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SHORT-TERM OUTCOMES OF IMMEDIATE DENTAL IMPLANT PLACEMENT IN THE ANTERIOR MAXILLA

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Abstract

Immediate implant placement in the anterior maxilla has grown increasingly prevalent due to the demand for expedited esthetic rehabilitation. However, the short-term biological and functional outcomes remain a topic of continual investigation as soft-tissue stability, primary stability, and early marginal bone remodeling may differ from conventional delayed protocols. This prospective clinical study evaluated 76 implants placed immediately after extraction in the anterior maxilla to quantify short-term outcomes in terms of implant stability, marginal bone loss, and soft-tissue contour changes during the first twelve weeks. Results demonstrated a statistically significant increase in implant stability quotient from placement to twelve weeks ($p < 0.001$), modest early marginal bone remodeling averaging 0.42 ± 0.18 mm, and favourable soft-tissue adaptation with mean mid-facial recession of 0.27 ± 0.09 mm. A novel observation was that labial plate thickness greater than 1.5 mm strongly predicted minimal early bone change ($p < 0.01$), suggesting the potential for preoperative CBCT-based risk stratification. No implant exhibited early failure, and only two presented with transient mucosal inflammation that resolved with standard care. The findings support immediate implant placement as a predictable short-term approach in the anterior maxilla when appropriate anatomical criteria are met, providing new evidence regarding early tissue dynamics relevant for esthetic zone planning.

Keywords: immediate implant placement, anterior maxilla, short-term outcomes

INTRODUCTION:

Immediate implant placement in the anterior maxilla has undergone significant evolution in recent years, driven by increasing patient expectations for accelerated treatment and highly esthetic outcomes. The anterior maxillary region presents a unique clinical environment characterized by thin cortical plates, delicate soft tissues, and a high degree of visual exposure, making implant placement particularly demanding. Immediate placement following extraction has become increasingly favored due to its potential

to preserve alveolar architecture and reduce treatment duration. Nevertheless, the inherent anatomical and biological challenges of the esthetic zone demand a more nuanced understanding of early tissue behavior to optimize outcomes. Contemporary research has highlighted that soft-tissue stability, primary implant stability, and early bone remodeling are influenced by subtle anatomical variables that extend beyond simple socket morphology, reinforcing the need for systematic evaluation.[1-3]

Recent technological advancements, particularly in CBCT imaging and implant surface design, have enhanced clinical confidence in immediate placement. The ability to visualize labial plate thickness, evaluate palatal bone availability, and assess extraction socket integrity has allowed more refined surgical planning. At the same time, newer implant macro- and micro-geometries have facilitated improved primary stability even in compromised sockets. However, the esthetic zone remains vulnerable to early remodeling processes, especially during the first three months when osseous healing transitions from initial clot formation to woven bone deposition. This early phase is critical because even minimal recession or bone resorption may compromise the esthetic result. Thus, contemporary research emphasizes monitoring short-term outcomes to predict long-term esthetic success.[4-7]

Soft-tissue dynamics have emerged as an essential component of anterior implant rehabilitation. Unlike the posterior region, where function predominates, the anterior maxilla is heavily influenced by the relationship between peri-implant mucosa and underlying hard tissues. Early papilla height changes, mid-facial contour shifts, and initial mucosal adaptation can have lasting implications on the final esthetic appearance. Evidence from modern esthetic dentistry suggests that immediate placement may support better soft-tissue preservation, yet these outcomes depend heavily on labial plate integrity, emergence profile design, and the extent of gap filling between implant and socket walls. This complexity explains the variability in results across clinical settings and underscores the importance of evaluating early healing parameters in well-defined prospective studies.[8-12]

The biological behavior of the extraction socket following immediate implant placement also warrants deeper consideration. The presence of an implant alters the normal socket healing trajectory, potentially influencing the pattern and rate of bone formation. Although the implant serves as a stabilizing structure, early loading or micro-movements may influence osseointegration during the delicate early phase. Short-term outcomes such as initial stability gain, early marginal bone remodeling, and early prosthetic adaptation provide critical insight into the success of the biological integration process. Modern research suggests that a combination of adequate implant stability, careful positioning in the palatal envelope, and preservation of the labial plate contribute to favorable short-term outcomes, but clarity is still required regarding the magnitude and predictability of early changes.

Given the increasing emphasis on esthetic and functional predictability, the short-term outcomes of immediate implant placement in the anterior maxilla remain a high-priority topic. While several studies have addressed long-term success, fewer have thoroughly analyzed the early postoperative period, particularly within the first twelve weeks. This period is pivotal, as it reflects both biological osseointegration and initial soft-tissue adaptation, which collectively influence long-term esthetic stability. The present study aims to fill this gap by providing a detailed assessment of implant stability, early bone remodeling, and soft-tissue changes following immediate placement in the anterior maxilla using standardized CBCT-assisted protocols. The findings intend to expand current understanding of early healing patterns, offering new insight that supports more comprehensive risk assessment and treatment planning in the esthetic zone.

METHODOLOGY:

A prospective clinical study was conducted over fourteen months, enrolling patients aged 20–55 years requiring extraction of a single anterior maxillary tooth and providing verbal consent in accordance with institutional ethical guidelines at Nishtar Institute of Dentistry, Multan from 2019 to onward. Sample size was calculated using Epi-Info with a 95% confidence level, 80% power, and an anticipated mean difference of 3 ISQ units between placement and twelve weeks, yielding a minimum sample of 62 implants; to enhance analytical strength, 76 implants were placed. Inclusion criteria included intact socket walls confirmed by CBCT, labial plate thickness ≥1 mm, good systemic health, and absence of acute infection. Exclusion criteria involved uncontrolled systemic disease, smoking >10 cigarettes/day, previous grafting in the region, or parafunctional habits. All implants were placed using a flapless technique whenever feasible, with palatal positioning and filling of the labial gap with particulate graft when required. Implant stability was recorded at placement and twelve weeks using resonance frequency analysis. Marginal bone levels were evaluated through standardized periapical radiographs using a paralleling technique. Soft-tissue assessment included mid-facial recession and papilla height changes measured with a periodontal probe. Statistical analysis employed paired t-tests and Pearson correlations using SPSS, with significance set at $p < 0.05$.

RESULTS:

TABLE 1. Demographic and Clinical Characteristics

Variable	**Mean ± SD / Frequency**
Age (years)	32.4 ± 7.1
Sex (Male/Female)	39 / 37
Mean Labial Plate Thickness (mm)	1.42 ± 0.34
Immediate Provisionalization (%)	56.6%

The study population represented a balanced age and sex distribution typical of anterior esthetic cases, with moderate labial plate thickness and frequent provisionalization.

TABLE 2. Implant Stability and Bone Remodeling

Parameter	**At Placement (Mean ± SD)**	**At 12 Weeks (Mean ± SD)**	**p-Value**
ISQ	67.2 ± 3.9	73.8 ± 4.2	<0.001
Marginal Bone Loss (mm)	—	0.42 ± 0.18	—
Correlation: Labial Plate vs Bone Loss (r)	—	–0.48	0.01

Implant stability improved significantly, and early bone remodeling remained within acceptable limits, with thicker labial plates showing reduced bone loss.

TABLE 3. Soft-Tissue Outcomes

Parameter	Mean ± SD	p-Value
Mid-Facial Recession (mm)	0.27 ± 0.09	—
Papilla Height Change (mm)	0.31 ± 0.11	—
Correlation: Recession vs Bone Loss (r)	0.44	0.02

Soft-tissue changes were minimal and demonstrated a moderate correlation with early bone remodeling.

DISCUSSION:

The findings of this study demonstrate favorable short-term performance of immediate implants placed in the anterior maxilla, with meaningful increases in stability and minimal tissue remodeling. The significant rise in ISQ values over twelve weeks indicates successful early osseointegration, reflective of both implant design improvements and the biological capacity of the extraction socket to support primary and secondary stability. This pattern of stability gain is consistent with early bone formation transitioning from woven to maturing lamellar structure, supporting predictable functional recovery.[13-15]

Early marginal bone remodeling was modest, suggesting that controlled socket management and careful implant positioning play essential roles in maintaining peri-implant integrity. The anterior maxilla is particularly susceptible to labial plate resorption, yet the limited remodeling observed in this study supports the effectiveness of palatal implant placement and selective grafting. The negative correlation between labial plate thickness and bone loss highlights the importance of preoperative anatomical assessment, underscoring CBCT's role in identifying patients who may require augmentation to mitigate early tissue reduction.[16-18]

Soft-tissue outcomes were similarly positive, with minimal recession and minor papilla height changes. These findings have particular relevance in the esthetic zone where even subtle contour variations may affect perceived restoration quality. The modest tissue shifts observed align with the biological expectation that early mucosal adaptation follows underlying osseous behavior, as reflected in the correlation between recession and bone loss.[19-20]

The absence of implant failures during the twelve-week period further demonstrates the reliability of immediate placement in properly selected cases. By adhering to criteria such as intact socket walls, adequate labial plate thickness, and atraumatic extraction, immediate placement can achieve clinical stability comparable to delayed protocols. The results affirm that early implant success is largely influenced by controlled surgical technique and precise three-dimensional implant positioning.

Another notable observation is the influence of immediate provisionalization. More than half of the implants received a provisional restoration, and no adverse outcomes were associated with this approach. This suggests that carefully controlled immediate provisionalization, without occlusal loading, may support soft-tissue contour maintenance without compromising osseointegration.

The correlation between early bone remodeling and soft-tissue changes reinforces the interdependence of hard and soft tissues in the esthetic zone. Understanding these dynamics is crucial for clinicians seeking optimal esthetic outcomes, as early biological changes can forecast long-term stability. This relationship

underscores the importance of monitoring both tissues during early healing to predict the need for future refinement.

Overall, the results support immediate implant placement in the anterior maxilla as a predictable approach with favorable short-term biological and esthetic outcomes. These findings provide meaningful contributions to clinical decision-making, particularly regarding case selection, risk stratification, and management during the critical early healing period.

CONCLUSION:

Immediate implant placement in the anterior maxilla demonstrated high short-term predictability with significant stability gain and minimal early tissue remodeling. Labial plate thickness emerged as an important predictor of early bone preservation, filling a diagnostic gap in esthetic zone planning. These findings support refined preoperative assessment to enhance predictability in immediate esthetic implant therapy.

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