

Clinical Replacement Therapy and the Immediate Post-extraction Dental Implant

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Abstract: Immediate dental implants have greatly reduced the treatment time and the number of surgical interventions. Recently it has been noted that this treatment modality can be used in aesthetically demanding cases especially the anterior maxilla. The aim of this article is to describe a clinical case in which a fractured maxillary canine was replaced by an osseointegrated implant using a simplified technique in a patient who was a smoker and presented poor oral hygiene. The technique adopted permits a reduction of the number of implant components and consequently a lower cost of treatment, while at the same time maintaining acceptable aesthetic and functional outcomes.

Keywords: Immediate implant, Immediate loading, postextraction implant, Aesthetic zone

I. Introduction

In implant dentistry the concept of osseointegration was first introduced by Brånemark in 1964, and the guidelines for obtaining a direct connection between bone and titanium were described in 1977 by the same author [1]. A stress-free

healing period is generally recommended to achieve osseointegration of dental implants without interposition of fibrous scar tissue [1]. In addition, the traditional guidelines recommend a six- to twelve-month healing period for the alveolar bone following tooth extraction. [2, 3]

As a result of the success of the protocol designed by Brånemark and his team for their dental implant system, other procedures were largely relegated for many years. Initially, a healing period of 9-12 months was advised between tooth extraction and implant placement. Nevertheless, as a result of continued research, a number of the concepts contained in the Brånemark protocol and previously regarded as axiomatic; such as the submerged technique concept, delayed loading, machined titanium surface, etc.; have since been revised and improved upon even by actual creators of the procedure.[4,5]

Fig.1



Fig.1; Delayed implant placement

Based on the time elapsed between extraction and implantation, the following classification has been established relating the receptor zone to the required therapeutic approach:

- A. Immediate implantation, when the remnant bone suffices to ensure primary stability of the implant, which is inserted in the course of surgical extraction of the tooth to be replaced (primary immediate implants)
- B. Recent implantation, when approximately 6-8 weeks have elapsed from extraction to implantation, a time during which the soft tissues heal, allowing adequate mucogingival covering of the alveolus (secondary immediate implants)

- C. Delayed implantation, when the receptor zone is not optimum for either immediate or recent implantation. Bone promotion is first carried out with bone grafts and/or barrier membranes, followed approximately 6 months later by implant positioning (delayed implants)
- D. Mature implantation, when over 9 months have elapsed from extraction to implantation. Mature bone is found in such situations.[5.7]

Primary implantation is fundamentally indicated for replacing teeth with pathologies not amenable to treatment, such as caries or fractures. Immediate implants are also indicated simultaneous to the removal of impacted canines and temporal teeth.[6.8]

Immediate implantation can be carried out on extracting teeth with chronic apical lesions which are not likely to improve with endodontic treatment and apical surgery. et al., in a study in dogs, inserted immediate implants in locations with Novae's chronic periapical infection. These authors reported good results and pointed out that despite evident signs of periapical disease, implant placement is not contraindicated if pre- and postoperative antibiotic coverage is provided and adequate cleaning of the alveolar bed is ensured prior to implantation. [6.8.9.10]

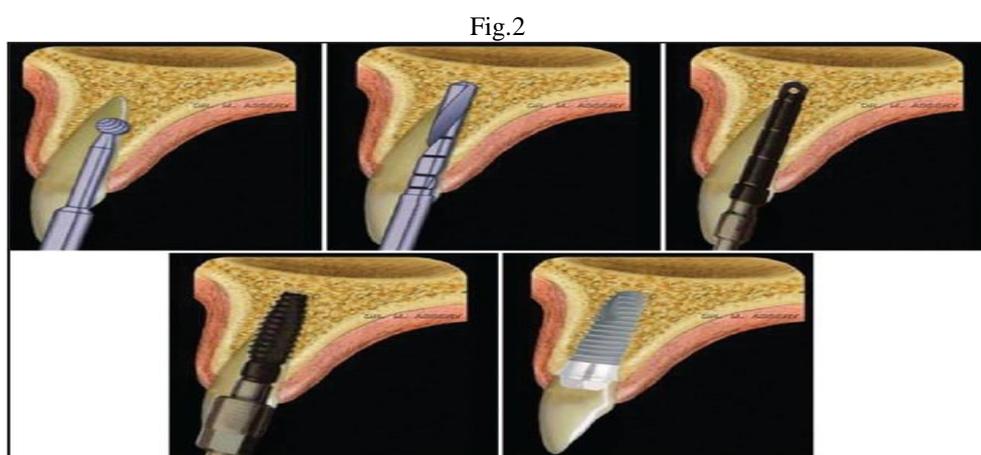


Fig.2; A conceptual graphic description for implant placement in the anterior esthetic zone

While immediate implantation can be indicated in parallel to the extraction of teeth with serious periodontal problems, Ibbott et al., reported a case involving an acute periodontal abscess associated with immediate implant placement, in a patient in the maintenance phase.[6]

One of the advantages of immediate implantation is that post extraction alveolar process resorption is reduced, thus affording improved functional and esthetic results.

Another advantage is represented by a shortening in treatment time, since with immediate placement it is not necessary to wait 6-9 months for healing and bone neoformation of the socket bed to take place. Patient acceptance of this advantage is good, and psychological stress is avoided by suppressing the need for repeat surgery for implantation.[6]

Preservation of the vestibular cortical component allows precise implant placement, improves the prosthetic emergence profile, and moreover preserves the morphology of the peri-implant soft tissues; thereby affording improved esthetic-prosthetic performance.

In anterior teeth, the ideal orientation of implant axis does not usually correspond to that of the socket. Implant placement in the direction of root would oblige vestibular emergence of retention screw or use of prosthetic additaments for the change in angle. The implant bed is to be prepared palatal, and osteodilators can be used to this effect. In the molar region of the upper jaw, it is preferable to establish fixation in the palatal root, since the buccal counterparts are covered by a fine bone layer. In the posterior mandibular region, the inferior alveolar neurovascular bundle often lies very close to the apexes of premolars and molars, and roots of the latter tend to be large; thereby precluding adequate primary fixation of the implant. A common situation is implant placement in the inter-root septum, which causes the bone bed surrounding the implant to condition very precarious initial stability. This problem can be solved by using an implant of larger diameter, waiting for the alveolar space to fill with bone, and then performing delayed placement or positioning two implants to reconstruct a lower molar .

A number of authors have introduced protocols that involve immediate implant placement and provisionalisation following tooth extraction. Although high survival rates for implants with these operative protocols are reported in several studies, postoperative complications such as gingival shrinkage and bone resorption in aesthetically important areas are an important limitation. Continued bone and soft tissue loss may

also cause exposure of the implant surface resulting in a compromised aesthetic outcome [4, 5]. These techniques make it possible to reduce the time required to restore a lost tooth from 9 to 18 months. The advantages of immediate implant placement include a reduction in treatment time, a reduction of surgical procedures and a reduction of aesthetic rehabilitation time [6, 8,9,10,11,12]

The aim of this article is to describe a clinical case in which a fractured maxillary canine was replaced by an osseointegrated implant using a simplified technique in a patient who was a smoker and presented poor oral hygiene. The technique adopted permits a reduction of the number of implant components and consequently a lower cost of treatment, while at the same time maintaining acceptable aesthetic and functional outcomes.

II. Case Report

A 65-year-old male, who is a long time patient in the our dental clinic presented with tooth #21 having suffered a vertical fracture below the gingival level on the lingual aspect. The coronal tooth fragment was retained by the gingival attachment. It was endodontically treated seven years earlier, and the patient elected not to crown the tooth as advised. A 1 mm diastema is present between the central incisors. Numerous wear facets and abfractions are noted, and the patient was advised on multiple occasions regarding the need for restorative and reconstructive dentistry. He has mild-moderate generalized periodontal disease, with no pockets greater than 4 to 5 mm. A periapical film was taken, and evaluated regarding possible implant placement. As the patient has frequent dealings with the public, he didn't want to be without a front tooth at any point in the procedure.



Fig. 3. #21 atraumatically extracted using a Periotome

The patient was presented with a number of treatment options. The choices included extraction of the fractured tooth followed by replacement with a bridge utilizing #11 to #22 as abutments, a removable partial denture or extraction of the fractured tooth and replacement with an immediate implant placement and PFM. The patient refused any removable options and requested an implant in the #21 site. It was explained to the patient that only following extraction of the tooth, could the alveolus be evaluated for possible immediate implant placement, and that if the alveolar conditions were not favorable i.e. due to buccal plate fracture during the extraction, or the presence of a fenestration, that the socket would be grafted and the implant placement delayed. Consent and medical forms were completed, and any patient questions answered.



Fig.4; #21 extraction socket. Buccal plate intact.

Following buccal and lingual infiltration local anesthesia was achieved (Ultracaine 1:100,000). A sulcular incision was made using a Bard-Parker #12 blade around #21, and a peritome was introduced in an apical direction into the periodontal ligament space Fig.3 . It is very important when using the peritome to minimize trauma to the alveolar bone or surrounding tissue. Small forces, with a waiting period of 15 to 60

seconds minimize possible damage to the alveolus. The use of the peritome should not apply to the facial aspect, in order to minimize damage to the thinner bone usually present in this area. Once application of the periotome was complete and tooth mobility verified, the root was gently removed with forceps . The exposed socket was degranulated and any soft tissue remnants removed with a curette. The buccal plate was evaluated using a periodontal probe, under magnification, and found to be intact Fig.4.



Fig.5; Allograft bone grafting material (Mineross) applied to facial aspect of socket.



Fig.6; Biohorizons implant and transfer abutment fully seated.

A Biohorizons 4.5 x 12 mm Tapered internal hex implant was selected for the site. The osteotomy was created in a step-wise manner using burs of increasing diameters under copious external irrigation using cooled saline. Care was taken to avoid the incisive canal . To avoid the tendency of the bur to ‘walk to the buccal’ the palatal wall was engaged approximately two thirds of the way apically by applying both apical and lateral pressure as necessary to achieve the desired implant position. Ideally, the implant position should have the implant center just palatal to the incisal edge in the cingulum position.

If this is not possible, a slightly palatal position is preferable to a buccal position, and can be more easily corrected at the prosthetic stage. Apically the implant shoulder was placed 3 mm below the adjacent tooth’s CEJ, so as to maintain a shallow sulcus depth and to ensure adequate soft tissue height for correct emergence profile formation. Following the osteotomy’s preparation, the implant guide pin was reintroduced into the socket and left in place. Slight voids along the coronal facial aspects were filled with Mineross particulate bone using an amalgam plugger (Fig. 5) and gently compacted, along the facial aspect .

The guide pin was removed, leaving the bone particulate alongside the facial aspect. The implant was placed, trying to avoid any pressure along the buccal plate, and primary stability and position were verified . Fig.5



Fig.7; Biohorizons PEEK temporary abutment seated on implant

The transfer abutment was removed and replaced in the mouth using a PEEK acrylic temporary abutment Fig.7 . A provisional crown was fabricated using a ‘suck-down stent’ fabricated by the laboratory . The suck down stent was tried in over the abutment to check for adequate clearance, and the abutment adjusted as needed. A small opening was made in the stent, over the screw access hole, to allow a hex tool to access the

screw hole . Next the screw access opening in the PEEK temporary abutment was covered with a cotton pellet, to facilitate its location and access later on. The adjacent teeth were lubricated with Vaseline. The #21 area of the stent was loaded with Perfectemp temporary crown and bridge material , seated to place and allowed to set in the mouth. While the material was setting, the screw channel was located by removing the cotton pellet, and the hex tool was reintroduced to remove the abutment screw.

The temporary crown/PEEK abutment was carefully removed from the mouth, while still in its rubbery state, to help prevent the temporary from getting locked into any undercuts and then allowed to set completely. A laboratory analogue was attached to the temporary crown/abutment, and composite resin was added to create the desired emergence profile in the final restoration. Any flash or rough areas were trimmed and polished, and any voids repaired with flowable composite Fig.8. The temporary crown also helped to contain the bone graft and ‘seal’ the extraction socket . Occlusion was checked in lateral and protrusive excursions, and adjusted so that the tooth was not in occlusion. Post-operative instructions were given, and antibiotics and analgesics prescribed prior to the patient’s dismissal. The patient was advised to avoid using the tooth when eating to avoid any micro-movement of the healing site. The patient was seen the following day, at one week, and three weeks post-operatively to evaluate healing and reconfirm that the provisional was not in occlusion. He reported no adverse symptoms and demonstrated good healing Fig.9 . At four months, the soft tissue emergence profile and health appeared excellent and the restorative phase could commence.



Fig.8; ‘Suck-down’ stent loaded with provisional C+B material and seated in mouth.

This technique is the same whether the provisional is made at the time of implant surgery, or during second stage uncovering of the implant. After the second stage implant recovery, or when the temporary crown and abutment is fabricated. if at the same appointment as the implant placement , the emergence contour is customized to the desired profile with either light cured composite resin or acrylic materials, and an appropriate healing time is allowed for osseointegration and soft tissue development. The healing abutment should recreate the subgingival contour of the tooth, and apply the correct pressure to the facial and interproximal tissues to support their contour and shape, and help prevent collapse. In the clinical case described, at the appointment for recording the impression, the customized healing abutment was removed from the mouth and attached to a laboratory analogue. This assembly was then embedded in silicone putty to about the level of the mid-facial. The buccal surface was marked to assist in the orientation of the post for future steps. Keeping the analogue in place within the putty, the customized healing abutment was



Fig.9;Temporary crown immediate post-op.

unscrewed, and a stock impression post was attached in its place to the analogue. Customization of the impression post can be done by flowing flowable composite, pattern resin or C+B acrylic such as Perfectemp temporary crown and bridge material , within the space between the stock abutment and the putty matrix, and

allowing it to set, or curing it with a light source . On setting, the resin was inspected for any voids or rough areas and polished or repaired as needed Fig.10,11. The



Fig.10;Soft tissue emergence profile at four months at impression

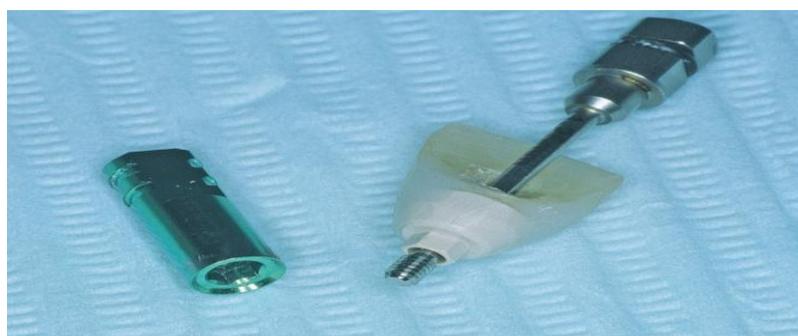


Fig.11; Temporary crown and implant analogue

customised impression post was then seated back on the implant, in the mouth, and the soft tissue carefully evaluated . A radiograph was taken to confirm complete seating of the impression post. Some collapse of the soft tissue can occur if the customization procedure takes a longer period of time, but the tissue should readily go back to its pre-operative state with the customized impression post. A polyvinyl siloxane impression was taken using a custom tray, and carefully evaluated.



Fig.12; Customized impression coping seated in mouth (facial view)

The temporary crown was resealed in the mouth. A face-bow registration and bite records were taken. An alginate impression was taken with the temporary crown in place, to assist the laboratory in duplicating the contours already worked out in the provisional. A laboratory analogue was attached to the custom impression post and resealed in the impression Fig.11 . Detailed instructions were provided to the laboratory regarding shade, shape, texture, occlusion.15-17 A master cast was poured and trimmed, and a soft tissue mask was created in the dental laboratory). The definitive crown was fabricated by the laboratory. Fig.12,13



Fig.13; Customized impression coping seated in mouth (occlusal view) ,Screw retained PBM #21 delivery

Ten days later, the patient returned, and the provisional crown was removed and the final screw retained crown/ abutment was tried in and tightened with light finger pressure. A radiograph was taken to verify complete seating of the abutment, and aesthetics, occlusion and contacts were evaluated and verified. No anesthesia was required for the seating steps. The new crown followed the emergence contour developed by the provisional crown Fig.14 . Once the position of the final abutment was verified by the radiograph, the screw was torqued down with a 20Ncm calibrated wrench . The screw access hole was sealed with plumber's Teflon tape, and flowable resin, which was light cured . The slight diastema, which existed pre-operatively, was closed using a Bioclear diastema closure matrix and Estelite Sigma composite resin , and the two central incisors proportions more closely matched than in the provisional stages. Occlusion was re-evaluated, and post-operative instructions included proper home care, and diet instructions such as avoidance of hard foodstuffs for a few month period to allow for transitional loading of the implant, and further bone maturation. The patient was seen the following day, the following week, and at one month for follow-up. The gingival levels are similar to the pre-operative state, and consistent with the patient's age and gingival biotype. Both the patient and dentist were pleased with the result obtained . Fig.15

III. Discussion

The anterior region of the maxilla is frequently termed the aesthetic zone due to its high visibility and influence on facial appearance. Single tooth implant replacement in this region can present many clinical challenges.[13,14,15,16] Not only must the crown conform in contour, shade, and texture to its neighbors, but the gingiva must also be in symmetry and harmony with the adjacent tissues.[15,16,17,18,19,20]



Fig.14; Screw access opening is plugged with Teflon plumbers tape prior to sealing the access with composite resin.

Correct clinical, prosthetic and surgical management of endosseous implants replacing missing teeth in the anterior maxilla enables the dental surgeon to achieve predictable aesthetic outcomes. The immediate placement in postextraction

sites is a surgical option capable of ensuring ideal periimplant tissue healing, while at the same time preserving the pre-surgical gingiva and bone [21, 22]. To achieve prosthetic success, it is essential to understand the patient's expectations

and desires, paying particular attention to his or her psychological and socio-economic status, as well as to his or her oral condition [23]. The prosthesis should integrate itself from the biological, functional and aesthetic points of view[24]. Some patients seek a rehabilitation capable of yielding the best aesthetic outcome possible despite the cost, whereas others request a rehabilitation capable of affording a satisfactory aesthetic result at a lower cost [25]. In cases such as the one reported here, we propose a simplified technique, which makes it possible to reduce the number of implant components and materials involved, and consequently to reduce the cost of treatment, while maintaining acceptable aesthetic and functional outcomes.



Fig.15; #21 three month post-op

The technique described in this report is characterised by the immediate loading of a conical implant in a postextraction site, with no flap elevation, filling the socket not with heterologous bone but with a fibrin sponge, the use of a mount as transfer and abutment, and finalisation with a metal-ceramic crown.

Immediate provisionalisation of dental implants enables the patient to avoid the physical discomfort of wearing a removable interim prosthesis or the psychological trauma of a compromised smile [27]. The provisionalisation makes it possible to condition implant soft tissues in order to preserve the interproximal papillae and restore a curved/rounded appearance of the gingival margin; it also permits immediate healing of the soft tissue with the formation of an adequate mucosal seal [28]. For a predictable aesthetic result, an important aspect seems to be the height and thickness of the buccal bone wall, which remains after immediate placement

of the fixture [21]. The immediate replacement of the missing root with a postextraction implant avoids the loss of bone in height and width [9].

After tooth extraction, there is a geometric discrepancy between the extraction socket and the implant design. Larger diameter implants, possibly combined with guided bone regeneration, have been advocated to address this discrepancy [8, 12]. Tapered screw-vent implants have a larger coronal diameter that permits a survival rate of 98.5% for all implants placed, with no discernible bone loss in 88% of surviving implants, 1 mm of bone loss in 10.5% implants and 2 mm of bone loss in the remaining implants [29]. Other studies have demonstrated a survival rate of 96.6-98.6% for tapered screw-vent implants and a crestal bone loss of 0.2-0.5 mm [30, 31].

Case reports are appearing in the literature of immediate implant placement and immediate temporization with acrylic crowns. It is important to stress that immediate implant placement does not halt the remodelling or resorptive processes associated with a tooth's loss. The implants placement should not put too much pressure on the buccal wall of the osteotomy. Thicker buccal plates tend to undergo less remodeling. Case selection is very important, as; if the immediate placement and temporization procedures are pushed too far, fibrous attachment formation as opposed to osseointegration can result. This can create the possibility of failure and the need to remove/replace the implant and possibly graft the hard and soft tissues at the implant site, increasing the cost to the patient and/or doctor, increasing the number of appointments and treatment time, and decreasing the satisfaction of the patient and doctor. The clinician must be aware of the advantages and limitations of a proposed treatment and negotiate the best health-esthetic compromise for the situation, and long-term health parameters must always be evaluated). Patients will accept our recommendations regarding longer treatment and healing times if they understand that their best interests are being considered.

Number of studies indicate that there is no evidence of different responses and behavior of the peri-implant marginal bone and soft tissue when titanium or gold-alloy abutments are used in conjunction with cemented single-tooth implant restorations [6].

Botticelli et al through a clinical study questioned the validity of this. In the study, 21 implants were placed into the extraction sockets of 18 patients. During the second stage surgery i.e. after 4 months of healing, it was found that most of the marginal gaps that were present following implant placement were filled with newly formed hard tissue and also that the buccal-lingual dimensions of the ridge were markedly reduced (buccal 45%, lingual about 30%) [32].

Hanggi et al used implants with internal hex connection and reported that causes of initial bone resorption were the biologic width and the microgap between implant and abutment. And most of the resorption took place without occlusal force [33].

Spray et al through his study observed the change in the labial bone thickness at the time of implant placement and at the second stage surgery by measuring the labial bone thickness. They found the most prominent resorptive pattern in less than 1 - 1.4 mm of labial bone thickness, reduction of resorption level in 1.4 - 1.7 mm, remarkable reduction of resorption or no change in more than 1.8 mm and also had a possibility of bone formation. They suggested that for the reduction of labial bone resorption and for the frequency of bone loss, the critical thickness should be 2 mm [34].

Hui et al conducted a prospective clinical study, in which 24 patients were followed. In 24 patients, single-tooth implant placement with immediate provisional protocol was done, including 13 patients who had immediate implant placement after tooth extraction. A surgical protocol aimed at enhancing the primary stability of implants was used for all the implants placed in the aesthetic zone. A minimal insertion torque of at least 40Ncm was also achieved. All the implants in 24 patients were stable within the follow-up period of between one and 15 months. No crestal bone loss of greater than one thread was detected. All the patients considered the aesthetic results to be satisfactory⁴⁰. The clinical outcomes of immediately loaded implants were evaluated after 12 months of placement in the maxillary incisal region by Lorenzoni et al. The implants were inserted with torque values of up to 45Ncm and immediately restored with unsplinted acrylic resin provisional crowns. Occlusal splints were provided for the patients. No implant failure was noticed up to 12 months after insertion. Mean coronal bone level changes at 6 and 12 months were 0.45 and 0.75mm respectively. Bone resorption seen after 6 and 12 months was less than that evaluated for implants placed using a standard two-stage procedure .^[35] The choice of a metal-ceramic crown was based on the patient's limited economic resources as well as on his limited aesthetic requirements as a result of his poor general oral condition . It was, however, possible to obtain a prosthesis integrated aesthetically and biologically with the remaining denture. The prosthesis presents a natural appearance without dark or opaque gingival margins due to metal prosthetic margins covered by gingival tissue .

IV. Conclusion

In this case, our patient met all the indications for immediate implant placement. Using this technique, we were able to provide the patient with a desirable aesthetic and functional outcome. Immediate implant placement may be a highly technique sensitive procedure. However, careful case selection and treatment planning usually result in good success rates.

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