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Review Article

Immediate implant placement - a review

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Abstract: The practice of immediate implant placement is gaining momentum in clinical practice and can be a very rewarding way to deliver implant therapy to patients. Appropriate patient selection and an understanding of newly developed techniques and protocols are needed to ensure that the high rates of success seen with conventional implant therapy hold true for implants placed immediately. While gaining in popularity in recent years, immediate implant placement is technically challenging and should only be undertaken by clinicians with considerable experience in implant dentistry, both surgically and prosthetically. The objective is to provide a general review about immediate implant placement and to summarize uses and applications in which this technique can be indicated.
Keywords: Implant placement, immediate implant, jumping distance.

INTRODUCTION

An endosteal implant is an alloplastic material surgically inserted into a residual bony ridge primarily as a prosthodontic foundation [1]. After healing is complete and the implant is anchored in the bone, an implant post or abutment and permanent tooth can be attached in a variety of designs.

A Swedish Orthopedic surgeon, Per Ingvar Branemark while conducting research into the healing patterns of bone tissue, accidentally discovered that when pure titanium comes into direct contact with the living bone tissue, the two literally grow together to form a permanent biological adhesion. This phenomenon was named "Osseointegration".

Osseointegration denotes atleast some direct contact of living bone with the surface of an implant at the light microscopic level of magnification [2]. After almost four decades of rapid growth in the field of implants, even today the clinician`s intent is to try and achieve the same biological adhesion between the implant surface and bone.

Hard tissue changes:

Morphologic changes in healing extraction sockets have been described by cephalometric measurements, study cast measurements, subtraction radiography, and direct measurements of the ridge following surgical re-entry procedures. Approximately 5 to 7 mm of horizontal or bucco-lingual ridge reduction, representing about 50% of the initial ridge width, occurs over a 6 to 12 month period. Most of these changes take place during the initial 4 months of healing [3].A corresponding apicocoronal or vertical height reduction of 2.0 to 4.5 mm accompanies the horizontal change [4].

The rate and pattern of bone resorption may be altered if pathologic or traumatic processes have damaged one or more of the bony walls of the socket. It is likely in these circumstances that fibrous tissue may occupy a part of the extraction socket, thereby preventing normal healing and osseous regeneration from taking place.

Soft tissue changes:

It is generally believed that the form of the mucosa closely follows the changes in the underlying bone. Loss of the soft tissue results with subsequent bone resorption which occurs after tooth extraction.

The original protocol proposed by clinicians was based mainly on clinical experience and not on sound scientific evidence [5]. It laid down a set of rules or protocol, which needed to be followed if osseointegration had to be achieved.

Classical protocol:

- After extraction of teeth, the edentulous site had to heal for a period of 8 –12 months. This waiting period was thought to be essential for socket ossification and bone maturation.
- The implant had to be placed within the bone and covered with soft tissue, so that the implant could integrate within bone for a period of 4 – 6 months, also known as the osseointegration period. If clinicians had to follow the original protocol, the entire treatment time would be more than one year. At the same time the benefits of osseointegration could be passed on to very few patients. The cost of this long drawn out treatment would be high. Hence, clinicians have challenged this original protocol to achieve osseointegration.

Need for Immediate Implants:

In a report by Denissen HW, Kalk W, Erdhis HA, Van Waas MA,[6] a delay of 3 months or more after tooth extraction in the anterior maxilla resulted in such an advanced stage of resorption, that only narrow diameter implants could be used [6]. Due to these external and internal dimensional changes in the socket and dimensional changes of the mucosa after 1 year, these sites may not be suitable for implant placement.

Protocol for Immediate Implants:

The protocol for immediate implants eliminates the socket ossification period or combines the socket ossification period with the osseointegration period. This reduces the treatment time by 6 - 8 months and the concomitant bone resorption associated with extraction.

Classification of the Immediate Implant Placement:

Several classifications have been proposed for the timing of implant placement following tooth extraction.

In one classification by Wilson TG, Weber HP [7]**,** the terms immediate, recent, delayed and mature were used to describe the timing of implant placement in relation to soft tissue healing and the predictability of guided bone regeneration procedures [7].

However, no guidelines for the time interval associated with these terms were provided. In a recent classification by Mayfield LJA, the terms like immediate, delayed and late were used [8]. The interval between 10 weeks and 6 months was not addressed.

However many other clinicians like Werbitt MJ, Lazzara RJ, Parel SM have defined the same terminologies in various implant treatment planning protocols [9-11] Thus, it is necessary to introduce clearer definitions of implant placement that are based on the morphologic, dimensional and histologic changes following tooth extraction.

Advantages of immediate implants:

- Reduction in the number of surgical interventions and in the treatment time required.
- Bone width and height of the alveolar bone is preserved, enabling maximal utilization of bone-implant surface area.
- Tooth angulations, ie., ideal implant location mesiodistally and buccolingually can be attained provided that the extracted tooth has a desirable alignment, crown length is in harmony with the adjacent teeth, natural scalloping and distinct papilla are easier to achieve and there is maximal soft tissue support.
- Ideal orientation of the implant.
- Preservation of bone at the extraction site
- Optimal soft tissue esthetics may be achieved.

Disadvantages of immediate implants:

- Tooth location: Malalignment of the extracted tooth may lead to unfavorable angulation of the fixture.
- Anchorage: Stabilization may require more bone than is available beyond the apex. Where vital structures, such as the maxillary sinus or the inferior alveolar nerve are closely related to the apex, immediate implantation may have hazardous consequences.
- Flap design. The mucogingival condition around the extraction socket may be unfavorable to primary closure.
- Presence of infection

Implant treatment planning:

The success of any implant treatment depends on careful preoperative planning. Radiography is an alternative, non-invasive technique for determining presurgically, the alveolar bone quantity as well as quality. In order to avoid morbidity caused by the surgical procedure, it is essential to know the location of vital anatomical structures such as the inferior alveolar nerve and the extension of the maxillary sinus. Another yield of the radiographic examination is to identify possible pathological conditions. As will appear from the above, radiographic examination may be regarded as an indispensable part of the implant treatment planning. In addition to a thorough clinical examination, radiographic assessment is essential to estimate the morphologic characteristics of the proposed implant site and the location of anatomical structures. The information acquired from radiography should be used to estimate the length and width of the implant to be inserted, the appropriate number of implants to be placed, and the location and orientation of dental implants

In implant treatment, a large variety of radiographic imaging techniques exist for preoperative planning. The choice of technique, projections, and number of exposures depend on the region of the suggested implant treatment in particular, but other factors should also be considered.

Furthermore, the accessibility of radiographic equipment, the financial costs, and radiation risk estimates play an important role. Ideally, the goal of the radiographic examination is to gather as much information on the jawbone as possible and at the same time minimize the radiation burden to the patient as well as the cost.

The different types of imaging techniques available possess both advantages and disadvantages, and a combination of different methods may be used in order to optimize the diagnostic outcome. Various imaging options are available for the evaluation of the recipient site.

Intra oral periapical radiographs

Periapical radiographs can be useful in identifying the approximate location of anatomical structures as well as the relative parallelism of roots adjacent to an edentulous site. A limitation of this method is that the images only display the maximum width of the alveolar process. The dimensional accuracy is poor in intraoral radiography due to inherent magnification and distortion. The technique is, however, readily available and rather inexpensive.

Panoramic radiography

A panoramic image yields an overview of the jaws and the general status of possible remaining teeth. It is most useful in the preliminary evaluation of the implant site. An obvious drawback is that the panoramic radiograph does not provide information on the bucco-lingual width of the alveolar process. However, an obvious limitation of these radiographic methods is that they do not provide information on the bucco-oral width or angulation and concavities in the alveolar process, and therefore, it may be preferable to supplement these examinations with some form of cross-sectional tomographic imaging. A position paper by the American Academy of Oral and Maxillofacial Radiology [12] recommended that conventional cross-sectional tomography should be the method of choice for most implant patients [12]. Nevertheless, the authors emphasize that currently there is no scientific evidence for that recommendation.

Computed Tomography

An advanced digital radiographic technique proposed for implant treatment planning is Computed Tomography, also called CT scanning or just CT. Like conventional tomography, this method is able to produce cross-sectional cuts of the jawbone. The technique was introduced in the 1970s, and was based on cross-sectional imaging in the axial plane. Along with CT, computer software was developed, capable of transforming the data of these axial slices into panoramic images and multiplanar cross-sectional images. This transformation is also known as reformatting or reconstruction[13].

Criteria for immediate implant placement

Not all extraction sites lend themselves to immediate implantation. Careful evaluation based on clinical guidelines must direct the clinician as to the suitability of the socket and the appropriate surgical procedures. Various pertinent classification systems have been formulated in the last few years that may serve as useful diagnostic tools.

A group of researchers [14] have proposed a pre-operative classification of extraction sites based on the classical definition of periodontal intrabony defects.[14] They divided the extraction sites into three types, each possessing distinctive characteristics:

Type 1 extraction site:

The type 1 site is an incipient defect environment with a good regenerative potential and an acceptable esthetic prognosis.

The environment is dominated by the four-wall socket or the incipient three–wall dehiscence type defect (5mm or less in the apico coronal direction). The osseous crests lie in the coronal third of the root to be extracted. Adequate bone is available (i.e. 4-6mm) beyond the apex for initial stabilization of the implant.

Osseous crestal topography is harmonious permitting an acceptable discrepancy between the head of the fixture, in the extraction socket and the necks of the adjacent teeth. Usually a 3-5 mm offset is best, because it allows an optimal emergence profile of the restoration from the fixture.

Type 2 extraction site:

A type 2 site is a moderately compromised regenerative and esthetic environment.

A moderate defect environment is predominant, and it extends through the middle third of the root; this includes a dehiscence of greater than 5mm. This would requires orthodontic extrusive augmentation in view of dehiscence of >5 mm. The discrepancy between the osseous crests of the remaining socket and the necks of the adjacent teeth is substantial.

Recession is significant and loss of the labial plate of bone is moderate. This is especially critical in the anterior region of the mouth in a patient with a high smile line.

The type 2 extraction environment poses several functional and esthetic limitations. The reduced regenerative potential of the significant defect environment may force a more apical and possibly less than ideal placement of the implant.

Type 3 extraction site:

A type 3 site is a severely compromised environment in which immediate implant placement is not an option. Vertical and buccolingual dimensions of bone are inadequate for placement and stabilization of the immediate implant.

Recession is present and loss of labial plate of bone is severe.

Severe circumferential and angular defects are present.

Not suitable for immediate implantation owing to inadequate vertical and buccolingual bone dimension, recession and severe loss of the labial bone plate, and severe circumferential and angular defects.

Another group of researchers, [15] have proposed an intra-operative classification of coronal bone-implant morphology so as to be able to evaluate the outcome of the regenerative protocols[15. The morphological relationships are stated as follows:

- No-wall defect = 1 socket wall missing;
- Three-wall defect = at least 1 socket wall has contact with the implant and all walls exist; and
- Circumferential defect = no contact between implant and coronal portion of the socket while all walls exist.

A grading scheme by clinicians, [16] regarding marginal bone loss with teeth present is as follows:

- A1 = no attachment loss, endodontic involvement (root fracture, possible periapical pathosis).
- B1 = one-third periodontal attachment loss.
- C1 = one-half periodontal attachment loss.
- D1 = three-fourths periodontal attachment loss; and
- E1 = bone loss to the root apex [16].

Implant success rate and Cause of extraction:

A number of studies have shown that the survival rate of implants placed following extraction of teeth with root fractures, perforations and combined endodontic periodontal problems is similar to that of implants placed in healed ridges [17]. However, implants placed in sites where teeth have been affected by chronic periodontitis have been associated with slightly elevated failure rates [18]. So there is currently, a lack of definitive evidence regarding the effect of local pathology on the success and survival of immediate implants.

Jumping Distance or Critical Space

In many cases, after immediate implant placement, a space often exists between the surface of the implant and the socket walls. This space is known as jumping distance and needs to be filled with bone to achieve an optimal outcome. This bone healing is dependent on stabilization of the initially formed coagulum in this space. Animal experimental studies have shown that both the distances from the bone to the implant and the surface characteristic of the implant are critical factors for stabilization of the coagulum [19].

Clot stabilization and bone formation may be adversely affected by lack of intact bony walls.

In the intact socket, a critical component of the peri-implant defect is the size of the horizontal defect, which is the longest distance in a perpendicular direction from the implant surface to the socket wall.

It has been shown that for implants with horizontal defect of 2 mm or less, spontaneous bone healing and osseointegration take place if the implant has a rough surface [21].

Horizontal defects in excess of 2 mm have been shown to not heal predictably with bone. However it may be possible to achieve predictable bone fill in such situations by using collagen barrier membranes and implants with a sand blasted and acid-etched surface.

Studies including one from Schropp L, Kostopoulos L, Wenzel A in 2003 have shown that bone augmentation techniques may not be required where the distance between the implant body and bony wall is less than 2 mm [22].

Dental implants today have become a highly predictable mode of replacement of missing teeth. The ultimate goal is to achieve comfort, function, and aesthetics, and also reduction of treatment time [23].

Initially a 3-6 month stress free healing period was recommended by Branemark et al to achieve optimum bone healing and osseointegration prior to loading. This undue waiting period was always a source of inconvenience, both to the patient and clinician, and many a time the reason for opting against implant therapy [24].

The previously stipulated healing time that is necessary before implants can be loaded has been proposed as a result of clinical observations rather than biological documentation. Moreover, early trials faced demanding conditions, such as non-optimized patient selection with poor bone quantity and quality, non-optimized implant design, short implants, non-optimized surgical protocols, and biomechanically non optimized prosthesis.

Szmukler-Moncler et al. stated that there is a range of micromovement within which implants can still achieve osseointegration. Beyond a certain level of micromovement, fibrous tissue will surround the implant, and osseointegration will not occur. This has also been supported by histologic evidence in humans from immediately loaded retrieved implants where a high degree of osseointegration was observed after long-term function [25].

Immediate loading of endosseous root form implants has been described in the literature for eliminating the 3 to 6-month healing period. Earlier, it was thought that micromotion resulting from early implant loading can result in fibrous encapsulation of the implant. In fact, Barone et al in 2003 have found the density of bone around immediately loaded implants to be higher than around those loaded after a delay [26].

Histologic evaluation in animals has demonstrated osseointegration when implants were immediately loaded [27]. Histologic evaluation from human beings regarding implants that received immediate loading has shown evidence of osseointegration [28].

The need to develop implant protocols has been felt, particularly for decreasing or even eliminating the healing periods before loading implants [29].

With better understanding of biomaterials, improvements in implant design and surgical protocols, creation of fixed implant supported prostheses via protocols for either immediate (same day) and early implant loading (within one to a few weeks of healing) have gradually become available during later years as additional concepts, aiming at reducing the treatment time and treatment costs. This is a totally new paradigm as compared to routine protocols.

In the words of Ganeles et al, once immediately loaded implants have clinically osseointegrated, they appear to take on the long-term predictability characteristics of conventionally healed and loaded implants [28]. Furthermore, as stated by Kinsel & Lamb, the new techniques may even offer several advantages, including increased masticatory function, minimized uncontrolled transmucosal loading through cross-arch stabilization, improvement of psychological well-being, and reduction in treatment time [29].

The importance of reduction of micromotion after implant placement has been emphasized by many workers (Proussaefs and Lozada et al, Attard and Zarb et al), all of whom have advocated that the crown be relieved of all occlusal contacts, when single tooth implants are immediately loaded [30,31].

CONCLUSION

Placement of an implant directly into a prepared extraction socket at the time of extraction has several advantages that have the potential to improve patient acceptance of the procedure. Possible explanations may be proper case selection, diagnosis, aseptic method of surgery, maintenance of labial cortical plate and good oral hygiene maintenance during follow-up period. In order to increase our understanding, studies need to be conducted with longer duration and more samples.

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