **Fig. 13:** Guided bone regeneration done with bone grafting material and a membrane. **Fig. 14:** Tension-free closure. **Fig. 15:** Immediate post-op radiograph after seating of the provisional crown.

bone, was mixed together with injectable platelet-rich fibrin to make sticky bone, which was then packed on the exposed implant side and later covered with a resorbable collagen bilayer membrane, and the flap was sutured with the same aforementioned suture thread (Figs. 13 & 14). An immediate postoperative radiograph was taken (Fig. 15).

Instructions regarding diet and oral hygiene were given to the patient. The patient was also instructed to avoid any wedging force on the anterior teeth. Subsequently, during the osseointegration period, endodontic re-treatment of the right central incisor was completed, enabling fabrication of both crowns together during the restorative phase.

Prosthetic phase

The screw-retained provisional crown was removed after four months, revealing healthy underlying tissue with well-maintained gingival contours (Figs. 16 & 17). The resonance frequency analysis performed with the bredent penguinRFA revealed an implant stability quotient value of 86, indicating sound osseointegration and implant stability. An analogue impression was taken with customised impression copings to register the soft-tissue contour (Fig. 18). The crowns were digitally fabricated by the technician (Fig. 19). For the implant crown, a titanium base was used and a single zirconia crown with a palatal screw access channel was fabricated. In addition, the adjacent tooth #11 was prepared for a definitive zirconia crown. The definitive implant crown was cemented extra-orally, steam-cleaned, torqued to 25 Ncm and plugged with PTFE and composite intra-orally (Fig. 20). A postoperative radiograph was taken after the definitive restoration, and an excellent aesthetic outcome was achieved (Figs. 21 & 22).

Clinical examination after six months revealed a healthy peri-implant mucosa and no bleeding on probing. The patient was satisfied with the results (Fig. 23). Furthermore, a six-month postoperative radiograph revealed maintained crestal bone levels (Fig. 24).

Discussion

Post-extraction ridge collapse is an inevitable process. Human re-entry studies have shown horizontal bone loss of 29–63% and vertical bone loss of 11–22% six months after tooth extraction.[2] Type 1 implant placement was planned and executed in this case.[3] Apart from preventing this bone collapse, immediate placement and restoration of a single implant in the aesthetic zone has several proposed benefits, including reduced overall treatment time, fewer surgical procedures, less traumatic surgery and greater patient satisfaction.[4] However, immediate placement of implants in infected sockets is debatable. This may be indicated for replacing teeth lost because of chronic periapical lesions with a history of endodontic failure when appropriate preoperative procedures are undertaken to clean and decontaminate the surgical sites.[5] The use of antibiotics and chemotherapeutic agents has been suggested as adjuncts, but they have limitations related to their release mechanisms and the induction of bacterial resistance over time.[6,7] Antimicrobial photodynamic therapy has gained much attention as a non-invasive and biocompatible approach that can be

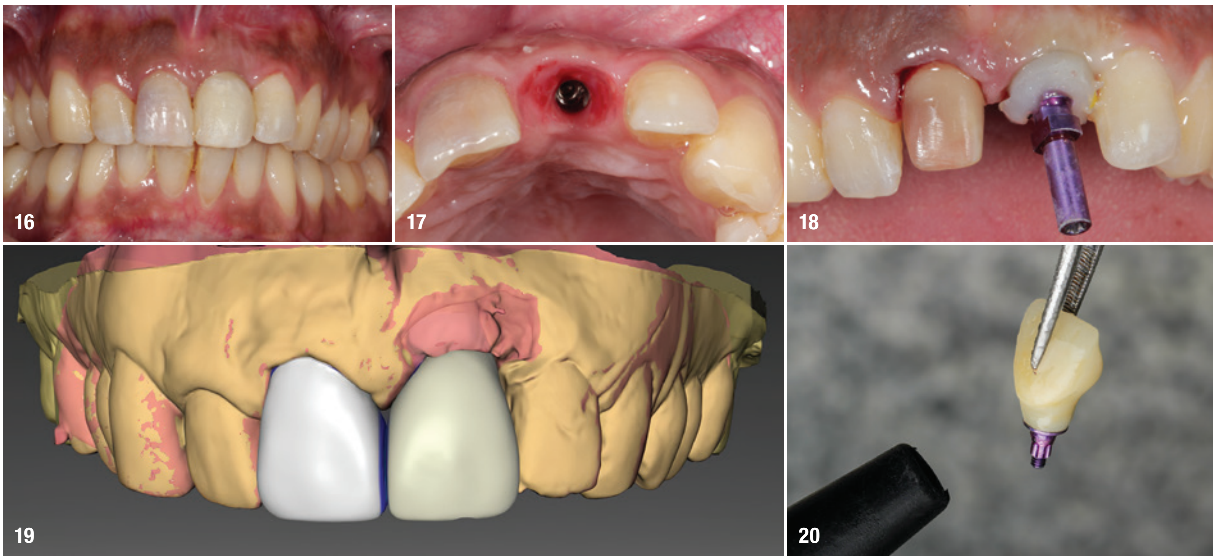
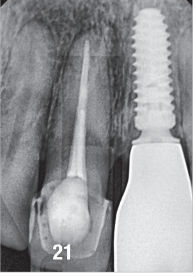


Fig. 16: Four-month post-op clinical evaluation, showing maintenance of the gingival contours. **Fig. 17:** Removal of the prosthesis revealed healthy underlying tissue. **Fig. 18:** Customised impression coping for recording soft-tissue contour. **Fig. 19:** Digital fabrication of crowns. **Fig. 20:** Steam-cleaning of the definitive implant crown.



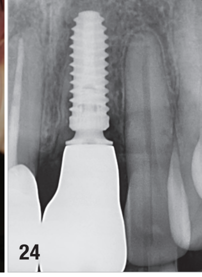


Fig. 21: Immediate post-op radiograph after placement of the definitive crowns. **Fig. 22:** Definitive restorations of teeth #11 and 21. **Fig. 23:** Six-month follow-up clinical image. **Fig. 24:** Six-month follow-up radiograph.

employed to prevent biological complications associated with implants.[8] HELBO antimicrobial photodynamic therapy was done as an adjunct to mechanical debridement of the granulation tissue in this case. Novaes et al. showed better results for immediate implants placed in sites decontaminated by debridement associated with antimicrobial photodynamic therapy.[9] The sites treated with mechanical debridement and antimicrobial photodynamic therapy led to osseointegration of the implants without evidence of inflammation; conversely, evidence of peri-implantitis was observed where antimicrobial photodynamic therapy was not used.[9]

Since the primary stability in this case was 45 Ncm and ISQ of 86, immediate loading was done. Studies have demonstrated that insertion torque value alone can be used as a benchmark for single crown immediate loading of implants placed in fresh extraction sockets if the attested insertion torque value score is > 30 Ncm.[10] Excellent primary implant stability is an absolute requirement for immediately loading an implant with a provisional restoration. It is dependent on bone density and quality, implant design and surface, as well as the technique and accuracy of the osteotomy preparation.[8]

The implant system used was selected due to its virtue of an unique osseo connect surface, owing to which the neck of the implant supports soft-tissue attachment, thereby preventing bacterial infiltration and providing protection for the implant. The sandblasted and etched surface enhances rapid osseointegration. It features a back-taper design, which has a positive influence on the marginal bone level, and a self-tapping double thread, which is important for the predictable attainment of high primary stability. The copaSKY implant system employs platform switching. Platform switching refers to placement of an abutment of a smaller diameter than that of the implant platform. This minimises crestal bone loss, as the inflammatory infiltrate is moved away from the crestal bone.[11] The self-tapping double thread achieves faster insertion of the implant with lower heat generation and bone condensation.[12] Sandblasted and etched implants with a self-tapping thread in a cylindrical and conical hybrid design show statistically higher insertion and removal torque values compared with machined implants, along with enhanced primary stability.[13]

Soft-tissue augmentation with a de-epithelialised free gingival graft was done, as the gingival biotype was thin. Autogenous soft-tissue procedures ensure good blood supply to the graft with predicable results. The long-term stability of pink aesthetics around dental implant prostheses has been strongly correlated with adequate peri-implant soft-tissue thickness, that is, a thick peri-implant biotype.[14, 15] When a thin biotype is diagnosed, a subepithelial connective tissue graft or a free gingival graft can be used to prevent potential long-term recession of the facial mucosal margin or permeation of a greyish discoloration from the implant.[16–18]

The case in discussion, shows satisfactory short-term results at six months based on all the above-mentioned clinical procedures and scientific considerations.

Conclusion

Complexities of anterior implant rehabilitation can be combated with thorough diagnosis and holistic treatment planning. Immediate implant placement with immediate loading is made more predictable with photodynamic therapy, especially in infected sockets. Guided bone regeneration and soft-tissue augmentation reinforce the foundation of the peri-implant seal, which is essential not only for long-term implant success but also for the harmony of the gingival architecture. Successful anterior implant rehabilitation is a combination of periodontal and restorative mastery.

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about the author

Dr Rita Singh completed her postgraduate degree in periodontics from Rajiv Gandhi University of Health and Sciences in Bengaluru in India in 2001. She was an associate professor in the department of periodontics at the Kathmandu University in Nepal until 2018 and is the director of Oracare Periodontal Clinic, a multi-specialty state-of-the-art dental clinic in Kathmandu specialising in implantology and periodontics. Dr Singh actively pursues implantology courses presented by different associations all over the globe and is focused on implant aesthetics and soft-tissue management, lecturing internationally on these topics. She is the president of the Nepalese Society of Implant Dentistry. She is a member of Zonta International, empowering women through service and advocacy in Nepal.

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Literature