Thai Moogambigai Journal Of Periodontics and Dental Science, 2024; Volume No: 5, Issue No: 4

Review Article | ISSN (O): 2582 6794

IMMEDIATE VS DELAYED IMPLANT

Manisha Sadish Prasad[1*], Balaji[1], Manikandan[1]

[1]Department of Periodontics & Implant Dentistry, CSI College of Dental Sciences and Research, Madurai. *Corresponding Author's Email: manishasadishprasad@gmail.com

Abstract

This literature review provides an overview and comparison of immediate and delayed dental implants in modern dentistry. With the growing use of immediate implants, several factors must be considered during placement, including surgical techniques and overall implant efficiency. This review thoroughly analysis studies from the selected articles, focusing on the advantages and disadvantages of both implant procedures Research indicates that immediate implants offer benefits such as shorter treatment duration and psychological comfort for patients. On the other hand, delayed implants have been shown to achieve higher success rates with fewer post-operative complications. Each approach has its own merits and drawbacks, and this review explores their effectiveness in contemporary dental surgeries

INTRODUCTION:

In recent years, implant placement has emerged as a highly reliable and widely accepted solution for the restoration and replacement of missing teeth. The foundation for modern dental implants was laid in 1965 when Brånemark successfully placed the first endosteal titanium implant in an edentulous ridge. Delayed implant placement, a widely practiced approach, involves inserting the implant into a fully healed extraction site, typically following a healing period of 5 to 6 months..(1) Advancements in implantology have led to the development of innovative techniques aimed at reducing the number of surgical interventions and expediting overall treatment timelines. One such approach is immediate implant placement, designated as Type 1 implant placement by the International Team for Implantology (ITI) (Hämmerle et al., 2004). Originally introduced by Lazzara in 1989, this technique involves the precise insertion of a dental implant into a fresh extraction socket immediately following tooth removal, optimizing both efficiency and clinical outcomes. (2). Evian et al. conducted a retrospective observational study evaluating 149 implants over a 943-day period. Their analysis revealed comparable survival outcomes between immediate and delayed implant placements, with success rates of 78.2% and 81.2%, respectively, highlighting the viability of both approaches in clinical practice. (3) Several studies have demonstrated that implants placed in fresh extraction sites can achieve successful osseointegration, with survival rates comparable to those placed in healed sites.

DECISION CRITERIA TO DETERMINE IMMEDIATE VS DELAYED PLACEMENT

It is assessed from three perspectives:, Prosthetic-driven approach, Operative technique, and Three-dimensional planning

Prosthetic-driven approach

Immediate implantation is indicated when the free gingival margin at the extraction site extends coronally beyond the gingival tissue of adjacent teeth, accompanied by a flat-scalloped gingival architecture, a thick periodontal biotype, a square tooth form, and a high osseous crest.

The position of the crestal bone plays a pivotal role in determining the post-extraction gingival contour. Facially, when the osseous crest is situated within ≤3 mm of the gingival margin, gingival recession remains minimal (<1 mm) following tooth removal. However, if the osseous crest exceeds 3 mm from the gingival margin, the risk of pronounced recession increases, necessitating corrective interventions such as orthodontic extrusion or bone grafting.

Interproximally, optimal esthetic papillary outcomes can be achieved when the alveolar crest is ≤5 mm from the interproximal contact point. In cases where the osseous crest extends beyond 5 mm from the papillary tip, predictable papillary height may require augmentation through orthodontic extrusion or grafting with either bone or soft tissue.(4)

Operative technique

A standardized classification system is essential for accurately characterizing the diverse clinical presentations encountered during tooth extraction. The identification of socket types relies on a combination of periodontal probing, visual inspection, and radiographic evaluation. Elian et al. proposed a classification framework as follows:

- Type I: The bony socket remains fully intact, preserving the natural soft-tissue architecture.
- Type II: Coronal bone loss is evident; however, the soft tissue remains structurally undisturbed.
- Type III: Both bony deficiencies and soft-tissue deformities are present.

This categorization plays a crucial role in determining the optimal timing for implant placement. A Type I socket is well-suited for immediate implant insertion, while Type II and Type III defects typically necessitate a delayed approach, often requiring hard- or soft-tissue augmentation prior to implantation. To accurately assess the socket type, clinicians should perform circumferential periodontal probing to detect bone dehiscences and analyze corresponding periapical radiographs for further structural assessment.(4)

Three-dimensional planning

Before proceeding with implant placement in the esthetic zone, a comprehensive assessment of the alveolar ridge morphology is essential, along with an evaluation of any local anatomic or pathologic constraints that may impede implant insertion. Traditional panoramic and intraoral radiography often fail to provide the level of detail required for precise planning. Consequently, cross-sectional imaging—specifically cone-beam computed tomography (CBCT)—is highly recommended to acquire the necessary diagnostic data.

In this context, Kan et al. introduced a classification system for sagittal root positions (Class I–IV) based on CBCT imaging. Among these, **Class I** is considered the most ideal for immediate implant placement, as it offers sufficient palatal bone for optimal implant positioning while also allowing for a buccal gap between the implant and the buccal plate, minimizing the risk of buccal plate resorption. **Class II** may also be suitable for immediate placement; however, its anatomical constraints make the procedure more technically demanding. In contrast, **Class III and IV** root positions are contraindicated for immediate implant placement due to unfavorable bone availability and positioning.

Given these considerations, the authors strongly advocate for preoperative CBCT imaging when planning immediate implant placement in the esthetic zone, ensuring precise case selection and optimal clinical outcomes.(4)

PROCEDURE OF DELAYED IMPLANT:

Precise and minimally invasive surgical placement plays a pivotal role in ensuring implant success, irrespective of the chosen treatment protocol. Excessive surgical trauma and thermal injury can trigger osteonecrosis, leading to fibrous encapsulation of the implant (Satomi et al., 1988). The generation of excessive heat during drilling, particularly without sufficient cooling, is directly linked to bone damage (Eriksson et al., 1982; Eriksson & Albrektsson, 1984; Eriksson et al., 1984a; Eriksson et al., 1984b). Research indicates that bone exposure to temperatures exceeding 47°C for one minute results in irreversible 'heat necrosis' (Eriksson & Albrektsson, 1983). Alarmingly, in the absence of irrigation, drilling temperatures can surpass 100°C within mere seconds of osteotomy preparation, with sustained temperatures above 47°C extending several millimeters beyond the surgical site (Yacker & Klein, 1996). Furthermore, achieving optimal outcomes with endosseous root-form implants necessitates the application of appropriate load on the drill during osteotomy preparation. Studies have demonstrated that independently increasing either drilling speed or applied load results in a rise in bone temperature. However, an intriguing observation by Brisman (1996) revealed that simultaneously increasing both speed and load enhances cutting efficiency without significantly elevating temperature. Several additional factors contribute to thermal generation within bone, including the volume of bone removed (Eriksson et al., 1984a), drill sharpness and design (Matthews & Hirsch, 1972; Wiggins & Malkin, 1976; Eriksson et al., 1984b), osteotomy depth (Babbush & Shimura, 1993; Haider et al., 1993), and cortical thickness variability (Hobkirk & Rusiniak, 1977; Eriksson & Albrektsson, 1984). Furthermore, implant placement inherently induces microfractures in the surrounding bone, particularly in scenarios involving press-fit techniques. The healing of these microfractures follows a precise biological sequence: angiogenesis, osteoprogenitor cell migration, formation of a woven bone scaffold, deposition of parallel-fibered or lamellar bone, and subsequent secondary remodeling of the bone (Schenk & Hunziker, 1994).(6)

Delayed implant was once standard practice to wait several months after tooth extraction before placing implants, allowing time for alveolar bone healing. Additionally, a load-free period of 3–6 months was recommended to ensure proper osseointegration. This approach, known as the delayed implant placement protocol, involves extracting the tooth, allowing the site to heal, and then performing a second surgical procedure to insert the implant, followed by a healing phase before loading the final restoration. (6)

PROCEDURE OF IMMEDIATE IMPLANT PLACEMENT:

The designated tooth for immediate implant placement was extracted with utmost precision and minimal trauma using a periotome, ensuring minimal disruption of the surrounding mucoperiosteal tissues. To optimize implant selection, preoperative radiographic assessment was performed to determine the appropriate implant dimensions.

Osteotomy was initiated using a pilot drill, followed by sequential drilling to achieve the desired preparation. In maxillary sites, the osteotomy was strategically positioned along the palatal aspect of the socket to maximize implant stability, whereas in mandibular sites, the interdental bone was utilized to ensure optimal primary stability and ideal prosthetic positioning in both the buccolingual and mesiodistal dimensions. The osteotomy was extended at least 3 mm beyond the apex of the extracted tooth's socket to enhance implant anchorage.

Subsequent drilling was performed in a stepwise manner, gradually expanding the osteotomy until the final drill was employed to achieve the precise implant bed dimensions. The implant was then inserted and torqued to 45 Ncm using a manual ratchet, ensuring primary stability at the crestal bone level. A cover screw was placed over the implant, and the residual gap between the implant and socket walls was filled with autogenous bone graft harvested from the local surgical site using a trephine drill. The harvested graft was processed into fine particulate form using a bone miller and meticulously packed into the defect site to promote osseointegration and preserve alveolar ridge integrity. (5)

Primary Stability Assessment

- **Resonance Frequency Analysis (RFA):** RFA provides objective quantification of initial implant stability. However, current research lacks conclusive data to establish definitive threshold values for safe initial stability measurements.(7)

- **Insertion Torque Values:** Optimal primary stability is generally achieved with insertion torque values ranging between **30 and 50 Ncm** before the implant reaches its final seating position. This range is considered sufficient to ensure the necessary mechanical stability for successful osseointegration.7

COMPARSION BETWEEN IMMEDIATE AND DELAYED IMPLANT

After tooth extraction, alveolar bone resorption can become so severe that, if left unaddressed, it may lead to significant bone deficiency. In extreme cases, this loss of bone volume can even contraindicate implant placement due to insufficient support for osseointegration. To mitigate these complications, immediate implant placement in fresh extraction sockets has emerged as a viable treatment option

Histomorphometric analyses have been employed to evaluate the structural quality of cancellous bone, revealing significant regional variations among the anterior, premolar, and molar areas. Cooper et al. outlined three critical biological factors influencing successful osseointegration under immediate loading conditions: (a) factors governing osteogenesis (bone formation), (b) factors contributing to peri-implant osteolysis (bone resorption), and (c) the impact of micromotion on peri-implant bone development. (8)

Following implant placement, initial stability declines over the first **3–6 weeks** due to the natural process of bone remodeling and shifts in the woven-to-lamellar bone ratio. The threshold for strain in the **mild overload zone**, where osteogenesis begins to be adversely affected, has been reported between **1500 and 3000 με**. To mitigate excessive strain, **rigid splinting** of implants (when applicable) and **reduction of occlusal forces** are recommended.

Bone cells are capable of sensing mechanical loads through **fluid dynamics within the lacunar–canalicular network**, with controlled strain levels stimulating osteocyte activation. The strategic application of **immediate mechanical loading**, when biologically optimized, fosters the formation of well-structured bone, enhances bone-to-implant contact (**BIC**), and ultimately promotes superior osseointegration. (8)

A study by Schropp (2003) compared **immediate-delayed implants** (placed approximately **10 days post-extraction**) with **delayed implants** (placed around **3 months after extraction**). After **2 years**, patients in the **delayed implant group** reported significantly lower satisfaction, perceiving the waiting period between extraction and crown placement as excessively long.

Additionally, an **independent blinded evaluator** assessed the peri-implant marginal mucosa relative to adjacent teeth, finding it to be **more aesthetically appropriate** in the **immediate-delayed group**. A potential biological explanation for this is that **early implant placement helps preserve alveolar bone height** by reducing post-extraction resorption, ultimately contributing to enhanced aesthetics. (9)

The **high implant survival rate (ISR)** associated with **immediately loaded (IL) implants** holds significant clinical importance, as this approach effectively reduces treatment duration while delivering substantial benefits to patients. While the **delayed loading protocol** has been successfully implemented for decades—resulting in a higher number of placed implants across various studies—the histological validation of IL implants has demonstrated comparable outcomes.

Immediate loading protocols can serve as a potent **osteogenic stimulus**, transmitting functional forces that may enhance bone formation—provided these forces remain within physiological limits. Additionally, the elimination of a **secondary surgical procedure** contributes to the **preservation of biological width** around the implant, further supporting peri-implant tissue stability.(8)

Research by **Romanos et al.** demonstrated that the **bone-to-implant contact (BIC) percentage** remains **comparable** between **immediately loaded** and **conventionally loaded** implants. Furthermore, **human and animal studies** indicate that	Immediate Implant Placement	Delayed Implant Placement

immediate loading promotes a higher percentage of **transverse collagen fibers**, which play a **crucial role in matrix calcification and bone maturation**, ultimately fostering a more organized and structurally sound osseointegration process.(8)Parameter		
Definition	Implant is placed at the same time as tooth extraction.	Implant is placed after a healing period of 3–6 months post-extraction.
Alveolar Bone Preservation	Helps preserve bone height and minimize post-extraction resorption.	Bone resorption may occur during the healing phase, requiring grafting in some cases.
Surgical Intervention	Single surgical procedure, reducing overall patient morbidity	Requires two separate surgical interventions: extraction and later implant placement.
Treatment Time	Faster overall treatment since healing and osseointegration occur simultaneously.	Longer treatment duration due to staged healing process.
Soft Tissue Preservation	Better soft tissue contour preservation, reducing aesthetic complications	Potential loss of soft tissue volume, affecting final restoration aesthetics.
Primary Stability	Achieving good primary stability can be challenging in fresh extraction sockets.	More predictable implant stability due to matured, healed bone
Indications	Ideal for cases with intact buccal bone and no active infection.	Recommended when significant bone loss, infection, or poor primary stability is a concern.
Long-Term Success Rate	High success rates when properly executed with good case selection.	Comparable success rates, often more predictable in challenging cases.

DISCUSSION

In 1989, Lazzara introduced the concept of immediate implant placement, where implants were placed directly into fresh extraction sockets. Since then, numerous studies have been conducted to evaluate the reliability and long-term success of this approach. Recent clinical and experimental research has shown that healing in post-extraction sites involves both bone regeneration within the socket and external dimensional changes due to bone resorption and bone remodeling.(1)

The healing process of an extraction socket progresses through three key phases: osteophyllic, osteoconductive, and osteoadaptive. Concurrently, osseointegration occurs as the implant surface integrates with the surrounding bone. Becker et al. reported a 93.3% success rate over five years for immediately placed implants when augmented with barrier membranes, with minimal crestal bone loss.(1)

In contrast, delayed implant placement presents certain challenges, particularly when the buccal or facial cortical plate is compromised during extraction. According to Misch and Judy (2000), the loss of this cortical bone leads to a reduction in both height and thickness of the alveolar ridge after healing, ultimately limiting the available bone for implant placement. This often forces the clinician to use a smaller-diameter implant, potentially affecting long- term stability.(1)

A prospective study by Covani and colleagues examined 38 implant sites across the maxillary and mandibular anterior and premolar regions following immediate implant placement. After six months of submerged healing, they observed a mean facial crestal bone height loss of 0.8 mm. While 38% of sites showed no change, 47% exhibited a loss between 0 mm and 1 mm, and 15% experienced a loss between 1 mm and 2 mm. However, when

compared to the significant bone resorption that typically follows tooth extraction without immediate implant placement, this level of bone loss was deemed clinically insignificant. (1)

Immediate implant placement requires minimal preparation, as the extracted tooth socket naturally preserves the anatomical shape of the tooth root, closely resembling root-form implants. To achieve optimal primary stability, the implant should be positioned at least 3 mm apical to the extraction site and 3 mm beyond the crestal bone level. The success of immediate implant placement is largely dependent on achieving adequate initial stability, making it essential to evaluate the extraction site for suitability before proceeding with the procedure. Implant stability can be assessed using resonance frequency analysis (RFA) to ensure proper osseointegration.(1)

Several studies have explored the use of barrier membranes and bone grafts to enhance the outcomes of immediate implant placement. Research has shown that crestal bone loss occurs in both immediate and delayed implant placement, but the extent of bone loss is generally lower with immediate implants. The use of bone grafts to fill the gap between the implant and the socket walls has been found to significantly reduce crestal bone loss, leading to better long-term results.(1)

Chrcanovic et al. that survival rates tended to be higher in the delayed implant group compared to the immediate implant group.The survival of implants in the meta-analysis tended to vary between 90 and 95% for immediately placed implants as compared to 97–100% for delayed implant placements (3)

Ganeles et al. observed that once **immediately loaded implants** achieve **clinical osseointegration**, they exhibit **long-term predictability** comparable to that of **conventionally healed and loaded implants**, demonstrating similar success rates and stability over time.(12)

A **prospective longitudinal study** conducted by **Attard et al.** examined IL protocols from both **clinician-related** and **patient-centered** perspectives. Their findings highlighted a **notable enhancement in patient satisfaction and overall quality of life** following implant treatment utilizing the **immediate loading approach**. (10)

Placing an implant into a **fresh extraction socket** presents several advantages for both the **patient** and the **clinician**. The **anatomical profile** of the socket immediately after extraction differs significantly from that of a site that has undergone **one year of healing**. When implants are placed **immediately post-**

extraction, they achieve **primary stability** by engaging the precisely prepared **bony walls** predominantly at the **apical region**, while the **coronal portion** of the socket gradually fills in as part of the **natural healing process.**(11)

The **immediate loading** of **endosseous root-form implants** has been extensively documented in the literature as a method to **bypass the traditional 3 to 6-month healing period**. Historically, concerns were raised that **micromotion** during early loading could lead to **fibrous encapsulation**, potentially compromising osseointegration. However, a study by **Barone et al. (2003)** revealed that the **bone density surrounding immediately loaded implants** was actually **higher** compared to implants that underwent **delayed loading**, suggesting a **positive osteogenic response** to early functional loading. (12)

CONCLUSION

In today's fast-paced world, patients seek quicker and more efficient treatment options. Immediate implant placement has emerged as a preferred choice, allowing implants to be placed directly into the extraction socket without the need to wait for months of healing and bone formation. This approach enables faster implant loading and quicker restoration of lost teeth, significantly reducing overall treatment time.

One of the key advantages of immediate implant placement is minimal crestal bone loss, especially when combined with autogenous bone grafting. Compared to delayed implant placement, this method offers better preservation of bone structure and soft tissue contours, provided that the clinical indications for immediate placement are met.

Immediate implants have gained widespread acceptance in modern dentistry as an advanced surgical technique. With a streamlined procedure, reduced healing time, and psychological benefits for patients, they have transformed the landscape of dental implantology. While delayed implants still provide a more predictable healing process and lower risk of failure, they are less commonly used today due to advancements in immediate placement techniques.

The evolution of technology has made immediate implant placement the preferred choice for many dental professionals. However, successful outcomes require careful case selection, precise planning, and thorough patient consultation. Before proceeding, it is essential to discuss the benefits and potential risks with the patient to ensure the best possible treatment decision.

REFERENCES

1. Immediate Implant vs Delayed Implant Placement A Review of 100 Cases Vijay Ebenezer, Balakrishnan Ramalingam, Shanmuga Priyan, M. Rakesh Mohan and T. Muthumani
2. Comparison of clinical outcomes of immediate versus delayed placement of dental implants: A systematic review and meta- analysis RubenGarcia-Sanchez1,2,3 | Jose Dopico4 Guillermo Pardo Zamora3 | Nikos Mardas7
3. Differences in Dental Implant Survival between Immediate vs. Delayed Placement: A Systematic Review and Meta-Analysis
4. Rishi Patel [1], Cemal Ucer [1], Simon Wright [1], Rabia S Khan
5. Guidelines for Immediate Vs Delayed Dental Implant Placement in the Esthetic Zone. Joseph Carpentieri, DDS; and Gary Greenstein, DDS, MS
6. Immediate Implant vs Delayed Implant Placement A Review of 100 Cases Vijay Ebenezer, Balakrishnan Ramalingam, Shanmuga Priyan, M. Rakesh Mohan and T. Muthumani doi: http://dx.doi.org/10.13005/bbra/1362 (Received: 02 March 2014; accepted: 04 April 2014
7. Critical review of immediate implant loading. Ricardo Gapski Hom-Lay Wang Paulo Mascarenhas Niklaus P. Lang
8. Immediate/Early Loading of Dental Implants: a Report from the Sociedad Espanola de Implantes World Congress Consensus Meeting in Barcelona, Spain, 2002 Carlos Aparicio, MD, DDS, MS;* Bo Rangert, Mech Eng, PhD;? Lars Sennerby, DDS, PhD’
9. Success of immediate loading implants compared to conventionally-loaded implants: a literature review Abdul-Aziz Al-Sawai1 & Hussein Labib2

9, Interventions for replacing missing teeth: dental implants in fresh extraction sockets (immediate, immediate-delayed and delayed implants) (Review) Esposito M, Grusovin MG, Polyzos IP, Felice P, Worthington HV

10. Survival Rate of Immediately vs Delayed Loaded Implants: Analysis of the Current Literature Georgios Romanos, DDS, Dr med dent, PhD1* Stuart Froum, DDS, MS2 Cyril Hery, DDS2 Sang-Choon Cho, DDS2 Dennis Tarnow,

11. Immediate and Delayed Implant Placement Into Extraction Sockets: A 5-Year Report Giovanni Polizzi, DDS, MD; Ueli Grunder, DDS; Ronnie Goenk, DDS;* Naoki Hatano, DDS;'
12. Patrick Henry, BDSc, MSD;S William J. Jackson, MDS; Kunio Kawamura, DDS;tt Franck Renouard, DDS;** Ruben Rosenberg, DDS;## Gilbert Triplett, DDS, PhD; Marvin Werbitt, DDS, MScD;*** Berit Lithnerttt
13. Immediate implant placement - a review Dr. Deepti Chaitanya Tadikonda1, Dr. Sasikala Pagadala