

# Immediate Loading of a Single Implant in the Esthetic Zone

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Received: February 27, 2016; Accepted: March 14, 2016; Published: March 24, 2016

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## Abstract

Implant dentistry has been a challenging field over the past decades with the introduction of multiple systems. The successful treatment outcomes of the dental implant were mainly due to the strict treatment protocols. However, the long waiting period between visits was challenging to the clinicians. In addition to other patient related issues. Immediate loading implant was introduced to overcome these problems. Nevertheless, several factors contribute to the success of immediate implant loading, which is advisable to be considered and assessed properly before the procedure, especially when replacing a missing tooth in the anterior zone of the maxilla with an immediate loaded implant.

## Introduction

Replacing a lost tooth by using an implant has been reviewed and discussed over the past 40 years with the invention of many systems and the implementation of several protocols. The high failure rate occurrence in installing a dental implant before 1960s made many dentists and researchers to consider it unreliable, until the great discovery that Branemark made in the late 1960s, his concept was to maximize the integration of the implant with the bone that later he named it osteointegration [1]. This approach was essentially about preparing the area for implant placement with strictly refined guidelines followed by a healing phase of 3 to 6 months after placement of the implant [1]. The delayed prosthetic phase was a patient related issue that had to be minimized. Later the years many researchers had to reevaluate and find a way to reduce the time required for the healing process, the surgical procedure, and placement of an occlusal functioning restoration in a lesser timeline [2].

Various implant related factors such as improved implants coating and implant design were introduced. It was claimed that these changes would provide better primary stability and enhance the osteointegration that improves the secondary stability [3]. Moreover, the type of bone quality [4] and other patient related factors were also found to be contributing to the success of the immediate loaded implant.

The concept of immediate implant loading has been emphasized in the treatment of a missing tooth in the esthetic zone particularly the maxillary arch, in which patient concerns

and demands to restore esthetic appearance as soon as possible is necessary. Patient satisfaction with an immediate loading can be obtained due to multiple reasons; the low cost of the treatment because of less surgical steps, the shorten length of the overall treatment and less surgical trauma to the pre-implant soft tissue that will help in the pleasant soft tissue profile appearance (Table 1) [5-8].

## Terminology

Over the years, ambiguous terminologies related to immediate Implant loading was a problematic issue, until 2002, when a consensus meeting was conducted in Spain to unify terminologies related to this concept.

They defined immediate loading as “the placement of the prosthetic restoration on the same day of installing the dental implant [6]. It can be either occlusal loading whereby contact with the opposing teeth should be achieved or non-occlusal that is a non-contact with the opposing dentation during centric occlusion [6].

Later on, according to Cochran et al, 2004, the definitions were modified in the third ITI consensus meeting in 2003 held in Gstaad, Switzerland. The modified definitions were as follows [9-11]: *Immediate loading*: A restoration is placed in occlusion with the opposing dentition within 48 hours of implant placement. *Immediate restoration*: A restoration inserted within 48 hours of implant placement but not in occlusion with the opposing dentition (Table 2).

**Table 1:** Immediate Implant Loading.

Advantages	Disadvantages
Time of Implant therapy is reduced.	Difficulty in achieving Primary stability
Restoring esthetic in lesser time.	Procedure is technique sensitive
Less surgical treatment steps.	Morphology of the site of placement varies between patients.
Preservation of the soft and hard tissue.	Thin gingiva biotype may compromise the final outcome.
Surgical trauma to soft tissue is minimized.	Post-Operative infection if failure to inspect socket in extraction site
Low Cost compared to conventional Implant.	Higher cost if bone augmentation is required.

**Table 2:** Definitions of Implant Loading [11].

<b>Immediate loading</b>	A restoration is placed in occlusion with the opposing dentition within 48 hours of implant placement
<b>Early loading</b>	A restoration in contact with the opposing dentition and placed at least 48 hours after implant placement but not later than 3 months afterward.
<b>Conventional loading</b>	The prosthesis is attached in a second procedure after a healing period of 3 to 6 months
<b>Delayed loading</b>	The prosthesis is attached in a second procedure that takes place sometime later than the conventional healing period of 3 to 6 months.
<b>Immediate restoration</b>	A restoration inserted within 48 hours of implant placement but not in occlusion with the opposing dentition.

**Patient Selection**

There is an absence of significant difference between the treatment with conventional dental implants and the immediate loading implant in regards to patient selection [6]. When planning any type of dental implant procedure, it is important to address the risk factors that can be associated post-operatively. Patient satisfaction for an Endosseous Implant retained prosthesis is relatively high compared to conventional dentures, because of the displeasure experience towards the tissue retained removable dentures and its drawback in stability and inability of patients to chew hard food, yet it is essential to identify quixotic expectation from the patient side [12].

Smoking is one the main variables that can be a significant risk factor when planning an endoossous implant therapy. However, under special circumstances dental implant therapy can be done successfully, though smoking is not considered an absolute contraindication for the placement of a dental implant [13,14]. In a study conducted by Kan et al 1999, it was mentioned that the implant success rate was 65.3% among smokers and to 82.7% among the non-smokers [15]. Furthermore, DeLuca S, et al. [16] claimed a 23.068% implant failure rate in smokers from a total sample of 464 versus 13.33% failure rate among non-smokers. Meanwhile, no correlation was found between smokers and no-smokers in implant failure rate. Although it is recommended to inform heavy smokers of the high risk of implant failure [13,17,18].

Exclusion of variety of Systemic diseases to undergo immediate implant therapy were mention by Chiapasco, et al, Ibanez et al. [19,20]. While other authors successfully preformed immediate loading implant treatment in heavy smokers, HIV patients and other systemic conditions [21]. It is critical to properly select patients for immediate implant loading therapy; a practical selection can be based on the American Society of Anesthesiology classification [22], intraosseous implant procedures are restricted to ASA I and ASA II, patients that fall under ASAIII category and above are screened with caution [23].

**Patient and Implant Mediated Factors**

A major advantage of the immediate loading is that the patient benefits from replacement of a missing tooth and immediate restoration of the esthetic zone by a fixed implant retained prosthesis (Table 3); hence it increases patient satisfaction by avoiding the use of a fixed prosthesis or temporary removable prosthesis. However, several patient and implant specific factors should be addressed to obtain high success rate for an immediate implant therapy.

**Biological Factors**

**Bone**

Bone density has an important role in the survivability of an immediate loaded implant; it is also to a great extent one of the main variables considered in the treatment plan [24]. Therefore, it is important to recognize the bone quality and quantity in order to obtain a clear expectation of the inserted implant sustainability in the hard tissue. In 1985 Lekholm and Zarb, [4] described and categorized bone quality of the jaws into four types. The Maxillary anterior zone falls in type 3that consist of a thin layer of cortical bone with dense trabecular core while the posterior maxillary arch is a low-density bone (type 4) in which several studies reported a high failure rate in this region [25]. Whereas bone quality is superior in the Mandible compared to Maxilla in regards of achieving implant stability [26,27]. In respect to primary and secondary stability, the physiological bone structure proportion consists of cortical bone that is beneficial for implant stability, and trabecular bone, which provides blood supply [28]. In Addition, females are at a higher risk to implant stability failure compared to men, that is in fact due to the structure of bone found in the jaws [25].

Further, bone volume should be taken into consideration, as it is essential to restore esthetic appearance in the anterior upper jaw zone. However, bone resorption due to the osteoclast activity takes place after the removal of a tooth and progresses with time [8]. Therefore, upper jaw ridge has been classified into five groups considering the ridge shape according to horizontal and vertical bone resorption. This classification ranges from minimal resorption to severe resorption (A: minimal resorption to E: severe resorption) which helps the clinicians selectively

**Table 3:** Replacement of a Missing Tooth and Immediate Restoration of the Esthetic Zone by a Fixed Implant Retained Prosthesis [8–10].

Indications	Contraindications
Single missing tooth in the Esthetic zone.	Heavy occlusal Contacts with the opposing dentition.
Implant placement in the extraction site.	Loss of buccal bone plate.
To reduce further buccal and interproximal bone loss.	Presence periapical Lesion and other bone disease.
Patient demands for immediate therapy.	Traumatic extraction.
	Insufficient Gingival converge.

choose patients who have high potential for successful treatment outcomes [4,29].

Immediate implant placement and loading after tooth extraction in the anterior maxilla can be compromised if there isn't a sufficient bone width of 4 mm labially and palatally. Therefore, soft and hard tissue augmentation is advisable to achieve an adequate amount of bone. Despite immediate loading after bone augmentation, prevention of vertical bone loss cannot be achieved compared to horizontal bone loss which can be reduced [30,31]. Nevertheless selecting slow resorption barrier membrane and bone grafts are preferred to avoid any further bone resorption and to deliver best bone quality [32,33]. Immediate provisionalization in a freshly extraction socket with intact labial plate can be remarkably successful and somehow recommended to prevent horizontal bone loss [34-36]. Although, these high success rates are encouraging, yet a large scale of patient sample and long-term case follow up is required [37].

The impact of using a piezosurgery over classical extraction method has been noticed by many researchers, its concept of providing minimum invasive extraction and maintaining the bundle bone inside the socket can induce the healing process and osteointegration [38]. Despite minimum socket trauma and the immediate implant placement to prevent vertical bone loss, crestal bone resorption still occurs [31,37]. In an animal study on dogs, implant placed subcrestally showed buccal bone loss irrespective of the graft used [39]. Other authors mentioned how to compensate the loss of crestal bone by over countering the ridge with a graft coronally and on the socket labially. This method may help in enhancing the final esthetic outcomes [40,41]. Conversely, bony tissue assessment by various approaches is essential for each implant site in the maxillary anterior. That is due to the difference in the bone structure present and the fact that only selected sites exhibit a minimum of 2 mm while other areas may have on average of 1.5 mm width [31].

Radiography evaluation of the bone in the esthetic zone is one of the major prerequisites prior to the surgical procedure. Although, the bone quality can be easily assumed based on the previously mentioned bone classifications in the region [4], radiographic evaluation is still necessary. The digital periapical radiograph has a great degree of accuracy compared to panoramic radiograph. But, both techniques only show a two dimensional image [27]. On the other hand, CBCT which provides a three dimensional image which is required to select the ideal site for immediate implant loading in regards to bone volume especially in the anterior maxillary zone where sufficient bone is critical not only for implant stability but also for the pleasant esthetic appearance [42].

According to several reports, when immediate loading is planned, torque values should range between 25-30 N.cm, to increase primary stability [26,43]. Similarly, after implant insertion micro-motion, to some degree, may harm the process of osteointegration, which later leads to failure. Thus, recommendations for the acceptable range of micro-motion can

be between 50-150 $\mu$ m. Due to the low density of bone found in the anterior maxilla, increased implant micro-motion can be detected; thereby caution should be taken when a clinician is immediately loading an implant in this zone [5,44,45]. Hence, believe that increasing the peak insertion torque can minimize the implant micro-motion; still it is dependent on the type of bone [26]. Reaching the highest torque possible may not be beneficial in regards to the process of osteointegration; therefore, it's logically appropriate to choose a torque that has a predictable outcome [46].

Another protective measure in the reduction of crestal bone loss, is the use of narrower abutment platform "platform-switching" which can have a beneficial effect on the preservation of the crestal bone and can increase the volume of the peri-implant connective tissue [47,48]. On the contrary, the use of this concept could contribute in the retrieval the lost esthetic in the anterior maxillary zone [47].

### Soft tissue

Peri-implant soft tissue architecture is substantially affected by the conventional tooth removal and damage to the integrity of the inter proximal [38]. Other methods such as using a periosteotomy can possibly prevent impairment of the papilla and the marginal gingiva. Although, recession of the marginal gingiva may take place if conventional implant is chosen over the immediate implant [49]. Thus, recreation of the emergence profile after placing an implant is of an important factor to reproduce esthetic appearance in the maxillary anterior zone.

**Papilla and mid-facial gingiva:** Immediate prosthetic loading can preserve the remaining amount of soft tissue present and could also provide an optimized level of papilla growth coronally while the mid-facial margin may recede slightly apically [50,51]. The extent of growth for the proximal papilla and its pleasant looking emergence depends several factors: Firstly, the distance between the bone crest and the contact point of the prosthesis that should be above 5 mm. Secondly, the formation of the biological width which occurs apically to prosthetic crown compared to natural teeth [52]. Thirdly, the given space between the adjacent tooth and the dental implant this can influence the papilla volume [53]. Many studies have fortunately proved acceptable treatment outcomes regarding the gingival zenith and the papilla after placing a post extraction immediate implant loading, yet further well controlled case studies should be addressed [24,30,54].

In a natural tooth, biological width is considered essential to protect the underlying crestal bone from further resorption, hereby it is important to restore the lost biological width especially in deep restoration. In the case of restoring with an implant it has been claimed that immediate implant loading in a fresh socket can yield a "longer epithelium interface" compared to healed sockets due to unhealed peri-implant tissue. However, there is insufficient information in respect to the difference in the surgical protocol of installation an implant in relation to the soft tissue formation [51,55].

**Gingival biotype:** Facial tissue biotype can be a predisposing factor to post-implant gingival recession. This preexisting factor is considered an esthetic risk and can compromise the final treatment results, whereas reports have identified less tissue recession in thick biotype [54]. Tissue augmentation is advisable in thin biotype even with the presence of intact buccal plate, as marginal recession will eventually lead to buccal crestal bone resorption [8,30,53]. However, it seems that gingival recession is restricted to the facial aspect this clarifies the absence of significant correlation between gingiva biotype and the modification of the inter proximal papilla levels has been noted [51].

**Flap design:** Nowadays, flapless immediate implant have raised many question regarding its superiority over mucoperiosteal flap, it may have several advantages such as minimum invasive to blood supply in the site of surgery and the buccal bone, but its risks may be overlooked. In a complicated tooth extraction, a clinician will require to examine the tooth, which is not achievable without raising a flap. Inspection of the buccal palate for any bony defect and the risk of perforation during osteotomy demand a mucoperiosteal flap [35]. Nevertheless, selecting the technique for access to the socket is not a vital element to attain esthetic outcome [30].

## Mechanical Factors

### Implant size

A highly skilled clinician should perform treatment of the esthetic zone, as each step in treatment plan is extremely sensitive and will affect the final outcomes. Accordingly, selecting the suitable implant size is determined by clinical examination of the alveolar ridge and digital radiographic images. A required length of <10 that will influence the success outcomes by increasing surface area contact of an implant with the bone [56,57]; thus, better implant-bone primary stability and osteoingration will be obtained [58]. A resorbed ridge will force the clinician to choose a shorter implant or proceed with bone graft and tissue augmentation that of coarse depends on the severity of the resorption; unfortunately this still increases the risk of failure especially in the anterior maxillary zone where it contains type 3 bone [33,41,59].

For proper implant diameter selection, evaluating the area with the aid of 3D- imaging device (CBCT) is recommended to assess the mesiodistal as well as Buccolingial distance of the alveolar crest that will anchor the implant successfully [60]. Although, improper selection of implant size can cause esthetic failure [61]. It has been agreed that overloading on the alveolar ridge when immediately loading an implant can increase undesirable biological response such as; bone resorption and loss of osteointegration, this can be avoided by increasing the diameter that can lessen the stress and strain on the surrounding bone [62,63]. However, the increased diameter of the implant is limited by the space available and bone width. Choosing an implant isa sensitive step that requires precise decision and each patient needs a special consideration [58].

### Implant design and pattern

Another influence on the primary and secondary stability of the implant is the type of design. Through the years researchers have focused on modifying the surface of the implant in a way to increase the surface contact with the bone. In spite of implementation of several designs the superiority of Screw-type tapered titanium implant has ruled over other implant configurations, as it posses higher mechanical retention, considerably withstand compression forces when loaded as well as providing better primary stability [64,65]. A cylindrical shaped implant used for immediate loading is vulnerable to failure thus, discarding this type from selection when planning the treatment is advisable [58,65].

Moreover, Self-tapping implant may eliminate the demand for an extra tapping step in the surgical protocol [66,67]. Accordingly, the surgical site can be prepared in a narrower diameter to allow the implant to be compressed against the walls of the socket; lesser torque is required due to the integrated cutting edge [64,68]. However, as mention previously, elevated primary stability is partially related to the increase of surface area on the implant which is associated with non-cutting screw-type compared to the self-cutting type [68]. When using a screw-shaped implant in immediate loading, micro-motion limited to 30 µm can assist positively as mechanical stimulus to the formation of bone around the interface and interestingly aid in the osteointegration [65]. Nonetheless, micro-movement associated when installing an implant is irrelevant to the torque applied despite the use of different designs [69].

The mainstay for a successful immediately loaded implant is the stability and its integration with bone. Therefore various techniques have been introduced and evolved over the past years to modify the surface of the implant and to obtain lesser healing time and a predictable implant survival [37]. Altering the topography of the implant surface is emphasized in situations where poor bone quality and volume is located, thus, micro-roughing the surface can be predictably successful [11,70]. Furthermore, macro-scale methods such as the use of titanium plasma-spraying, blasting with ceramic particles and acid-etching to roughen the surface were found favorable where as newer nano-scale approaches have emerged to control cell adhesion and proliferation to stimulate bone response [70,71]. In addition, Treatment of the titanium surface can promote cellular activity to induce osteogenesis and favorably adjust the hydrophilicity in the implant-bone junction where biological fluids are present. However, fewer studies conducted in respect to the success of these surface topography [70,72].

It was concluded according to several animal and human studies that the advantage of oxidized implants over the mechanically machined implant was observed significantly when prosthetic crown was placed immediately after insertion of an implant [72]. Nevertheless, further clinical studies should be conducted due to the insufficient clinical evidence regarding the preferred implant surface [37].

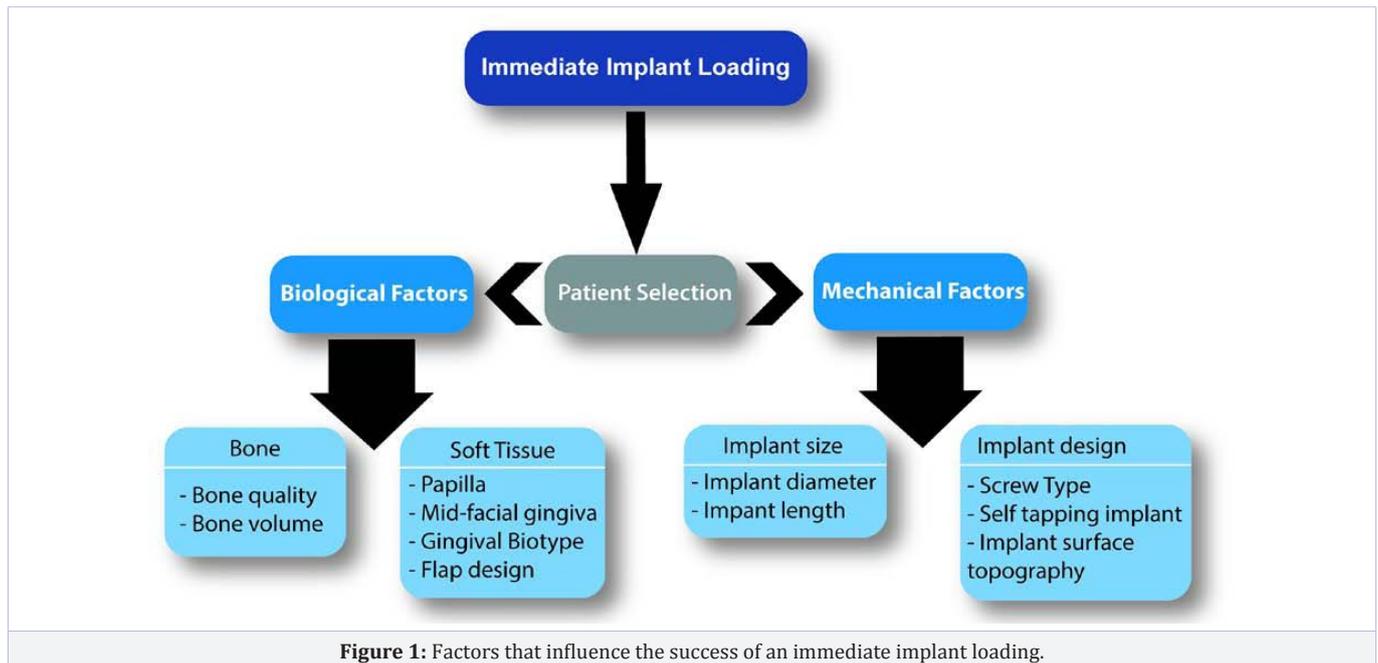


Figure 1: Factors that influence the success of an immediate implant loading.

## Conclusion

Replacing a missing tooth in the anterior zone of the maxilla with an immediate loaded implant is considered one of the most challenging procedures; it involves proper patient assessment and clinical examination, not to mention the aid of CBCT to inspect the quality and quantity of bone. According to the data acquired before proceeding with surgical treatment, it indicates that many variables should be considered and re-evaluated to ensure a favorable procedure outcome. Bone quality and quantity in the esthetic zone, which contain a softer bone, can have a major impact on the primary and secondary stability of the immediate loading. Nowadays different companies have developed new technologies for coating the implant surface, they stated that it increases anchorage and stability of the implant inside the jawbone, however, these claims should be supported by more human trials are needed with a long-term follow up. Soft tissue regrowth is another critical importance that a clinician should emphasize to obtain esthetic appearance. Loading the prosthetic crown immediately after installing the titanium implant in the bone is a technique sensitive and should be performed by an expert operator. Several studies have claimed a high success rate of immediate loading even with presence of risk factors. Although, these high success rates are encouraging, yet a large scale of patient sample and long-term case follow up is required for this technique to be widely used (Figure 1).

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