



COMPREHENSIVE REVIEW OF IMPLANT PLACEMENT AND LOADING PROTOCOLS FOR PATIENTS WITH PARTIAL EDENTULISM

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Abstract:

This review article delves into the various strategies and protocols associated with implant placement and loading in patients with partial edentulism. Partial edentulism presents a unique challenge in restorative dentistry, requiring careful consideration of implant positioning and loading to achieve optimal functional and esthetic outcomes. The review comprehensively explores the current literature on implant placement techniques, including conventional two-stage approaches, immediate placement, and guided surgery methods. Moreover, loading protocols, such as immediate, early, and delayed loading, are discussed in relation to their advantages and limitations. The review also highlights advancements in digital dentistry and their impact on implant planning and execution. By synthesizing evidence-based insights, this article provides valuable guidance for clinicians in selecting appropriate implant strategies tailored to the individual needs of partially edentulous patients. Proper decision-making regarding implant placement and loading protocols not only ensures successful osseointegration but also enhances patient satisfaction and quality of life.

Keywords: Dental Implants, Early Loading, Early Placement, Immediate Loading, Immediate Placement

INTRODUCTION

The landscape of implant placement and loading protocols for partially edentulous patients has witnessed dynamic evolution over the years, presenting a range of techniques and strategies. These protocols play a pivotal role in achieving successful outcomes by addressing the unique challenges posed by partial edentulism. By carefully considering factors such as implant positioning, timing of loading, and patient-specific conditions, clinicians can tailor their approaches to maximize functional restoration and esthetic outcomes. Historically, the approaches to implant placement and loading were relatively standardized, primarily following the principles of two-stage implant placement with delayed loading. However, advancements in both surgical techniques and materials, coupled with a deeper understanding of osseointegration and biomechanics, have given rise to innovative alternatives that challenge the conventional paradigms. This review aims to explore and elucidate these diverse implant placement and loading protocols, shedding light on their distinctive characteristics, benefits, and potential drawbacks. Through an in-depth examination of these protocols, this review seeks to provide clinicians with valuable insights into the evolving landscape of implant dentistry. By delving into the intricacies of each protocol and assessing their

suitability within the context of different clinical scenarios, practitioners can make informed decisions to ensure optimal treatment outcomes for their partially edentulous patients. Furthermore, the integration of digital technologies into implant planning and execution has brought an additional layer of precision and predictability to the field, further enriching the options available to clinicians. As implant dentistry continues to advance, the choice of implant placement and loading protocols has become increasingly tailored and nuanced. This review serves as a comprehensive resource for clinicians, offering a comprehensive exploration of these protocols and equipping them with the knowledge necessary to navigate the intricacies of implant placement and loading in the context of partial edentulism.¹ The traditional method comprises a two-step surgical process. Initially, implants are positioned in the jawbone and covered with gum tissue. After a healing period lasting from 3 to 6 months, a subsequent surgery unveils the implants, connecting abutments. The final step involves creating and placing the prosthetic restoration onto the implants. This approach prioritizes osseointegration before functional loading.² Immediate implant placement entails the immediate installation of implants in sockets after tooth extraction. However, loading the implants is postponed to ensure proper osseointegration. This approach offers the benefit of minimizing surgical interventions, maintaining soft tissue contours, and ultimately improving aesthetics.³ In specific scenarios, immediate implant placement can be combined with immediate loading. This procedure involves extracting remaining teeth, inserting implants, and promptly providing a temporary prosthesis, typically within 24 to 48 hours. Successful implementation of immediate loading necessitates careful case selection and ensuring adequate primary implant stability.³ This technique involves placing implants during the initial surgery and promptly loading them with a provisional prosthesis. The final restoration is delivered after a healing period. This approach is suitable when the implants achieve initial stability, allowing immediate functionality and aesthetic benefits.⁴

All-on-4®/All-on-X Concept:

Originally designed for fully edentulous individuals, the concepts of All-on-4 or All-on-X can be adapted for those with partial edentulism. This approach involves strategically implanting four or more implants at specific angles to optimize both bone support and implant stability. The decision between immediate or delayed loading depends on the specific circumstances of each case. This concept offers a fixed full-arch prosthesis, often utilizing immediate or early loading strategies, providing a cost-effective and efficient treatment avenue.

It's crucial to emphasize that the choice of the most suitable implant placement and loading protocol for each patient hinges on various factors, including bone quality and quantity, implant location, patient expectations, occlusion considerations, and the expertise of the clinician. A comprehensive evaluation and meticulous treatment planning process must be undertaken to ascertain the best approach tailored to the unique characteristics of each individual case. Moreover, the integration of digital dentistry, such as computer-guided implant placement and virtual planning, has substantially heightened the predictability and success rates of implant procedures for partially edentulous patients. In recent times, there has been a noticeable trend towards reducing the time between tooth extraction and implant insertion, as well as minimizing the delay between implant placement and restoration. The traditional guidelines established in the 1980s, which suggested a healing period of about three months post-tooth removal and an osseointegration period of 3 to 6 months following implant placement, are undergoing reevaluation due to the pursuit of shorter treatment timelines. Patients' growing interest in quicker delivery of the final implant-supported prosthesis, while upholding predictability, has led to immediate implant insertion post-extraction and the possibility of same-session implant restoration. This accelerated approach not only potentially reduces overall treatment duration but also bears the potential to lower associated costs. Additionally, it's proposed that this approach could contribute to preserving existing bone and soft tissues more effectively than traditional methods. In the realm of implant placement and loading protocols, recent trends lean towards shortening both the interval between tooth extraction and implant placement and the delay between implant placement and the delivery of implant restoration. Immediate implant placement directly after tooth extraction, often using simplified techniques like flapless surgery, followed by prompt restoration, has gained attention. This approach aims to uphold the level of predictability established in previous decades while substantially minimizing treatment time and associated expenses.⁹

Furthermore, it's worth noting that various surgical and prosthodontic protocols within oral implantology significantly impact the long-term success of implant prostheses. These protocols are differentiated based on the duration of healing after tooth extraction before implant placement, as well as the period of healing post-implant placement before the initial provision of a provisional or definitive implant restoration. Notably, the past three ITI Consensus Conferences (in 2003, 2008, and 2013) have defined different implant placement options, categorized as immediate, early, and late implant placement.¹³ These options each carry distinct clinical considerations. Reducing overall treatment time through immediate and early implant placement protocols holds appeal for both patients and clinicians. However, immediate implant placement is notably influenced by the local alveolar anatomy post-tooth extraction, and dimensional changes following extraction can affect long-term aesthetic outcomes. The thickness of the labial buccal bone following extraction influences the degree of dimensional changes, with thicker buccal bone leading to more predictable results for immediate implant placement. These considerations highlight the importance of guided bone regeneration techniques to address dimensional ridge alterations. The definition of loading protocols has evolved over the years, currently encompassing immediate, early, and conventional loading. Immediate and early loading strategies are particularly attractive due to their potential to shorten treatment times and potentially eliminate the need for removable provisional prostheses. Surface modifications on dental implants have expedited bone response during healing, resulting in high survival rates across various loading protocols. Nonetheless, bone turnover during the healing phase can impact implant stability and its resistance to lateral forces before achieving full osseointegration. Traditionally, implant placement and loading protocols were often discussed separately. However, recent insights highlight the interplay between the implant placement technique and its immediate surgical outcomes in the selection of appropriate loading protocols. Notably, primary implant stability stands out as a key factor for success across both placement and loading protocols. Thus, a multitude of treatment factors need careful alignment alongside thorough patient and site assessment to determine the optimal placement and loading strategy.¹⁴

MATERIALS AND METHODS

In the context of the Third ITI Consensus Conference, the timing of implant placement after tooth removal and the timing of implant restoration were defined as follows:

1. Timing After Tooth Extraction:

- Immediate implants: Placed on the same day as tooth extraction.
- Early implants: Placed 6 to 8 weeks after tooth extraction.
- Delayed/late/conventional implants: Placed 3 months or later after tooth extraction.

2. Timing of Loading/Restoration:

- Immediate loading/restoration: Done within 48 hours after implant placement.
- Early loading/restoration: Done more than 48 hours and less than 12 weeks after implant placement.
- Delayed (conventional) loading: Done 3 months or more after implant placement.

For implant placement protocols:

- Immediate implant placement: Implants are put in the socket on the same day as tooth extraction.
- Early implant placement: Implants are inserted after 4–8 weeks of soft tissue healing or 12–16 weeks with partial bone healing following tooth extraction.
- Late implant placement: Implants are inserted after complete bone healing, more than 6 months after tooth extraction.

For implant loading protocols:

- Immediate loading: Implants are connected to a prosthesis in occlusion within 1 week after implant placement.
- Immediate restoration: Implants are connected to a prosthesis held out of occlusion within 1 week after implant placement.
- Early loading: Implants are connected to the prosthesis between 1 week and 2 months after implant placement.
- Conventional loading: Implants are allowed a healing period of more than 2 months after implant placement without connecting the prosthesis.

DISCUSSION

According to the latest systematic study by Galluci et al^{1,16}

Type 1A: Immediate Placement + Immediate Restoration/Loading	35 of 1,079 Type 1A implants failed. The success rates ranged from 87% to 100%.
Type 1B: Immediate Placement + Early Loading	One of the 43 Type 1B implants failed. Implant success rates ranged from 93.75% to 100%.
Type 1C: Immediate Placement + Conventional Loading	In total, 24 of 963 Type 1C implants failed. The success rates ranged from 91.8% to 100%
Type 2A: Early Placement with Soft Tissue Healing + Immediate Restoration/Loading	None of the included study reported on this protocol.
Type 2B: Early placement with Soft Tissue Healing + Early Loading	None of the 45 implants failed. The success rate was 100%.
Type 2C: Early Placement with Soft Tissue Healing + Conventional Loading	In total, 5 of 106 Type 2-3C implants failed. The success rates reported by no comparative studies were 100%.
Type 3A: Early Placement with Partial Bone Healing + Immediate Restoration/Loading	None of the included study reported on this protocol
Type 3B: Early placement with Partial Bone Healing + Early Loading	None of the 45 implants failed. The success rate was 100%.
Type 3C: Early Placement with Partial Bone Healing + Conventional Loading	In total, 5 of 106 Type 2-3C implants failed. The success rates reported by no comparative studies were 100%.
Type 4A: Late Placement + Immediate Restoration/Loading	In total, 42 of 1,338 Type 4A implants failed. The success rates ranged from 72.2% to 100%
Type 4B: Late Placement + Early Loading	In total, 9 of 789 Type 4B implants failed. The success rates ranged from 82.4% to 100%.

Type 4C: Late Placement + Conventional Loading.	In total, 11 of 898 Type 4C implants failed. The success rates ranged from 88% to 100%.
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CONCLUSION

Proposed classification for assessing implant placement timing and loading combinations allow comprehensive treatment selection. Immediate placement with immediate loading, and immediate placement with early loading are clinically documented protocols while immediate placement with conventional loading is scientifically and clinically valid protocol. Early placement with immediate loading, and early placement with early loading presents clinically insufficient documentation while early placement with conventional loading is scientifically and clinically valid protocol. Late placement with immediate loading is clinically documented protocol while late placement with early loading and late placement with conventional loading are both scientifically and clinically valid protocols. When considering placement and loading protocols, multiple factors can affect intended treatment outcome.

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