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Esthetic zone rehabilitation through immediate implant placement : A case-based approach

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Abstract

Background: Rehabilitation of missing teeth in the esthetic zone presents significant clinical challenges, requiring the preservation of hard and soft tissues to achieve functional and esthetic outcomes. Immediate implant placement following atraumatic extraction has become a predictable approach when anatomical and biological conditions are favorable.

Case Presentation: This report describes the management of a 22-year-old male patient requiring extraction and immediate implant placement in the anterior maxilla. Careful pre-surgical evaluation, including three-dimensional imaging and assessment of bone and soft tissue quality. Atraumatic extraction techniques preserved the buccal plate and surrounding soft tissue architecture. Implant placement was prosthetically driven, ensuring optimal three-dimensional positioning, primary stability, and soft tissue support. Guided-bone-regeneration (GBR) was performed using a xenograft and cross-linked collagen membrane. Immediate provisional restoration was used to guide soft tissue healing and emergence profile.

Results: At follow-up, the implant achieved stable osseointegration, and soft tissue contours were maintained, resulting in satisfactory esthetic and functional outcomes. No peri-implant complications were observed, and patient satisfaction was high.

Conclusion: Immediate implant placement's success in esthetic zone relies on thorough clinical assessment, atraumatic extraction, prosthetically guided implant positioning, and appropriate tissue augmentation when necessary. This case underscores the importance of integrating surgical and prosthetic considerations to achieve long-term esthetic and functional results.

Keywords: Immediate implant, esthetic zone, atraumatic extraction, soft tissue management, bone grafting, provisional restoration.

Introduction

Over recent decades, dental implantology has shifted from a primarily functional focus to one where esthetic outcome are equally prioritized, particularly in the anterior maxilla, or “esthetic zone.” Patients increasingly expect restorations that restore both function and natural appearance, making implant therapy in this region uniquely challenging. Success relies on biological integration and the harmonious blending of implants with adjacent teeth and soft tissues, taking into account extraction site anatomy, hard and soft tissue condition, timing of placement and loading, and patient esthetic priorities. (1)

Preservation of hard and soft tissues is critical for proper implant positioning and long-term esthetic outcomes (2,3). Techniques such as atraumatic extraction, socket preservation, and grafting help maintain tissue architecture and support prosthetic results. Advances in diagnostic imaging, digital planning, biomaterials, and surgical techniques—including CBCT, intraoral scanning, and digital workflows—enhance precision, predictability, and individualized treatment planning. Interdisciplinary coordination between surgical and prosthetic teams is essential to meet both functional and esthetic goals.

This case report illustrates a comprehensive workflow for achieving predictable esthetic results in anterior implant therapy, emphasizing clinical decision-making, optimal timing, peri-implant tissue management, and patient-specific considerations.

Case presentation

A 22-year-old male patient, with no pathological antecedents, non-smoker, has consulted the department of the university hospital Farhat Hached of Sousse for a level 3 mobility of the tooth 11 associated to soft tissue recession due to radicular fracture in the medium third after a traumatic accident for 3 months after the failure of the attempt to preserve the coronal fragment through endodontic treatment and vestibular retention.

The extra-oral examination has showed an adequate mouth opening with a low lip line
The intra-oral examination has showed good oral hygiene, since the patient was in maintenance phase after initial periodontal therapy, his periodontal phenotype was thick and low scalloped and a degree 3 mobility of the tooth 11 associated to vestibular recession with 2mm of remaining keratinized gingiva. (Figure 1)

Figure 1: Intra oral view showing contention failure of the tooth 11 associated to soft tissue recession with a thick periodontal phenotype

A CBCT scan was performed to assess the height and the width of the residual bone. The coronal section view has showed a Horizontal bone defect; a resorption at the buccal cortical bone. (Figure 2)

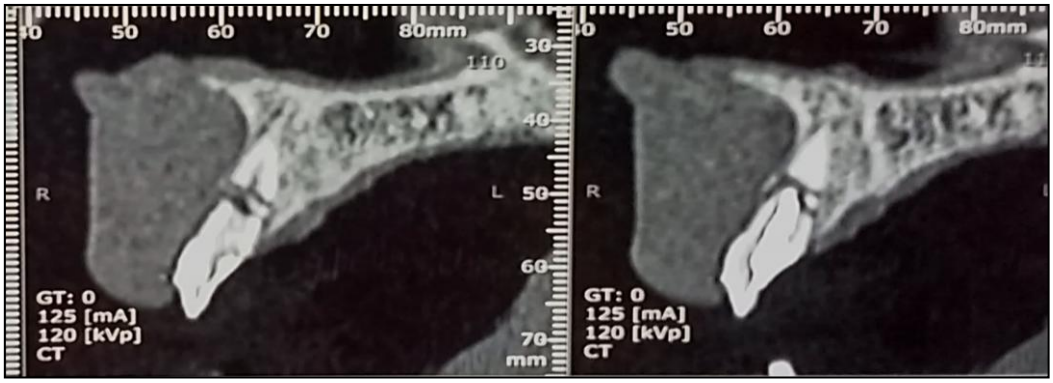

Figure 2: The coronal section showing the radicular fracture associated to buccal bone defect of the cortical bone.

Taking all these factors into account, essentially the thick periodontal biotype and the low aesthetic risk, the therapeutic decision was the extraction of the tooth 11 and immediate Implant placement and loading.

The treatment plan has included the following steps:

1/ Atraumatic extraction and implant placement:
The coronal and apical fragments were carefully removed to preserve the surrounding alveolar bone and soft tissues (Figure 3). Following extraction, the post-extraction socket was thoroughly evaluated to ensure complete removal of the fragments and prepare the site for subsequent procedures. Pilot drilling was performed to verify the correct axis and orientation for the future implant (Figure 4), followed by sequential osteotomy to the planned depth and diameter, preparing the site for implant placement. The implant was then inserted with primary stability achieved.

Figure 3: The post-extraction socket after removing coronal and apical fragments

Figure 4: Pilot drilling and verification of the axis.

2/ Guided-bone-regeneration (GBR):
A full-thickness flap was elevated to expose the bone defect (Figure 5). The horizontal defect was reconstructed using a xenograft, which was carefully packed to fill the defect, and then covered with a cross-linked collagen membrane to maintain the graft in place and promote bone regeneration (Figure 6).

Figure 5: Flap elevation and exposure of the bone defect

Figure 6: The xenograft packed in place to bridge the horizontal bone defect then covered with the collagen membrane.

3/ Impression and soft tissue management:
An impression for the provisional restoration was taken using the pick-up technique (Figure 7, Figure 9). An autologous platelet-rich fibrin (PRF) membrane was placed over the collagen membrane to enhance soft tissue healing (Figure 7). The flap was then repositioned and secured with vertical mattress sutures using non-absorbable monofilament material (Figure 8). The healing abutment was placed while the provisional prosthesis was fabricated in the laboratory (Figure 10).

Figure 7: Pick-up transfer connection and placement of autologous PRF membrane over the collagen membrane

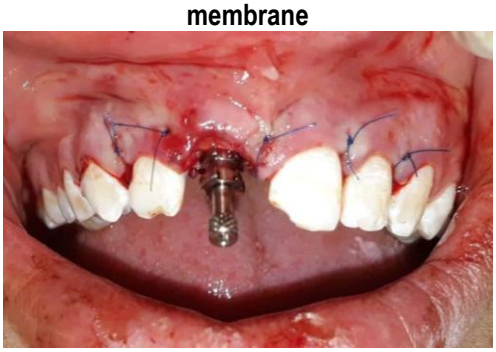

Figure 8: Flap repositioning by vertical mattress sutures using non-absorbable monofilament material

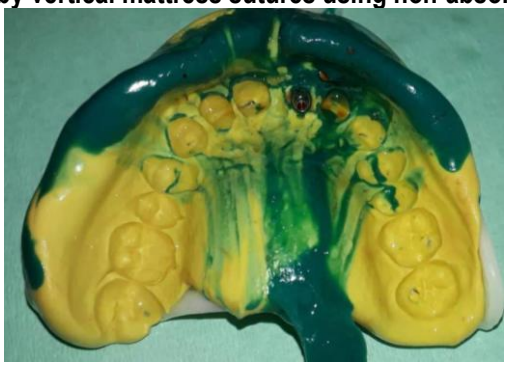

Figure 9 : Impression with the transfer pick up in place

Figure 10 : Placement of the healing abutment while the provisional prosthesis was being made in the laboratory.

4/ Esthetic temporization:

The provisional restoration was delivered 24 hours post-operatively to ensure immediate esthetic rehabilitation (Figure 11). Clinical evaluation at one month demonstrated satisfactory mucosal healing and integration of the soft tissues around the provisional restoration (Figure 12).

Figure 11: Patient's smile with the provisional prothesis in place

Figure 12: Clinical view showing mucosal healing after 1 month.

5/ Definitive restoration: After four months of healing, the definitive all-ceramic prosthesis was placed. The final outcome demonstrated optimal esthetics and functional integration, and the patient expressed full satisfaction with the result (Figure 13). The definitive prosthesis was complemented by two ceramic veneers on teeth 12 and 21 to achieve harmonious anterior esthetics.

Figure 13: Definitive all-ceramic prosthesis in place, combined with two ceramic veneers on teeth 12 and 21.

Discussion

The timing of implant placement—immediate or delayed—significantly influences osseointegration, esthetics, functional stability, and patient satisfaction (1). Implant stability can be objectively assessed using the Implant Stability Quotient (ISQ) via Resonance Frequency Analysis (RFA), which differentiates primary stability (mechanical engagement at placement;

ISQ >70 indicates excellent stability) from secondary stability (biological stability arising from bone remodeling, measured 2–12 weeks post-placement).

Loading protocols are categorized as immediate (prosthesis placement within one week, requiring high primary stability, ISQ >70, torque 35–45 Ncm), early (1 week–2 months, for moderate stability), and conventional (>2 months, allowing complete osseointegration). The choice of protocol depends on ISQ, bone quality, and patient-specific factors. (4–8)

Pre-surgical evaluation for anterior implants

Systemic health, chronic conditions, and medications strongly influence implant outcomes. Diseases such as diabetes, osteoporosis, and cardiovascular disorders can compromise osseointegration, with poorly controlled diabetes increasing the risk of infection and implant failure (8,9). Medications including SSRIs, PPIs, and NSAIDs may negatively affect bone metabolism, remodeling, and healing; however, low-dose bisphosphonates are generally considered safe for implant integration (10–12). The ITI Group recommends conventional loading for patients with compromised immunity or parafunctional habits (13–16).

Local factors, including oral hygiene, smoking, lip line, and soft tissue biotype, are also critical for esthetic outcomes. Thin gingiva and heavy smoking are associated with higher risks of gingival recession, graft failure, and peri-implantitis (17–20). Proper management of occlusion, temporomandibular disorders, parafunctional habits, and pre-existing infections is essential, as immediate implant placement in infected sites or compromised bone may increase early failure risk (8,21–23).

Esthetic outcomes are further influenced by papilla morphology, keratinized tissue, tooth shape, and extraction socket condition. Tools such as the Esthetic Risk Assessment Score (ERAS) aid case-specific planning, particularly in the anterior zone (24–28). Patient- and site-specific factors, combined with evidence-based protocols, are important for achieving predictable functional and esthetic results.

A thorough pre-surgical assessment includes evaluation of mouth opening, inter- and intra-arch relationships, edentulous site dimensions, adjacent teeth, soft tissue characteristics, alveolar ridge anatomy, and smile line. Three-dimensional radiographic assessment with CBCT is strongly recommended for immediate implant placement to evaluate bone anatomy, assist digital planning, and optimize implant positioning (29–32).

Modern implantology emphasizes prosthetically guided placement, aligning the implant axis with the future crown to improve esthetic predictability, force distribution, and restorative options (7,32–36). Apical and palatal bone quantity is decisive for primary stability, requiring at least 4–5 mm of bone; Kan et al.'s classification guides feasibility for immediate placement (8,31,37–39). Vestibular bone thickness over 1 mm is essential to prevent gingival recession; immediate placement is contraindicated if this is insufficient (18,27,40,41).

Implant dimensions in the anterior maxilla generally favor narrow diameters (3.3–4.3 mm) with minimum lengths of 8 mm (RP) or 10 mm (NP) (31,32,39,42). Proper three-dimensional positioning—sagittal, interproximal, and vertical—is critical for esthetics, occlusion, soft tissue integration, and long-term implant survival. Sagittal placement aligns the implant with the incisal edge or cingulum, maintaining 2 mm from the buccal bone and 1 mm from the palatal bone (43–47). Interproximal spacing requires over 1.5 mm from adjacent teeth or over 3 mm from other implants to preserve bone and papillae (48). Vertical positioning places the implant platform 2–4 mm apical to the gingival margin, with 3–4 mm apical drilling beyond the apex to ensure primary stability and maintain biological width (48–50).

If optimal anatomical conditions are not achievable, delayed implantation with pre- or intraoperative bone augmentation is recommended (31,33,39).

The following table analyzes the pre-operative factors in our case influencing the predictability of esthetic result in case of immediate implant placement in the esthetic zone according to ITI esthetic risk assessment score (ERAS). (Table 1)

Table 1 : The esthetic risk assessment (ERA) tool introduced by the ITI group

Esthetic risk assessment	Low	Medium	High
Medical status	Healthy		Compromised
Smoking habits	Non smoker	Light smoker (<10 cigarettes per day)	Heavy smoker (≥ 10 cigarettes per day)
Patient's esthetic expectations	Low	Medium	High
Lip line	No exposure of papillaes	Exposure of papillaes	Full exposure of mucosa margin
Periodontal phenotype	Low-scalloped, thick	Medium-scalloped, medium-thick	High-scalloped, thin
Shape of tooth crowns	rectangular		Triangular
Infections at implant sites	None	Chronic	Acute
Bone level at adjacent teeth	≤ 5mm to contact point	5.5 to 6.5 mm to contact point	> 7mm to contact point
Prosthodontic status of neighboring teeth	Virgin		Restored
Width of edentulous span	1 tooth (≥ 7mm)	1 tooth (<7mm)	2 teeth or more
Soft tissue anatomy	Intact		Defective
Bone volume	Horizontally and vertically sufficient	Horizontally deficient	Deficient vertically or deficient vertically and horizontally

Surgical protocol

Atraumatic extraction is essential to preserve the buccal bone plate and surrounding soft tissues, preventing complications that may necessitate delayed implantation (39,51). Techniques include root separation in bucco-palatal directions to minimize bone stress; luxation with fine elevators or periotomes avoids damage to the buccal plate (52). Moreover, Systems such as Benex® allow gentle longitudinal tooth removal while protecting fragile bone, especially in aesthetic zones. Ultrasonic micro-vibrations selectively cut mineralized tissue, minimizing trauma, hemorrhage, and thermal injury, enhancing healing and reducing complications (53).

Granulation tissue must be removed mechanically with a periodontal curette to optimize osseointegration; however; chemical decontamination has no added benefit in this context (22). Flapless implant placement preserves periosteal blood supply and gingival architecture,

reducing buccal and papillary recession (54). Evidence supports flapless surgery for predictable, long-term esthetic outcomes (ITI).

Sequential drilling under irrigation prevents overheating and trauma; undersizing drills may enhance primary stability in low-density bone (Type 1A). Implant positioning should be 4 mm apical to the adjacent cemento-enamel junction **(**CEJ) and 1 mm palatal to CEJ alignment. Immediate provisional restoration is indicated when primary stability reaches 25–40 N/cm or ISQ >70.

Hard and soft tissue management

Onlay-Grafting is indicated for ridge resorption without antagonist overeruption, with the ascending ramus as a donor site. Grafts are fixed with titanium screws, and pre-drilled vascular channels improve integration. Long-term studies report high implant survival (91.8% over 8.9 years) and stability (2).

Guided Bone Regeneration (GBR) excludes epithelial and connective cells, promoting bone formation (3). Indicated for vertical and horizontal defects as in our case report (55), GBR relies on PASS principles: primary wound closure, angiogenesis, space maintenance, and graft stability (56–58). Immediate implantation favors gap filling with resorbable membranes for small defects, while larger defects require bone blocks with particles and membranes for delayed placement (59).

Soft tissue management

Connective tissue grafts increase crestal labial thickness to more than 2 mm in the aesthetic zone (60). Techniques include subepithelial grafts (palate, tuberosity, edentulous ridge) (61,62), pouch, crestal vertical, horizontal vestibular, and tunnel approaches. Apically-repositioned-flap **(**ARF), roll technique, or ARF combined with connective tissue graft are applied depending on the need for thickness or keratinization (38,63,64).

Palacci's papilla rotation flap during second-stage surgery optimizes interproximal tissue healing and papilla reconstruction. (60)

Prosthetic protocol

Provisional Restorations guide soft tissue maturation and emergence profile. Pre-implant prostheses include removable dentures (65) or resin-bonded bridges (66). Post-implant provisionals are placed within 48 hours, out of occlusion, to maintain primary stability (67).

Implant abutments establish the emergence profile and support platform switching to preserve crestal bone (68,69). Cement-Retained as titanium, ceramic, or zirconia; are aesthetically favorable but may risk peri-implantitis due to residual cement (70,71). However, screw-retained abutments are preferred in esthetic zones due to reduced biological complications (70,72,73).

Axis correction with angled or castable abutments allows prosthetic-driven alignment; digital CAD/CAM technology enables precise customization.

The final restoration with its emergence profile sculpts surrounding soft tissue for optimal esthetics (74). All-ceramic crowns (zirconia, lithium disilicate, leucite-reinforced glass-ceramic) are preferred over metal-ceramic for esthetics and biocompatibility (73,75–77). Hybrid materials (ZLS, PICN) combine strength and esthetics. The restoration should respect natural tooth occlusion, with anterior guidance essential for function and esthetics.

Conclusion

Rehabilitation of missing teeth in the esthetic zone is among the most demanding procedures in implant dentistry, requiring not only functional restoration but also biological integration, biomechanical stability, and superior esthetics. Success is challenged by thin periodontal biotypes, post-extraction resorption, and patient expectations for immediate, natural-appearing restorations.

Clinical decision-making between immediate, early, and conventional implant placement depends on anatomical and biological conditions. Immediate placement is suitable for non-infected sockets with intact buccal bone (≥1 mm) and sufficient primary stability (≥35 Ncm) and must account for gingival biotype, occlusion, and esthetic demands.

Three-dimensional implant positioning is critical, with palatal placement supporting facial bone and soft tissue contours. The ultimate objective is restorations that are visually indistinguishable from natural teeth while ensuring long-term peri-implant health and stability.

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