Review Article

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Immediate vs. Delayed Implant Placement: A Comprehensive Review on Current Concepts and Future Directions in Implant Timing Protocols

Singh A[1], Sachan S[2], Singh R[3], Garg J[4], Singh P[5]

AUTHOR'S AFFILIATION

1. **Dr. Akanksha Singh**
   Department of Periodontology, Institute of Dental Sciences, Bareilly International University, Bareilly, Uttar Pradesh, India
2. **Dr. Shikha Sachan**
   Associate Professor,
   Department of Public Health Dentistry,
   Maharana Pratap Dental College,
   Kanpur, Uttar Pradesh, India
3. **Dr. Rika Singh**
   Professor & Head
   Department of Periodontology, Institute of Dental Sciences, Bareilly International University, Bareilly, Uttar Pradesh, India
4. **Dr. Jaishree Garg**
   Professor,
   Department of Periodontology, Institute of Dental Sciences, Bareilly International University, Bareilly, Uttar Pradesh, India
5. **Dr. Pushpendra Singh**
   Department of Skin,
   Rohilkhand Medical College, Bareilly International University, Bareilly, Uttar Pradesh, India

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*Corresponding Author:
Dr. Akanksha Singh
Department of Periodontology,
Institute of Dental Sciences,
Bareilly International University, Bareilly
Uttar Pradesh, India
Email: [akkisingh014@gmail.com]
Phone: [+91-7007141450]

ABSTRACT

Background: The timing of dental implant placement, whether immediate or delayed following tooth extraction, significantly impacts clinical outcomes, esthetic results, and patient satisfaction. A comprehensive understanding of both protocols is essential for optimizing treatment planning and success rates.

Objectives: This review aims to compare immediate and delayed implant placement in terms of clinical outcomes, survival rates, and patient satisfaction. Additionally, it discusses indications, contraindications, and critical factors influencing the choice between these approaches.

Methods: Relevant studies, systematic reviews, and clinical trials were identified through electronic searches of PubMed/MEDLINE, Scopus, Google Scholar, and the Cochrane Library. Manual screening of reference lists of relevant articles was also performed to assess outcomes associated with both immediate and delayed implant placement. Key parameters evaluated included implant survival (reported survival and failure rates), esthetic outcomes (soft tissue stability, marginal mucosal recession, and esthetic indices where applicable), patient-reported satisfaction (questionnaire-based or self-reported outcomes), and complications (biological and mechanical complications) as described in the included studies.

Results : Both immediate and delayed implant placement protocols demonstrate high survival rates, often exceeding 95%. Immediate placement offers advantages such as reduced treatment time, preservation of alveolar bone, and enhanced patient satisfaction. However, it carries risks related to primary stability and esthetic outcomes, particularly in cases with compromised extraction sites. Delayed placement allows for better healing and bone regeneration but may require additional surgical interventions due to alveolar ridge resorption.

Conclusion: Immediate and delayed implant placements are both viable and predictable when appropriate patient selection and surgical techniques are applied. Immediate placement is preferable when conditions are ideal, while delayed placement remains the standard when managing infection, bone defects, or poor soft tissue quality. Careful evaluation of patient-specific factors is critical to achieving optimal clinical and esthetic outcomes.

Keywords: Immediate implant placement, delayed implant placement, dental implants, implant success rate, patient satisfaction, clinical outcomes.

INTRODUCTION

Dental implantology is firmly established as a predictable and long-term modality for the replacement of missing teeth; however, clinical success is influenced by several biological, mechanical, and patient-related variables. Among these, the timing of implant placement following tooth extraction is considered a critical determinant affecting osseointegration, peri-implant tissue stability, esthetic outcomes, and overall treatment complexity. Traditionally, delayed implant placement performed after a healing period of approximately three to six months has been regarded as the conventional protocol, primarily due to the establishment of a healed, infection-free recipient site that supports predictable implant integration.[1]

Immediate implant placement—defined as implant insertion into a new extraction socket at the same surgical visit—has become more and more clinically accepted because to advancements in implant surface technology, surgical methods, and three-dimensional diagnostic imaging.[2] While both immediate and delayed placement protocols aim to restore function and esthetics through stable osseointegration, they differ substantially in biological requirements, technical sensitivity, and risk profiles, underscoring the need for individualized treatment planning rather than a universal approach.[3]

Immediate implant placement has been proposed as a strategy to reduce overall treatment time, preserve alveolar ridge dimensions, and minimize the number of surgical interventions. Placement of the implant within the extraction socket may partially mitigate post-extraction ridge resorption and facilitate early prosthetic rehabilitation, particularly in esthetically demanding regions such as the anterior maxilla.[4] However, these advantages must be interpreted cautiously, as immediate placement is inherently technique-sensitive and highly dependent on favorable local conditions. Challenges related to achieving adequate primary stability, managing peri-implant soft tissues, and controlling infection at the extraction site may adversely affect outcomes if strict case selection criteria are not applied.[5]

In contrast, delayed implant placement allows complete healing of soft and hard tissues before implant insertion, creating a more controlled biological environment for osseointegration. This approach is especially advantageous in extraction sites compromised by infection, periodontal disease, or traumatic injury.[6] Delayed placement also enables the use of ridge preservation and guided bone regeneration techniques when indicated, thereby improving implant positioning and esthetic predictability, albeit at the expense of prolonged treatment duration and additional surgical procedures.[7]

Evidence from comparative studies and systematic reviews indicates that both immediate and delayed implant placement protocols demonstrate high and largely comparable survival rates, often exceeding 90% when appropriate clinical protocols are followed.[8] Despite similar survival outcomes, clinically relevant differences have been reported with respect to soft tissue stability, esthetic predictability, and the need for adjunctive augmentation procedures.[9]

The condition of the extraction socket remains a decisive factor in determining implant timing. Immediate placement is generally recommended when socket walls are intact, sufficient apical bone is available to achieve primary stability, and active infection is absent.[2,10] Conversely, compromised sockets characterized by bone defects, insufficient bone volume, or unfavorable soft tissue conditions often necessitate a delayed approach to minimize the risk of complications.[6,7] Systemic factors such as smoking, diabetes, and poor oral hygiene further influence clinical decision-making and may contraindicate immediate placement in selected patients.[11]

Esthetic considerations are particularly critical in the anterior region, where minor discrepancies in implant positioning or peri-implant soft tissue contours can significantly affect treatment outcomes. Immediate placement in this zone demands meticulous planning and execution, whereas delayed placement combined with soft tissue augmentation procedures may offer greater esthetic predictability in high-risk cases.[12,13]

Patient expectations and satisfaction also play an important role in selecting implant timing. Immediate placement is often preferred by patients due to reduced treatment duration and the possibility of immediate provisionalization; however, patients must be thoroughly informed about the associated risks and limitations.[4,8] The integration of digital technologies, including cone-beam computed tomography and computer-assisted implant planning, has further enhanced diagnostic accuracy and procedural predictability for both immediate and delayed placement protocols.[14]

This review critically evaluates immediate and delayed implant placement protocols with respect to clinical outcomes, survival rates, esthetic considerations, patient-reported satisfaction, indications, and contraindications, with the aim of supporting evidence-based decision-making and optimizing patient-centered implant therapy.

Immediate implant placement

Immediate implant placement involves insertion of a dental implant directly into a fresh extraction socket at the time of tooth removal. The increasing popularity of this approach is largely attributable to reduced treatment duration, potential preservation of alveolar ridge dimensions, and early restoration of function and esthetics in appropriately selected cases.[2]

Since post-extraction bone remodeling, especially of the buccal plate, can adversely affect implant location and aesthetic results, preservation of the alveolar ridge is commonly

mentioned as a key benefit of rapid insertion.[1] Immediate placement may help limit these dimensional changes while supporting peri-implant soft tissue architecture, especially in the anterior maxilla.[12] Patients often favor this approach due to shorter rehabilitation periods, fewer surgical interventions, and reduced postoperative morbidity.[3,14]

Nevertheless, achieving adequate primary stability remains a principal challenge in fresh extraction sockets due to the presence of anatomical voids between the implant surface and socket walls. Surgical strategies such as under-preparation of the osteotomy and the use of longer or wider implants are commonly employed to enhance stability.[15] Soft tissue recession, particularly in patients with a thin gingival biotype, represents a significant esthetic risk and may compromise long-term outcomes.[16] Adjunctive procedures, including connective tissue grafting and immediate provisionalization, have been proposed to mitigate these risks.[17]

The presence of active infection at the extraction site remains a critical consideration. Although successful immediate placement in previously infected sites has been reported following thorough debridement and infection control, delayed placement is generally considered a safer and more predictable alternative in such situations.[18] Ideal indications for immediate implant placement include intact socket walls, absence of infection, sufficient apical bone for stability, favorable soft tissue biotype, and good systemic health.[15,19] Advances in digital planning and CBCT-based assessment have further refined case selection and improved procedural predictability.[14]

Delayed implant placement

Delayed implant placement involves implant insertion after a healing period ranging from several weeks to months following tooth extraction. This conventional approach provides a biologically mature recipient site, facilitating predictable osseointegration and prosthetic rehabilitation.[6] Allowing natural healing reduces the risk of infection, supports soft tissue closure, and enables augmentation procedures when required.[7] A healed alveolar ridge offers improved control over implant positioning and stability, particularly in sites compromised by infection, trauma, or bone loss.[1] Delayed placement allows management of residual pathology and implementation of ridge preservation or guided bone regeneration techniques, contributing to predictable long-term outcomes.[7] Resolution of infection prior to implant placement is a major advantage, as it significantly improves implant survival in previously infected sites.[18]

Soft tissue maturation during the healing phase enhances esthetic predictability, especially in the anterior region, by reducing the risk of mid-facial mucosal recession commonly associated with immediate placement.[12,13] However, delayed placement is associated with physiologic alveolar ridge resorption, which may necessitate additional grafting procedures if ridge preservation is not performed.[1]

The primary limitation of delayed implant placement is extended treatment duration, which may affect patient satisfaction and compliance.[17] Clinical decision-making should therefore consider socket morphology, systemic health, oral hygiene status, and esthetic demands. Patients presenting with compromised bone quality, active infection, or systemic risk factors often benefit from a delayed approach.[11,18] CBCT-based planning and digital workflows have further enhanced the precision and predictability of delayed implant placement.[14]

Clinical outcomes and success rates

Both immediate and delayed implant placement protocols have been shown to achieve high levels of clinical success, with long-term survival rates consistently reported above 90% in contemporary literature. Recent systematic reviews and meta-analyses indicate that, when appropriate case selection and standardized surgical protocols are followed, survival rates for immediate and delayed implants are comparable, often exceeding 95% for both approaches.[15,2,28-30]

Although overall survival outcomes are similar, differences have been reported with respect to esthetic performance and peri-implant tissue stability. Immediate implant placement, particularly in the esthetic zone, has been associated with a higher risk of mid-facial mucosal recession, especially in patients presenting with a thin gingival biotype or deficient buccal bone plate.[14] In contrast, delayed implant placement allows for soft tissue maturation and stabilization prior to implant insertion, thereby reducing the risk of recession and contributing to more predictable esthetic outcomes.[15]

Marginal bone level changes around implants are generally minimal with both protocols when evidence-based surgical principles are respected. However, some studies have reported slightly greater early marginal bone loss around immediate implants, particularly when early or immediate loading protocols are applied.[16,9]Immediate implants may initially demonstrate reduced primary stability due to post-extraction socket morphology; nevertheless, advances in implant design and optimized site preparation techniques have been shown to achieve stability comparable to that of delayed placement.[17]

Immediate provisionalization enables rapid restoration of function and esthetics, which may enhance patient comfort and psychological well-being, but it requires strict control of occlusal loading to minimize biological and mechanical complications.[18] Delayed implant placement, although associated with longer treatment duration, often provides greater predictability in soft tissue contours and prosthetic outcomes. Overall, patient satisfaction remains high with both approaches, with immediate placement preferred for shorter edentulous periods and delayed placement favored when long-term esthetic stability is a primary concern.[18,19,30]

Indications and contraindications

The choice between immediate and delayed implant placement represents a critical clinical decision that must be individualized for each patient. This decision is influenced by local anatomical factors, socket morphology, systemic health, esthetic risk profile, and patient expectations. Careful case selection and strict adherence to biological and surgical principles are essential to achieve predictable and long-term outcomes with either protocol.

Indications for immediate implant placement

Immediate implant placement is indicated when favorable local and systemic conditions allow predictable primary stability and uneventful healing. One of the most well-established indications is single-tooth replacement in extraction sites with intact socket walls and absence of active infection. In such situations, the existing socket anatomy can guide optimal three-dimensional implant positioning, contributing to preservation of alveolar bone and peri-implant soft tissue architecture, provided sufficient apical bone is available to achieve primary stability.[19]

The anterior maxilla is another important indication for immediate implant placement in carefully selected cases. When adequate bone volume and a thick gingival biotype are present, immediate placement may help preserve gingival contours and interdental papillae, thereby supporting favorable esthetic outcomes. The addition of immediate provisionalization in these cases can further enhance soft tissue stability and facilitate early restoration of esthetics and patient confidence.[15]

Immediate implant placement may also be considered following traumatic tooth loss, provided the extraction socket is free from infection and significant alveolar bone damage. In such scenarios, immediate placement can help maintain ridge dimensions and reduce the need for subsequent bone augmentation procedures.[20]

Patient-related factors also influence treatment selection. Individuals who prioritize shorter treatment duration, fewer surgical interventions, and faster functional and esthetic rehabilitation may benefit from immediate placement, provided they are thoroughly informed about the technique-sensitive nature of the procedure and associated risks.[3]

Indications for delayed implant placement

Delayed implant placement is generally preferred in compromised clinical situations where immediate placement may increase the risk of biological or mechanical failure. A primary indication is the presence of active infection or inflammation at the extraction site, such as periapical pathology or advanced periodontal disease. Allowing a healing period enables complete resolution of infection and formation of healthy bone, thereby improving the predictability of osseointegration and reducing the risk of early implant failure.[22] Severe bone deficiencies or ridge deformities also favor delayed placement. In these cases, delayed protocols allow implementation of ridge preservation techniques, guided bone regeneration (GBR), or bone grafting procedures to improve ridge dimensions prior to implant insertion.[7] This staged approach enhances implant stability and long-term success.

Patients with systemic risk factors, including uncontrolled diabetes, heavy smoking, or immunocompromised conditions, often benefit from delayed implant placement. These conditions may impair wound healing and osseointegration, and postponing implant placement allows time for medical optimization and improved host response.[23]

Delayed placement is particularly indicated in high esthetic risk cases, such as patients with a thin gingival biotype or deficient buccal bone plate. Allowing soft tissue maturation before implant insertion reduces the likelihood of mid-facial mucosal recession and contributes to more predictable esthetic outcomes.[24] Additionally, sites requiring bone graft maturation necessitate delayed placement to ensure adequate graft integration and long-term implant stability.[22]

Contraindications for immediate implant placement

Despite its potential advantages, immediate implant placement has well-recognized contraindications. Active infection or severe periodontal pathology at the extraction site remains a major contraindication, as it significantly increases the risk of compromised osseointegration and implant failure.[3]

Immediate placement is also contraindicated when adequate primary stability cannot be achieved due to insufficient bone volume or unfavorable socket morphology. Mechanical stability is a prerequisite for successful osseointegration, and failure to achieve it increases the risk of early implant loss.[23]

Systemic conditions that impair healing, such as uncontrolled diabetes or heavy smoking, further contraindicate immediate placement and favor a delayed approach.[24] In the esthetic zone, immediate implants should be avoided when there is a high risk of soft tissue recession, particularly in patients with a thin gingival biotype and compromised buccal plate, as this may result in unfavorable and irreversible esthetic outcomes.[25]

Contraindications for delayed implant placement

Delayed implant placement may be less favorable in situations involving pronounced post-extraction ridge resorption when ridge preservation procedures have not been performed. Progressive loss of alveolar bone volume can complicate implant positioning and often necessitates extensive hard tissue augmentation to achieve functional and prosthetic requirements.[26]

Poor patient compliance represents another limitation of

delayed implant protocols, as successful outcomes depend on multiple clinical visits and strict adherence to long-term treatment schedules.[18] Furthermore, long-term edentulism, especially in the anterior esthetic zone, may cause psychological discomfort, a lower quality of life, and decreased patient satisfaction, all of which might affect how well a treatment is accepted overall.[27]

Comparison of auccess eates

Both immediate and delayed implant placement protocols demonstrate consistently high survival rates, frequently exceeding 90%, when appropriate case selection and evidence-based surgical principles are followed. Systematic reviews and meta-analyses have reported no statistically significant difference in long-term survival between the two approaches, indicating that implant timing alone is not a decisive predictor of survival.[3] However, immediate implants may be associated with a slightly increased risk of early failure in compromised clinical scenarios, particularly in the presence of poor oral hygiene, smoking habits, or uncontrolled systemic conditions. In such cases, delayed implant placement offers greater biological predictability due to complete soft tissue and bone healing prior to implant insertion.[3]

Clinical outcomes beyond aurvival

While survival rates are comparable, differences become more evident when clinical outcomes beyond survival are considered. Functional parameters, including mastication and speech, are generally similar for both immediate and delayed implant placement once successful osseointegration is achieved. Esthetic outcomes, however, tend to be more predictable with delayed placement, especially in the anterior region, owing to improved soft tissue maturation and a reduced risk of mid-facial mucosal recession. Patient-reported satisfaction is high for both protocols; immediate implants are often favored because of shorter treatment duration and reduced edentulous periods, whereas delayed placement is preferred when long-term esthetic stability and soft tissue predictability are prioritized.[18]

Complications and risks

Immediate implant placement is associated with specific biological and mechanical risks, including residual infection due to inadequate debridement, difficulty in achieving primary stability, buccal bone resorption, soft tissue recession, and biomechanical overload during immediate provisionalization.[3,29] These risks highlight the technique-sensitive nature of immediate placement and the importance of meticulous surgical execution.

Delayed implant placement, although generally more predictable in compromised sites, is not without limitations. Potential complications include the need for additional bone grafting procedures, longer treatment times, soft tissue scarring, delayed osseointegration, and progressive ridge resorption during healing if ridge preservation is not done. These issues are most likely to occur in patients with compromised health.[24]

Cost-effectiveness and clinical decision-making

From a cost-effectiveness perspective, immediate implant placement may reduce overall chair time and treatment duration by combining extraction and implant placement into a single surgical procedure, although adjunctive grafting materials may increase procedural costs. Delayed implant placement often involves higher initial costs due to multiple surgical stages but offers superior predictability in complex or compromised clinical situations. Consequently, cost-effectiveness should not be assessed in isolation but rather in conjunction with the patient's clinical risk profile, esthetic expectations, and the likelihood of requiring additional interventions.

CONCLUSION

The choice between immediate and delayed implant placement remains a central consideration in contemporary implant dentistry. Immediate implant placement offers advantages such as reduced treatment time, fewer surgical interventions, and enhanced patient satisfaction when ideal clinical conditions are present. It supports preservation of alveolar bone and peri-implant soft tissue architecture and may be successfully combined with immediate provisionalization to meet patient expectations for rapid rehabilitation. However, its success is highly dependent on careful case selection, advanced surgical expertise, and thorough evaluation of risk factors such as infection, bone availability, and soft tissue biotype. Conversely, delayed implant placement, despite requiring a longer treatment timeline and multiple interventions, provides a more predictable and standardized approach, particularly in complex or compromised cases. Allowing complete healing of the extraction site creates a stable biological environment for osseointegration and reduces the risk of early implant failure. Both protocols demonstrate high success rates when applied appropriately. Therefore, the decision regarding implant timing should be based on a comprehensive assessment of patient-specific anatomical, functional, and esthetic requirements, in combination with the clinician's experience and available resources. Individualized treatment planning, shared decision-making, and the integration of modern diagnostic technologies are essential for optimizing long-term outcomes in implant dentistry.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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DATA AVAILABILITY STATEMENT

The data presented in this study are available on reasonable request from the corresponding author.

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