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# Criteria for immediate placement of oral implants – a mini review

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**Abstract**
The introduction of osseointegrated implants in dentistry represents a turning point in dental clinical practice. Thanks to their multiple therapeutic possibilities and the high predictability of success, implant therapy is now regarded as an extremely reliable approach to replace missing teeth. The concept of immediate implant loading has become popular due to less trauma, reduced overall treatment time, decreased patient's anxiety and discomfort, high patient acceptance and better function, and esthetics. Nonetheless, research and understanding in this area are confusing and sometimes contradictory. Hence, the purpose of this review to provide clinical benefits of immediate implants, and analyze criteria for immediate placement. Results from this review indicated that dental implants that are immediately placed into carefully selected extraction sockets have high survival rates comparable to implants placed in healed sites. However, a careful case selection, proper treatment plan, meticulous surgery, and proper design of prosthesis are essential for optimal outcomes when this approach is adopted.

**Keywords:** Immediate implant; osseointegration.

## Introduction

As dental professionals, we find ourselves immersed in an exciting era of revolutionary therapeutic change. As endosseous dental implant therapy rapidly becomes the prosthetic standard of care for a vast array of clinical applications, we faced with the challenge of developing dynamic treatment planning protocols. However, despite the high success rate of endosseous implant therapy, it has yet to achieve wide public acceptance and utilization (Cavicchia and Bravi, 1999). The most frequently cited reasons for underutilization of endosseous implant therapy are that treatment cost is perceived to be too high and treatment takes too long (Branemark's original treatment protocols required one to two years to complete treatment).

An obvious area of focus has been to decrease the amount of time necessary to complete implant therapy. Three approaches to achieve this goal have dominated clinical research and practice: delayed/immediate implant loading, improving implant surface technology (promotion of quicker healing and better osseointegration), and immediate placement of an endosseous implant after extraction of a natural tooth. This paper will focus on these three approaches and will discuss current trends in immediate endosseous dental implant case selection criteria.

For the purposes of this paper, the working definition for an immediate endosseous implant is extraction of a natural tooth followed by immediate placement (within the same surgical procedure) of an endosseous dental implant.

Immediate implants have become widely accepted despite controversial beginning and the available literature consistently cites high level of success (ranging from 94 to 100% on average).

The primary advantages of immediate implant placement are the reduction in time and cost of therapy, the reduction in surgical episodes, and preservation of the bone and gingival tissues. The greatest rate of bone resorption occurs during the first six months following tooth extraction unless an implant is placed or a socket augmentation procedure performed. The early maintenance of gingival form will greatly facilitate the peri-implant gingival tissue esthetics by maintaining support for the interdental papillae.

The primary disadvantage of immediate implant placement is the fact that the clinician may not be able to place the implant at the time of extraction even though time has been scheduled. The patient must always be informed that although an immediate placement will be attempted, it is not guaranteed since there is always a possibility that factors such as ankylosis, bone fractures of facial plates, socket expansion during extraction, or extensive infection might make immediate placement impossible. These areas will require extraction socket healing and possible augmentation before an implant can be placed.

*Indications for immediate implants*

Immediate dental implants may be considered the treatment of choice for an endodontically infected tooth, root fracture, root resorption, periapical pathology, root perforation, and unfavorable crown to root-ratio (not due to periodontal loss). However, site selection remains very controversial.

**Selection Criteria**

There is no universally agreed-upon case selection criteria (Coatoam and Mariotti, 2000; Douglass and Merin, 2002). The need to further develop case selection criteria for immediate dental implants is particularly note worthy, because when they are employed in a clinically appropriate situation, immediate implants provide clinically recognizable benefits.

In general, immediate dental implant selection criteria dependent on the unique circumstances that pertain to each individual patient and should reflect the following factors:

1) Achieving predictable osseointegration.
2) Anatomical considerations.
3) Maximizing esthetic results and soft tissue maintenance.
4) Restoring function.
5) The surgical technique and experience of the dental surgeon, and the patient's medical status, expectations, and level of compliance, etc.

*Achieving predictable osseointegration*

*(a) Primary stability*

Histological analysis of successful immediate dental implant therapy demonstrates that osseointegration is predictably attainable and efficacious and requires a minimum of 3–5 mm of intimate bone to implant contact (Garber and Belser, 1995). Bone quality and quantity and surgical technique are predominant clinical determinants that affect primary stability and will be discussed in further detail. The literature repeatedly points to primary stability as essentially the most important osseointegration determinant because it allows for vital bone maintenance, clot stabilization, and prevention of soft tissue collapse and epithelial downgrowth. In other words, primary stability is dependent on several other selection criteria (see below), and the ideal immediate implant site should have a significant amount of supporting alveolar bone.

*(b) Quantity and quality of bone*

Bone quality has been suggested as an important prognostic indicator of dental implant success and is of special importance when considering immediate implants (Grunder *et al.*, 1999). Lekholm and Zarb's bone type classification is widely accepted and will serve as a guide for our discussion. Type I bone is a homogeneous, compact bone; Type II bone is a thick layer of compact bone surrounding a core of dense trabecular bone; Type III bone is a thin layer of cortical bone surrounding a core of dense trabecular bone of good strength; and Type IV bone represents a thin layer of cortical bone surrounding a core of low density bone (Levine *et al.*, 1999). Placement of an immediate implant has the desirable effect of preserving alveolar bone width and height. When a tooth is extracted, predictable bone resorption ensues for six months. A typical defect of such resorption is a loss of crestal bone with a labial concavity. Delayed implant placement may result in compromised esthetics and function due to lingual placement of the implant (Mayer *et al.*, 2002). Hence, in certain circumstances, immediate implants will provide for more ideal prosthetic placement and will optimize esthetics, all via the preservation of bone.

The ideal extraction site for an immediate implant demonstrates little or no periodontal bone loss, adequate remaining supporting alveolar bone, adequate sub-apical bone, and dense crestal bone (Types II and III bone are desirable and increase the likelihood of success). Such sites are most often found in the parasymphyseal mandible. In general, bone quality and quantity are superior in the mandible; hence, immediate implant success is greater in the mandible as compared to the maxilla (Saadoun

and Landsberg, 1997). Cornelini *et al.*, 2005 cite studies with mandibular success rates of 95% and maxillary success rates of 92%. Careful case selection may preclude immediate implants in the posterior region of the maxilla when bone quality and quantity are poor and/or deficient.

The number of remaining osseous walls is an important parameter in case selection criteria. Research consistently demonstrates that the presence of three to four remaining osseous walls is essential to immediate implant success and that implant failure rates significantly increase when this principle is violated.

According to Douglass and Merin, a bony defect with two or three missing walls is not suitable for an immediate dental implant. The prospective site should be carefully examined for circumferential crestal bony defects and labial bony defects. Should either be present and deemed severe, the site is not suitable for an immediate dental implant. However, such defects are not contraindicated if current osteogenic techniques (e.g., Guided Tissue Regeneration (GTR) barrier membranes, bone grafts, and combinations thereof) are able to provide an adequate barrier to span the defect and promote bone fill. In the buccal-lingual dimension, an immediate implant site should possess a minimum bone measurement of 4 mm, and the individual plates should be thick enough to engage the implant without undue stress. The bony height of the socket (from the apex of the alveolus to the crest of bone) should demonstrate a minimum bone measurement of 7–10 mm. Bone levels beyond the apex (sub-apical) are likewise important, especially if more bone is needed to achieve adequate implant stability (to facilitate the previously mentioned requirement of 3–5 mm of intimate bone to implant contact). According to some clinicians, 4–5 or 3–5 mm of sound bone beyond the apex is necessary to achieve this goal.

However, failure to meet the above criteria is not necessarily a contraindication for immediate implants. These principles may be violated if other parameters are able to compensate for a given deficiency and the site is delicately prepared.

**Anatomical Considerations**

*Extraction site morphology*

Residual extraction site morphology is an important determinant of immediate implant success and can complicate implant positioning. The important aspects of residual extraction site morphology are axial inclinations (slope), root curvature of the extracted tooth (dilacerations), and location of the socket apex. An assessment of the root orientation must be made, since this has a direct bearing on the angulation of the implant. Maxillary incisors and canines are curvilinear in shape and as such the long axis of the root and the long axis of the crown are not parallel. Placement of the implant along the long axis of the extraction socket (long axis of the root) in these situations may result in buccally angulated implants. An assessment of the root's shape (round, ribbon-shaped, etc.) must be made, since it has a direct bearing on both the type of implant bone interface that can be expected once the implant is placed as well as the angulation of the implant.

Since there are a limited number of implant diameters available (most sizes being 3.75 and 4.0 mm) it is reasonable to assume that spaces exist between the implant and the prepared bone site because of the shape of the extraction socket. The implant–bone interface can be classified as Types I, II, or lll.

*Type I interface*

Ideally, one would prefer to see an implant with freshly prepared bone along its complete periphery (Type I). This can be accomplished when the root is smaller than the implant and is often seen when small teeth are extracted or when the teeth that are extracted had periodontal disease and the remaining socket size is minimal. The Type I interface can be created by placing the implant deep into the socket so as to engage only the apical portion of the socket and the prepared bone beyond the apex. In these situations, once the site is prepared the implant will be in contact with freshly prepared bone along its complete periphery. The Type I interface can also be created when an alveolectomy is performed, thereby allowing the implant to be placed into basal rather than alveolar bone. The alveolectomy also reduces the potential implant length and therefore it may be preferable to have immediate implants stabilized within the confines of the socket at a more ideal occlusal height and then use guided tissue regenerative procedures to fill the bone implant void.

*Type II and III interfaces*

Because of the different shapes and sizes of roots there is a greater likelihood that when dealing with immediate implants a space will be

present between the implant and the prepared socket. In the Type II situation a space is present at the coronal aspect of the implant, while the apical portion of the implant is secured in freshly prepared bone. A Type III situation exists when a space is present along the lateral border of the implant. This may be the reason that the immediate implantation procedure was slow to develop, since this gap may have initially concerned researchers as a possible mode for failure.

Finally, the extraction site must be large enough to accommodate an appropriately selected commercial dental implant.

*Surrounding anatomy*

The proximity of structures such as the maxillary sinuses, the mental foramina, mandibular sublingual concavities, and the inferior alveolar neurovascular bundle. We reiterate that 3–5 mm of sound bone beyond the apex is desirable in order to better facilitate osseointegration (Garber and Belser, 1995). Furthermore, this "cushion" of bone is an important guideline to prevent impingement of aforementioned anatomical structures.

*Maximizing esthetic results and soft tissue maintenance*

Esthetic demands are placed on the dental surgeon by both the patient and the presenting clinical circumstances. All things being equal, an immediate implant may be the treatment of choice for an esthetically demanding patient. As previously discussed, there is bone resorption during the first six months post extraction, which may lead to an undesirable esthetic defect. According to Douglass and Merin, selecting an immediate implant protocol allows for early maintenance of gingival form and greatly facilitates peri-implant gingival tissue esthetics (due to maintenance of interdental papillae). The success of immediate implants in the esthetic zone can be enhanced further with the use of custom healing abutments (which serve to preserve crestal soft tissue and inter dental papillae) (Garber and Belser, 1995).

*The surgical technique*

Atraumatic extraction technique is very important for the success of immediate implants and facilitates maintenance of the maximum amount of bone (Cavicchia and Bravi, 1999; Garber and Belser, 1995). For example, atraumatic extraction will allow for the preservation of buccal plate bone (preventing perforations/alveolar bone fracture), without which an immediate implant might be contraindicated (Garber and Belser, 1995). Atraumatic extraction may be prevented by ankylosis, which is a relative contraindication to immediate implant therapy. Gross iatrogenic expansion of the alveolus during extraction is likewise a relative contraindication.

In 1999, Cavicchia and Bravi reported that immediate implants should not be loaded immediately (delayed loading is a necessity). The rationale for delayed loading only stems from the idea that immediate loading carries a great risk for fibrous encapsulation of the bony defect, lack of osseointegration, apical epithelial migration onto the implant surface, and lack of primary bone contact. Cooper *et al.*, 2001 report 100% success (at 6–18 months) after placement of 54 immediate implants with immediate loading. In this study, the criterion for loading was primary stability. The authors outline the following advantages to this implant protocol: maintenance of vertical dimension, elimination of reline procedures and interim denture therapy, and potential improvement of soft tissue healing.

*Presence of infection and pathology*

Opinions vary from removing all residual infection prior to implant placement to the position that moderate infection (without active suppuration) is actually beneficial for immediate implant success. The most interesting argument comes from Gelb, who states that residual infection is not a contraindication (Garber and Belser, 1995). He argues that sites with residual infection (without active suppuration) have increased vascularity and cellular elements. Both vascular tissue and cellular elements are supportive of osseointegration (Cavicchia and Bravi, 1999; Schwartz-Arad *et al.*, 2000), regeneration, and repair. Hence, the residual infection may provide a favorable environment. However, as with surgical criteria, clinicians must consider patient-specific factors such as cigarette use, alcohol consumption, oral hygiene, periodontal status, and the presence of an interim prosthesis (Schwartz-Arad *et al.*, 2000).

*Implant component selection for immediate implants*

Screw type implants have superior primary stability and long-term osseointegration as compared to press-fit/machined surface implants

(Schwartz-Arad *et al.*, 2000). Implants with enhanced surfaces (increased roughness) are also superior because they facilitate better osseointegration. Specifically, immediate implants must maximize bone formation rate and clot retention (which affects osseoconduction). The literature also suggests the use of wide-diameter implants for immediate implants. Implants with a width less than 4 mm have been associated with implant failure (Wagenberg and Ginsburg, 2001). An emerging implant system is the immediate placement of anatomically shaped dental implants. The suggested advantages of anatomically shaped implants are as follows: prevention of alveolar bone resorption, improvement in health of the soft tissues, prevention of epithelial down-growth, elimination of barrier membranes, and reduction in postoperative infection.

## Conclusion

The conclusions drawn after reviewing the relevant literature on immediate dental implantation are: (1) Implants placed into fresh extraction sockets have a high rate of survival, ranging between 93.9 and 100%; (2) implants must be placed 3–5 mm beyond the apex in order to gain a maximal degree of stability; (3) implants should be placed as close as possible to the alveolar crest level (0–3 mm); (4) there is no consensus regarding the need for gap filling and the best grafting material; (5) the use of membrane does not imply better results – on the contrary, membrane exposure may carry complications in its wake; and (6) the absolute need for primary closure remains to be established.

Short-term survival rates and clinical outcomes of immediate implants were similar and were comparable to those of implants placed in healed alveolar ridges, long-term studies are needed to conclusively prove the usefulness of this procedure.

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