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Immediate Placement with Immediate Functional Loading of Single-Tooth Implants: Report of a Clinical Case

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ABSTRACT

Background: Immediate implant placement with immediate loading has emerged as a predictable protocol that minimizes treatment duration and optimizes esthetics. Although conventional protocols recommended a 3–6 month healing phase for osseointegration, innovations in implant macro- and micro-design now permit earlier functional loading in selected sites. This study aims to evaluate the clinical performance of single-tooth implants immediately placed and loaded in the anterior maxilla, with emphasis on surgical and prosthetic parameters. **Methods:** A case report was conducted on a patient requiring replacement of a maxillary anterior tooth due to trauma. The tooth was atraumatically extracted, and the implant was immediately placed into the fresh socket with primary stability achieved. The implant was immediately restored with a provisional crown to maintain esthetics and function. Clinical follow-up included evaluation of healing, implant stability, peri-implant tissue response, and esthetic outcomes. **Results:** Healing was uneventful, with minimal postoperative discomfort and no signs of infection or implant mobility during the follow-up period. The peri-implant soft tissues remained stable, and sutures supported preservation of papillary architecture. The provisional crown provided satisfactory esthetics and function during the osseointegration phase. Early clinical assessment indicated successful osseointegration with favorable tissue response. **Conclusion:** Immediate implant placement with immediate loading can be a predictable and esthetically pleasing treatment modality in selected cases with good primary stability and intact surrounding bone. Careful case selection, precise surgical technique, and meticulous prosthetic management are critical to achieving optimal outcomes.

1. INTRODUCTION

The concept of osseointegration, introduced by Brånemark, refers to the “direct structural and functional connection between ordered, living bone and the surface of a load-carrying implant” at the light microscopic level (Branemark, 1977). This principle has revolutionized modern implant dentistry and serves as the foundation for predictable implant success. Traditionally, clinicians advocated a stress-free healing period of 3 to 6 months prior to functional loading to allow undisturbed osseointegration (Brunski, 1992 ; Brunski, et.al., 1979). During this period, premature loading was considered to risk fibrous tissue encapsulation instead of stable bone-to-implant contact (Szmukler, et.al., 2000).

Despite this conventional approach, there has been growing interest in immediate implant placement and immediate functional loading protocols. These methods are driven by patients' increasing esthetic and functional demands, particularly in the anterior esthetic zone, as well as by the desire to reduce treatment time and avoid the use of removable interim prostheses (Szmukler, et.al., 2000 ; Misch, et.al., 2008). Several clinical reports and randomized controlled trials have demonstrated that, under specific conditions, immediate placement combined with immediate loading can achieve survival rates comparable to those of conventional staged protocols (Grunder , 2001; Ganeles, et.al, 2008 ; Cooper), et.al., 2002). Primary stability remains the most critical factor for successful immediate loading. The literature emphasizes that insertion torque, implant design, and bone quality play crucial roles in achieving sufficient initial stability to withstand early functional demands (Ottoni , et.al., 2005 ; Degidi , et.al, 2005 ; Sennerby, et.el., 1998). Advances in implant surface technology, such as hydroxyapatite coating and roughened surfaces, have also improved bone response and accelerated osseointegration, thereby supporting immediate loading strategies (Piattelli), et.al., 1998). Moreover, immediate protocols may preserve peri-implant soft tissue architecture, including papillae and gingival contours, which are critical for esthetic outcomes (Kan , et.al., 2011; Tarnow, 1997). However, concerns remain regarding increased risks of early implant failure, marginal bone loss, and compromised integration in cases with poor bone quality, infection, or insufficient primary stability (Esposito , et.al., 1998 ; Malo, et.al., 2003). This report presents a case of immediate placement and immediate loading of a single-tooth implant in the anterior maxilla. The aim is to highlight the clinical protocol, short-term outcomes, and to discuss the findings within the context of existing literature.

1.1. Problem Statement

The conventional implant protocol historically recommended a long, stress-free healing period (3–6 months) before functional loading to ensure osseointegration. While this staged approach is predictable, it often results in extended treatment duration and necessitates the use of removable interim prostheses, which do not meet the increasing esthetic and functional demands of patients, particularly in the highly visible anterior esthetic zone. Therefore, the clinical problem addressed is the need to evaluate and confirm the predictability and safety of the immediate placement and immediate functional loading protocol for single-tooth implants as a viable, time-saving, and esthetically superior alternative to conventional methods.

1.2. Significance of the Study

This case report is significant because:

- Minimizes Treatment Time: It reinforces protocols that drastically reduce the overall treatment duration, meeting modern patient expectations.
- Optimizes Esthetics: It highlights the potential of immediate loading to preserve peri-implant soft tissue architecture (papillae and gingival contours), which is crucial for achieving optimal, natural-looking esthetic outcomes in the anterior maxilla.
- Contributes to Literature: It adds specific clinical data to the growing body of literature supporting immediate loading, especially in demanding single-tooth scenarios where achieving primary stability and managing prosthetic parameters are critical for success.

1.3. Objectives of the Study

The primary objectives of this study are:

1. To evaluate the clinical performance of a single-tooth implant placed immediately into a fresh extraction socket and subjected to immediate functional loading in the anterior maxilla.
2. To highlight the specific surgical and prosthetic protocol utilized to achieve sufficient primary stability and maintain esthetic outcomes during the immediate loading procedure.
3. To assess the short-term outcomes regarding healing, soft tissue response, implant stability, and the success of osseointegration in the context of existing literature.

2. METHOD

2.1 Study Design: This clinical study was conducted to evaluate the outcomes of immediate implant placement with immediate loading in the anterior maxilla. Patients presenting with a single missing or non-restorable tooth in the esthetic zone were included based on specific selection criteria.

2.2 Patient selection: Eligible patients were systemically healthy and had adequate bone volume and density at the extraction site, confirmed by cone-beam computed tomography (CBCT) (Figure 1). Adjacent teeth demonstrated healthy periodontal conditions. Exclusion criteria included uncontrolled systemic diseases, active infection at the implant site, parafunctional habits, heavy smoking, and poor oral hygiene.

2.3 Surgical protocol: All procedures were performed under local anesthesia. Atraumatic tooth extraction was carried out to preserve alveolar bone integrity. After thorough debridement of the socket, implants with appropriate dimensions were placed in a prosthetically driven position, ensuring primary stability with an insertion torque of at least 35 Ncm (Figure 2). Bone grafting was performed if required to fill residual gaps between the implant and socket walls.

2.4 Prosthetic protocol: A screw-retained provisional crown was fabricated and delivered on the day of surgery (Figure 3). The crown was adjusted to eliminate occlusal contact in centric and eccentric movements. After a healing period of one month, definitive prostheses were fabricated and placed following evaluation of osseointegration.

Follow-up and evaluation: Patients were reviewed at 1 week, 1 month, 3 months, and 6 months postoperatively. Clinical parameters assessed included implant stability, peri-implant soft tissue health, probing depth, bleeding on probing, and marginal bone level changes evaluated radiographically. Success was defined according to the criteria proposed by (Albrektsson et al., 2008) including absence of mobility, pain, infection, and progressive bone loss exceeding 1.5 mm.

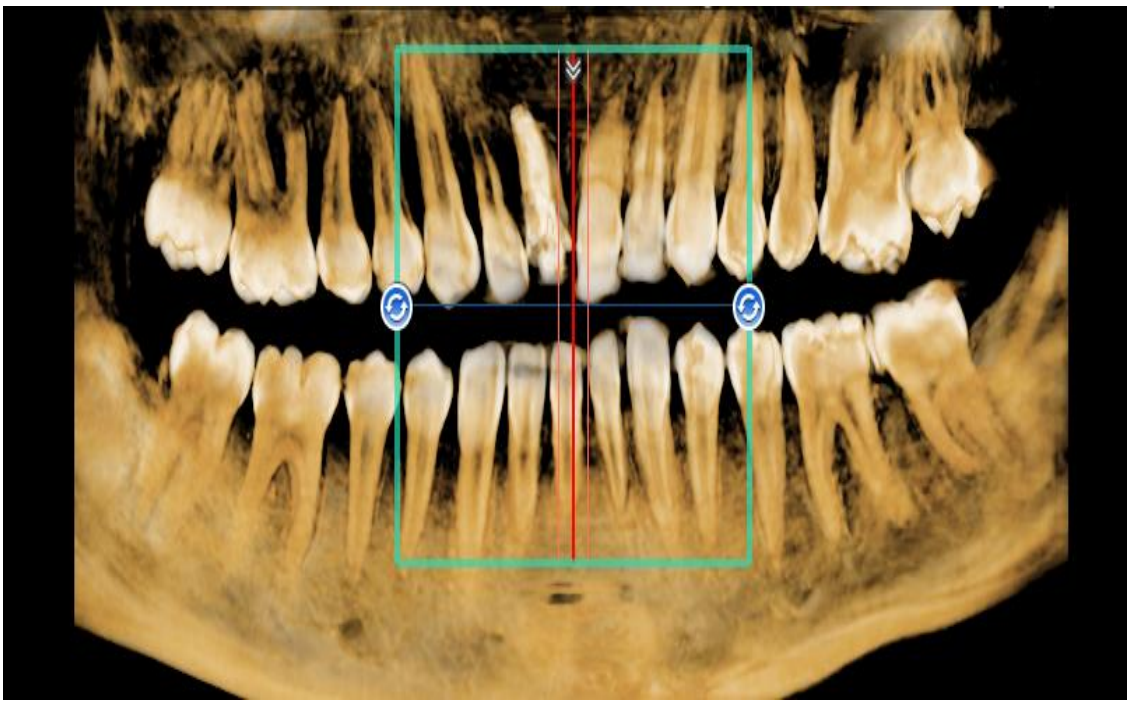

Figure 1. Pre-operative CBCT showing the fractured right maxillary central incisor with intact labial plate and sufficient apical bone height for implant placement:

Preoperative cone-beam computed tomography (CBCT) revealed a fractured right maxillary central incisor with adequate bone volume and intact buccal cortical plate. The surrounding alveolar bone demonstrated favorable density (D2 type) and no periapical pathology.

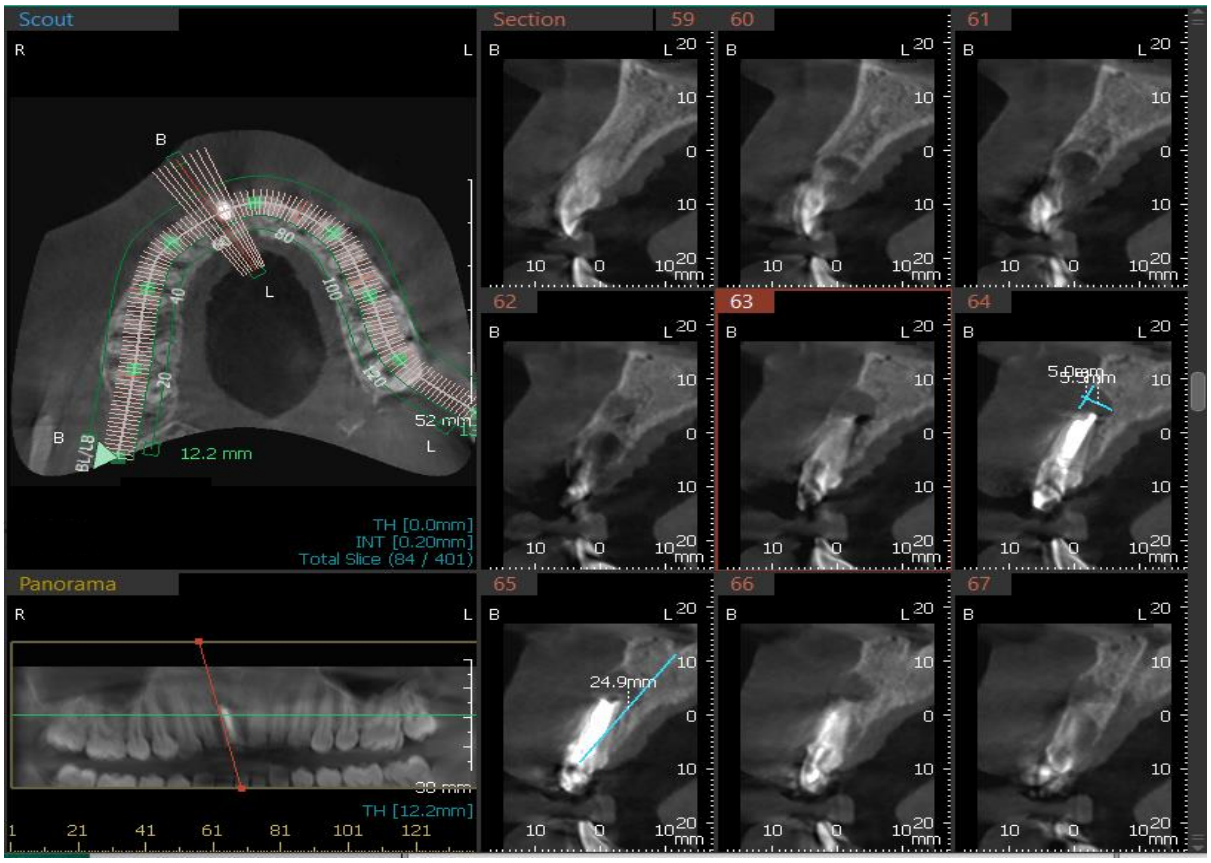

Figure 2. Sequential CBCT images demonstrating osteotomy preparation and implant positioning with verified primary stability.

Sequential CBCT slices illustrate the planned implant site with preserved labial bone and sufficient apical anchorage for primary stability. The 3D reconstruction confirms proper prosthetically driven positioning and measurement of socket depth and width for implant planning.

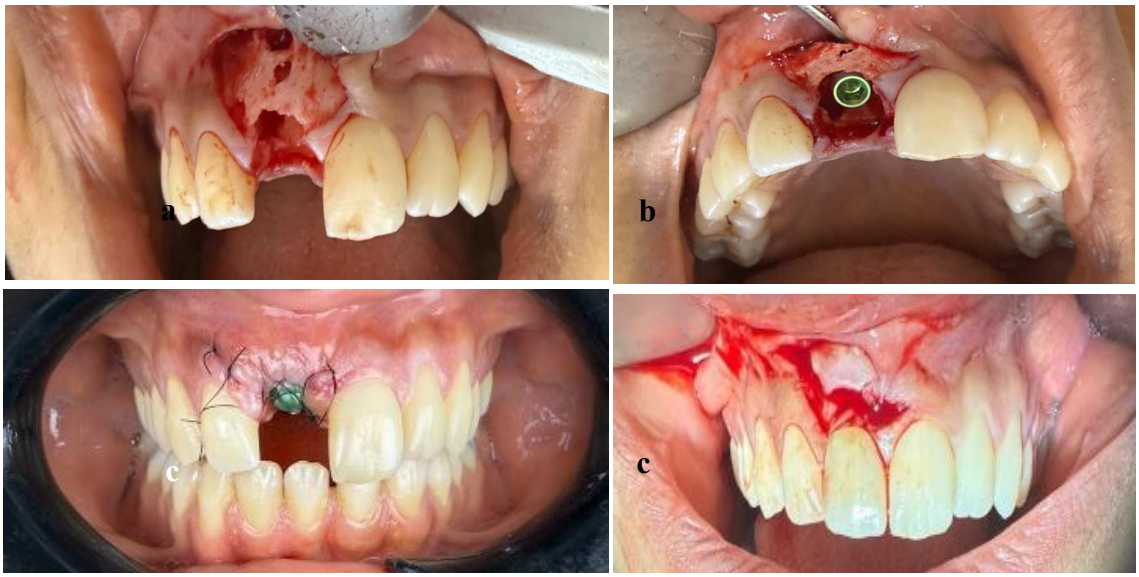

Figure 3. Clinical sequence showing atraumatic extraction, socket debridement, implant insertion, and immediate provisional restoration maintaining gingival contour.

Atraumatic extraction of the central incisor was performed, followed by immediate implant placement in a slightly palatal position. The implant achieved high primary stability, and a screw-retained provisional crown was delivered immediately, ensuring soft-tissue support and maintenance of the gingival contour.

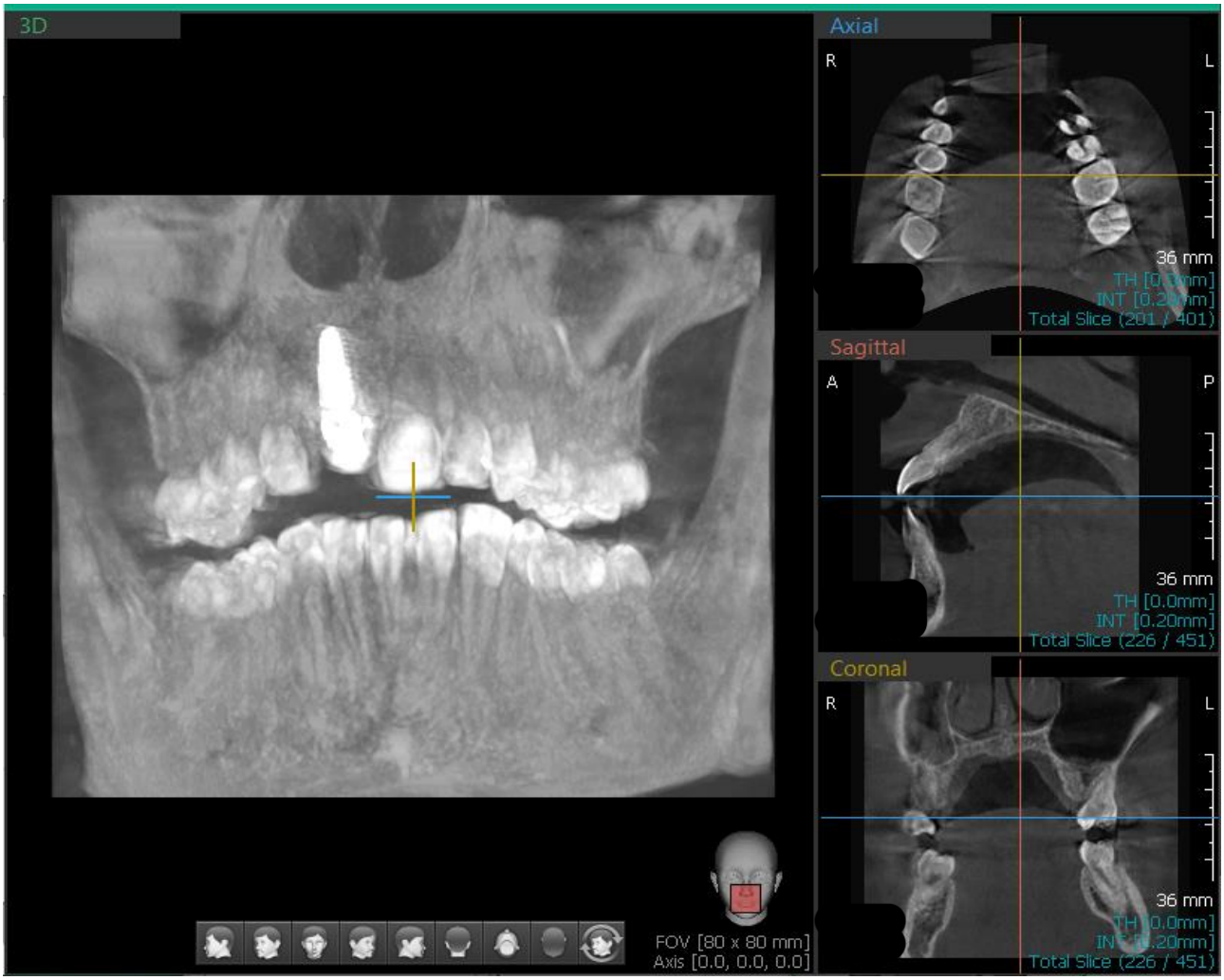

Figure 4. Post-operative CBCT showing implant position in axial, sagittal, and coronal planes, confirming correct angulation and complete bony support in the anterior maxilla

Following atraumatic extraction and socket debridement, a JD implant, 3.7 mm in diameter and 13 mm in length, was placed immediately into the extraction socket in a slightly palatal position to maintain buccal bone support. The implant achieved primary stability exceeding 35 N cm, allowing immediate functional loading. No flap elevation or membrane placement was required (see Table 1).

Table 1. Clinical and Implant Characteristics of the Case

Patient Gender	Age (yr)	Implant data			Site	Bone quality	Complications	Final restoration (mo)	Follow-up (mo)
		Type	Diameter (mm)	Length (mm)					
F	17	JD	3.7	13	Right Maxillary Central Incisor	D2	None	3	6

A screw-retained provisional crown was fabricated and inserted on the same day to maintain the soft-tissue contour and gingival papillae. Occlusal adjustments eliminated eccentric contacts while maintaining light centric guidance.
Healing progressed uneventfully, with no postoperative pain, swelling, or infection. At the one-week and one-month follow-ups, soft-tissue healing was satisfactory, showing stable gingival margins and intact interdental papillae.
At the three-month evaluation, the provisional crown was replaced with a definitive zirconia crown, fabricated according to the established emergence profile.
At six months, clinical examination revealed stable peri-implant tissues, healthy mucosa without bleeding or suppuration, and probing depths within physiologic limits (< 3 mm). The implant was immobile, and the patient reported full comfort and satisfaction with esthetics and function.
Radiographically, CBCT assessment (Figure 5) demonstrated a well-integrated implant with preservation of the buccal plate and stable crestal bone levels around the platform, indicating successful osseointegration and absence of marginal bone loss or radiolucency.
Overall, the implant demonstrated successful osseointegration and maintained functional stability, with no mechanical or biological complications observed throughout the six-month follow-up period.

4. Discussion

Osseointegration, as originally defined by Brånemark, represents a direct structural and functional connection between vital bone and a load-bearing implant at the microscopic level (Branemark, 1977). Historically, it was considered essential to maintain a stress-free healing period before implant loading, to prevent fibrous tissue encapsulation and allow direct bone-to-implant contact (Brunski, 1992 ; Brunski, 1979). For this reason, traditional protocols recommended a healing period of 3 months in the mandible and 6 months in the maxilla before functional loading was initiated (Adell), et.al., 1981).

Recent clinical and histological studies, however, have demonstrated that under certain conditions—particularly when high primary stability is achieved—immediate functional loading can result in outcomes comparable to delayed protocols (Esposito, et.al., 2013 ; Cooper, et.al., 2002 ; Tarnow, et.al, 1997; Wolfinger , et.al., 2003). Immediate placement into fresh extraction sockets further reduces treatment time, preserves alveolar bone, and maintains gingival architecture, particularly in the esthetic zone (Gelb, et.al., 1993 ; chen, et.al., 2004).

The present case supports these findings. Primary stability was achieved with sufficient insertion torque, permitting immediate provisionalization. Careful occlusal adjustment of the provisional crown minimized non-axial forces, thereby reducing the risk of micromotion that could compromise osseointegration. This is in agreement with previous reports suggesting that micromovement below 100–150 μm may still allow for bone healing and integration, while excessive movement leads to fibrous encapsulation and failure (Szmukler, et.a;, 2000 ; Cameron, et.al., 1993).

Several factors influence the success of immediate loading, including bone quality, implant macro- and micro-design, surgical technique, and control of occlusal forces (Degidi, et.al., 2003 ; Cochran , et.al., 2004). Histological evidence suggests that immediate functional loading, when performed under controlled conditions, may even stimulate bone remodeling and enhance bone-to-implant contact compared with unloaded implants (Testori, et.al., 2007). Moreover, immediate provisionalization provides esthetic and psychological benefits for patients, avoiding the use of removable prostheses and preserving soft tissue contours (Glauser, et.al., 2003 ; Ericsson , et.a;, 2000).

Nevertheless, limitations remain. Immediate loading in fresh extraction sockets should be avoided in cases with acute infection, insufficient bone volume, or lack of primary stability (Chen, et.al., 2007. Long-term randomized controlled trials are still needed to validate survival rates and marginal bone stability over extended follow-up periods.

Within the limitations of this report, immediate implant placement combined with immediate functional loading demonstrated favorable results in terms of implant stability, soft tissue healing, and esthetic integration. These outcomes reinforce the growing evidence that, in properly selected cases, immediate loading of single-tooth implants is a predictable and beneficial treatment option.

5. ETHIC APPROVAL

All surgical and prosthetic procedures pertaining to this clinical case were carried out at the Ajiad Centre for Dental Medicine and Implantology, Sirman, Libya. These procedures were executed following the acquisition of written informed consent from the patient, ensuring strict adherence to all applicable ethical and professional guidelines.

6. RESULT

This clinical case underscores the potential of immediate implant placement with immediate functional loading as a reliable option for single-tooth replacement in the esthetic zone. The favorable outcome achieved in this young patient highlights the importance of careful case selection, atraumatic extraction, precise surgical technique, and prosthetic planning. Preservation of alveolar bone and gingival architecture, coupled with high primary stability in D2 bone, enabled safe immediate loading without compromising osseointegration. The provisional crown, designed to avoid occlusal loading, not only protected the implant during healing but also provided immediate esthetic and functional benefits, supporting the patient's comfort and psychosocial well-being.

At six months of follow-up, the implant demonstrated stable osseointegration, healthy peri-implant tissues, and preservation of soft tissue contours, resulting in a harmonious esthetic outcome. The patient expressed high satisfaction with the final restoration, confirming the clinical and psychosocial value of this treatment approach. Within the limitations of a single case, immediate implant placement with immediate loading in the anterior maxilla appears to be a promising and minimally invasive protocol that reduces treatment time, maintains tissue integrity, and enhances patient satisfaction. With strict adherence to surgical and prosthetic principles, it can serve as a valuable alternative to conventional delayed protocols and contribute meaningfully to modern implant dentistry.

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