ARTICLES SCIENTIFIQUES

Esthetic Zone Rehabilitation Using Guided Implant Placement and Simultaneous Guided Bone Regeneration: A Case Report

Réhabilitation de la zone esthétique par pose implantaire guidée et régénération osseuse guidée simultanée : à propos d'un cas clinique

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Résumé

Contexte : La réhabilitation implantaire dans le maxillaire antérieur présente des défis importants en raison des exigences esthétiques élevées et de la résorption tissulaire post-extractionnelle. La planification numérique et les techniques chirurgicales guidées ont amélioré la précision et la prévisibilité de la pose d'implants, en particulier dans les cas complexes impliquant des déficits osseux et tissulaires. **Présentation du cas** :Une patiente de 22 ans présentait une perte de l'ncisive centrale droite maxillaire suite à un traumatisme et à un échec du traitement endodontique. L'évaluation clinique et radiographique a révélé une résorption osseuse buccale et une invagination des tissus mous. Une pose d'implant différée a été planifiée à l'aide d'un flux de travail numérique axé sur la prothèse. La planification virtuelle avec le logiciel Exoplan® a guidé la fabrication d'un guide chirurgical imprimé en 3D et soutenu par les dents. Un implant a été posé à l'aide d'un protocole entièrement guidé avec régénération osseuse guidée simultanée. Après six mois, une deuxième intervention chirurgicale avec une technique de lambeau roulé et une couronne provisoire vissée sur une base en T a été réalisée afin d'optimiser les contours des tissus mous. **Résultats** :La cicatrisation s'est déroulée sans incident et la maturation des tissus mous a donné des résultats esthétiques et fonctionnels favorables. **Conclusion** : Ce cas souligne l'intérêt d'intégrer la planification numérique, la chirurgie implantaire guidée et les techniques d'amélioration des tissus mous pour obtenir des résultats prévisibles et esthétiquement harmonieux dans la réhabilitation des défauts maxillaires antérieurs post-traumatiques.

Mots clés : Chirurgie implantaire guidée ; Planification numérique ; Régénération osseuse guidée ; Technique du lambeau roulé ; Implant en zone esthétique ; Gestion des tissus mous.

Abstract

Background : Implant rehabilitation in the anterior maxilla presents significant challenges due to high esthetic demands and post-extraction tissue resorption. Digital planning and guided surgical techniques have enhanced precision and predictability in implant placement, especially in complex cases involving bone and soft-tissue deficiencies. **Case-Presentation**: A 22-year-old female patient presented with the loss of the maxillary right central incisor following trauma and failed endodontic treatment. Clinical and radiographic evaluation revealed buccal bone resorption and soft-tissue invagination. A delayed implant placement was planned using a prosthetically driven digital workflow. Virtual planning with Exoplan® software guided the fabrication of a tooth-supported 3D-printed surgical guide. An implant was placed using a fully guided protocol with simultaneous guided bone regeneration. After six months, second-stage surgery with a roll-flap technique and a screw-retained provisional crown on a T-base were performed to optimize soft-tissue contours. **Results:** Healing was uneventful, and soft-tissue maturation showed favorable esthetic and functional outcomes. **Conclusion:** This case highlights the value of integrating digital planning, guided implant surgery, and soft-tissue enhancement techniques to achieve predictable and esthetically harmonious outcomes in the rehabilitation of post-traumatic anterior maxillary defects.

Key words : Guided implant surgery; Digital planning; Guided bone regeneration (GBR); Roll flap technique; Esthetic zone implant; Soft-tissue management.

INTRODUCTION

Tooth loss in the anterior maxilla poses a significant clinical and aesthetic challenge for both patients and clinicians (1,3). Among the various etiologies, dental trauma in young adults is a frequent cause and often results in complex biological and prosthetic complications (4,).

Traumatized teeth may subsequently develop pulpal necrosis, root resorption, or other sequelae that compromise the prognosis of conservative treatments such as endodontic therapy (5,6).

In such cases, tooth extraction followed by implant-supported rehabilitation remains the most predictable approach to restore oral function and aesthetics (2,11,final). The replacement of a maxillary central incisor, particularly the central incisor, is considered one of the most challenging procedures due to high aesthetic expectations and the need for optimal hard- and soft-tissue integration (1,23).

This case report details the multidisciplinary management of a 22-year-old female patient presenting with the loss of the maxillary right central incisor secondary to dental trauma and subsequent failure of endodontic treatment (23). Following a provisional removable prosthetic phase, the patient sought a definitive fixed solution that would fulfill both functional and aesthetic requirements through implant-supported rehabilitation (23,10). The therapeutic approach was based on comprehensive diagnostic evaluation and evidence-based surgical planning, with particular emphasis on the reconstruction of the buccal alveolar defect and optimization of peri-implant soft tissues to achieve long-term stability and a harmonious aesthetic integration within the anterior maxilla (3,23).

CASE REPORT

A 22-year-old non-smoking patient presented with the loss of the maxillary right central incisor (tooth 11) following trauma and a failed endodontic treatment. The tooth had been extracted six months earlier (figure 1), and a flexible removable partial denture had been provided as a temporary prosthesis. The patient reported discomfort and aesthetic dissatisfaction with this solution.

Figure 1 Endobuccal view 10 days after tooth extraction

Clinical examination revealed a healed edentulous ridge with buccal depression and a thick, irregular soft-tissue biotype (figure 2). CBCT analysis confirmed a combined horizontal and vertical buccal bone deficiency of approximately 4 mm each. The treatment plan involved implant placement with simultaneous guided bone regeneration (GBR) to restore ridge volume and optimize aesthetics.

Figure 2 Preoperative endobuccal view

Digital planning was performed using Exoplan® software by merging CBCT data with intraoral scans to achieve prosthetically driven implant positioning (figure 3). A tooth-supported, 3D-printed surgical guide was used to ensure precision in implant angulation, depth, and mesiodistal alignment. (figure 4)

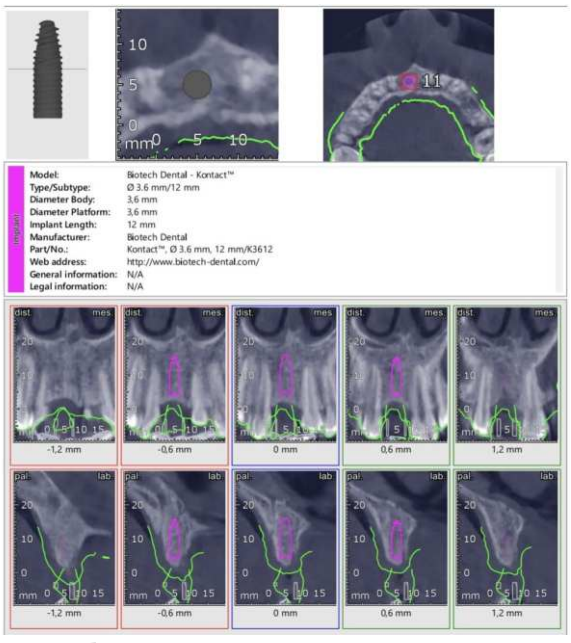


Figure 3 Surgical planification using Exoplan® software

Figure 4 3D-printed surgical guide with a sleeve integrated

Under local anesthesia, a full-thickness flap was raised following a crestal incision with vertical releases (figure 5 and 6). The guided protocol allowed the insertion of the implant, positioned 2 mm subcrestally (figure 7, 8, 9). GBR was performed using a xenogeneic bovine graft mixed with blood and covered by a resorbable collagen membrane, stabilized apically and sutured for tension-free closure (figure 10, 11, 12).

Figure 5 Intraoperative view showing incision

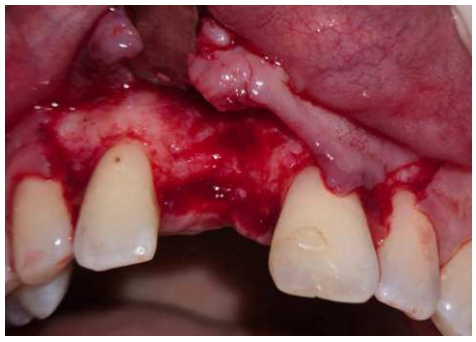


Figure 6 Full-thickness flap

Figure 7 Surgical guide fixed on the adjacent teeth (Dental supported)

Figure 8 Fully guided Implant placement

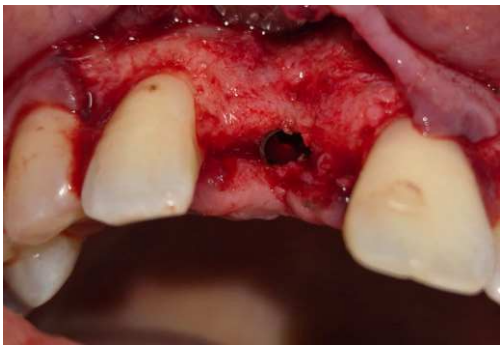


Figure 9 Implant positioned 2 mm subcrestally

Figure 10 Xenogeneic bovine graft in site

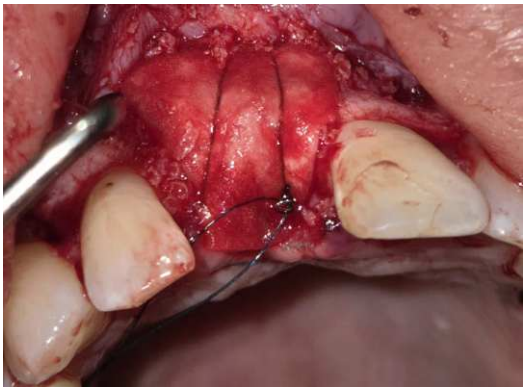


Figure 11 Resorbable collagen membrane, stabilized apically

Figure 12 Tension free sutures

Postoperative management included antibiotic, analgesics, and local antiseptic care. Healing was uneventful, and the patient was instructed to avoid wearing the removable prosthesis during the initial phase. A Maryland-type resin-bonded bridge was provided for esthetics during osseointegration. (figure 13)

Figure 13 15 days follow-up, a Maryland-type resin-bonded bridge was provided 3 days after surgery

At six months, radiographic evaluation confirmed successful osseointegration (figure 16). A roll-flap procedure was performed to enhance buccal soft-tissue thickness, followed by placement of a healing abutment (Figure 14, 15). After 48 hours, an intraoral scan with a biotech scan-body was done and a screw-retained provisional crown on a titanium base (T-base) was fabricated to sculpt the emergence profile and achieve gingival harmony (Figure 18).
The conception of the crown was done with Exocad software (Figure 17).

Figure 14a Incisal view showing the healing after 6 months

Figure 14b Buccal view showing the healing after 6 months

Figure 15a Paramarginal incision and de-epithelialisation of crestal and buccal mucosa

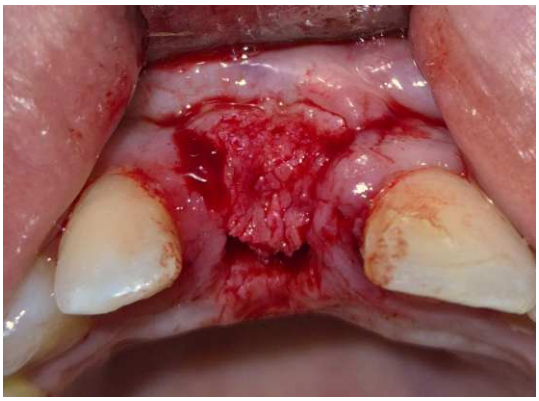


Figure 15b Full thickness flap crestally

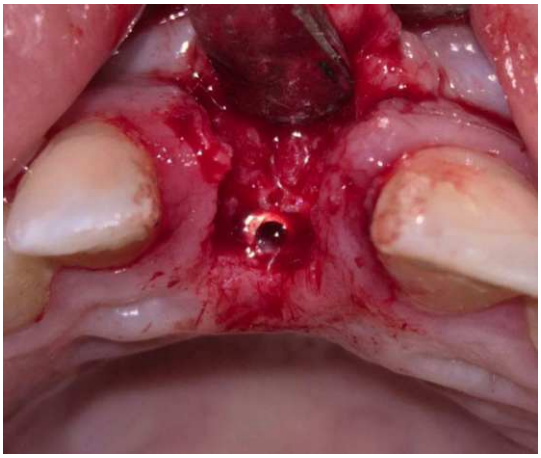


Figure 15c Partial thickness flap buccally

Figure 15d Placement of a healing abutment provisionally for 24 hours

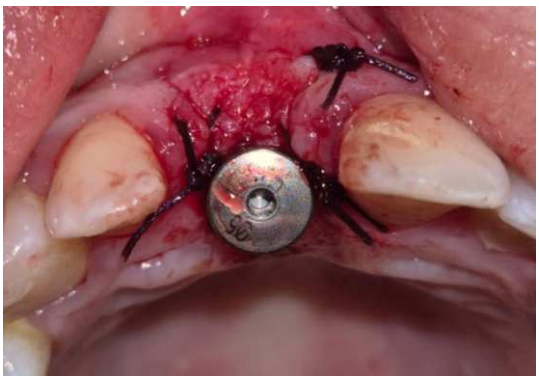
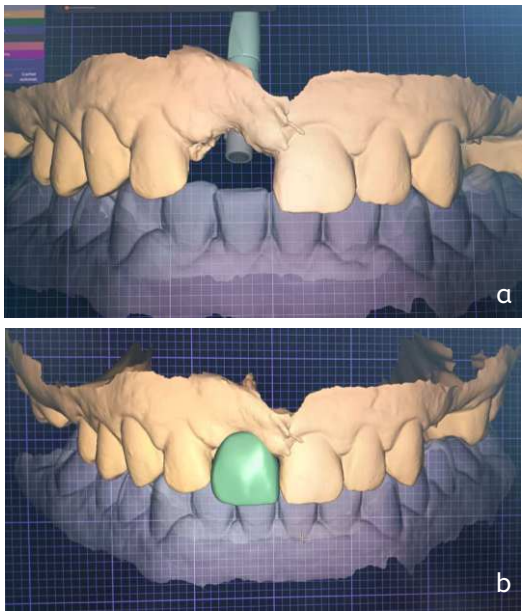


Figure 15e Horizonal mattress sutures

Figure 16 Radiographic evaluation confirmed successful osseointegration



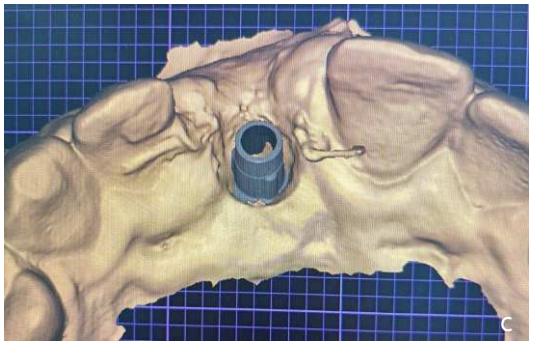


Figure 17a, b et c Planification of a screw-retained provisional crown on a titanium base (T-base) with Exocad

Figure 18 Screw-retained provisional crown on a titanium base (T-base) fixed after 48 hours

At the two-month follow-up, the peri-implant tissues demonstrated stability and natural aesthetics (Figure 19). The patient remains under evaluation for definitive restoration or possible additional connective tissue grafting to further refine the gingival contour. A radiographic evaluation confirmed successful osseointegration 9 months after implant placement (Figure 20).

Figure 19a, b, c, d Two-month follow-up, the peri-implant tissues demonstrated stability and natural aesthetics

Figure 20 9 months radiographic evaluation

DISCUSSION

Implant rehabilitation in the anterior maxilla remains one of the most demanding procedures in contemporary dentistry due to the combined esthetic, functional, and biological challenges (1,2). Successful outcomes depend not only on osseointegration but also on achieving harmonious gingival contours, adequate soft-tissue volume, and a natural emergence profile (3).

Post-traumatic bone loss, as in this case, further complicates treatment because horizontal and vertical resorption often coexist with fibrotic soft tissue (4). The timing of implant placement is critical for long-term hard- and soft-tissue stability (5). In this patient, delayed placement six months after extraction allowed the ridge to remodel and provided a clearer assessment of bone and soft-tissue conditions (6). According to current evidence, delayed implant placement remains a reliable option when bone defects or esthetic risks are present, providing more control over the regenerative phase and reducing postoperative complications compared with immediate placement (7,8).

The integration of digital technology fundamentally changes how implant surgery is planned and executed (9). Using Exoplan® software, the CBCT scan and intraoral optical impression were merged to generate a prosthetically driven digital plan (10). This approach allowed visualization of both bone anatomy and prosthetic requirements simultaneously, ensuring accurate three-dimensional positioning of the implant relative to the adjacent roots and future crown contours (11).

Fully guided implant placement using a tooth-supported 3D-printed guide increased precision and safety (12). Several studies have shown that guided surgery can significantly reduce angular and depth deviations compared with freehand placement, especially in esthetic areas where even small positional errors can compromise the final appearance (13,14). In the present case, the guided approach facilitated control of the implant's buccolingual positioning and ensured respect of the interproximal distances needed for papilla preservation and optimal emergence profile design (15). The buccal bone deficiency was addressed with guided bone regeneration (GBR) using a xenogeneic bovine graft covered by a resorbable collagen membrane (16). Predictable GBR relies on membrane stability, space maintenance, tension-free closure, and adequate healing time (17). Membrane fixation with apical mattress sutures and periosteal-releasing incisions created a stable environment, promoting undisturbed bone regeneration (18).

Beyond bone reconstruction, the management of peri-implant soft tissues is crucial for achieving and maintaining esthetic results (19). The roll-flap technique used during the second-stage surgery has the advantage of preserving vascularization while augmenting soft-tissue volume, improving color match, and reducing the risk of gingival recession (20). The provisional screw-retained crown, fabricated on a titanium base (T-base) using a digital workflow, allowed progressive conditioning of the mucosa and natural shaping of the emergence profile (21).

Current evidence emphasizes that sufficient soft-tissue thickness (>2 mm) and the presence of keratinized mucosa are critical factors for long-term

peri-implant health (22). For this reason, the potential addition of a buried connective tissue graft is being considered to further enhance the gingival architecture and ensure the stability of esthetic outcomes over time (23). Precision, reduced chair time, and improved patient satisfaction.

This case underscores the value of an interdisciplinary, digitally guided approach in managing complex anterior implant cases (24). The integration of guided bone regeneration, advanced soft-tissue techniques, and digital planning allows precise, minimally invasive, and predictable restoration of function and esthetics (25). Such approaches enable clinicians to manage post-traumatic anterior maxillary defects with high accuracy, reduced chair time, and improved patient satisfaction (26).

Contemporary developments in implant dentistry emphasize immediate implant placement and provisionalization, which help preserve soft tissue architecture and maintain esthetic contour following traumatic extraction in the anterior maxilla (27). Computer-aided design and reverse engineering for provisional restorations enable efficient transitions from surgery to restoration while optimizing the emergence profile (28).

Emerging surgical procedures, such as sinus elevation, alveolar distraction osteogenesis, and the use of zygomatic or pterygoid implants, dramatically expand treatment options for severely resorbed or anatomically compromised maxillae (29,30). These techniques achieve favorable long-term implant survival and esthetic results even in challenging cases (31,32).

A multidisciplinary workflow—including prosthodontic planning, tissue engineering, and digital prosthesis design—is critical for evaluating risk factors, personalizing surgical protocols, and adapting to anatomical constraints in the esthetic zone (33,34). Ongoing documentation of clinical and three-dimensional soft-tissue changes, together with regular post-operative maintenance, is vital for ensuring stability and patient satisfaction with complex anterior implant rehabilitations (35,36).

Recent reviews support individualized, prosthetically driven planning and early engagement of surgical and prosthetic teams to optimize long-term success in the anterior maxilla (37,38).

CONCLUSION

This case demonstrates that delayed implant placement with simultaneous guided bone regeneration and fully guided surgery can achieve predictable and esthetic outcomes in post-traumatic anterior maxillary rehabilitation. Digital planning, guided execution, and soft-tissue management, including roll flap and potential connective tissue grafting, are key to ensuring long-term functional and esthetic success.

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