IMMEDIATE IMPLANTATION AND PROVISIONALIZATION PROTOCOL FOR SINGLE-TOOTH REPLACEMENT IN THE ANTERIOR MAXILLA

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ABSTRACT

This article describes the immediate tooth removal process, implant placement and provisionalization procedure in a single tooth maxillary central incisor.

Keywords:

Implant, Anterior maxilla, Provisional

INTRODUCTION

The undetectable esthetic replacement of missing anterior teeth can be considered the ultimate challenge for the cosmetic dentist.

The management of missing anterior teeth with endosseous dental implants is often the most conservative treatment of choice for the patient .[1, 2, 3] This could be attributed to its high predictability from a functional and esthetic point. However, maintaining and creating natural soft tissue contours and emergence profiles around dental implants is a key challenge in achieving a life- like appearance in the final result.

In the anterior maxilla, the high rate of bone resorption during the first month following extraction results in loss of the buccal alveolar plate, which may lead to palatal implant positioning of the implants .[4]If the teeth are still in place and an extraction is indicated as a result of trauma or limited apical infection, then hard and soft tissue volume and contours usually are well developed. In such cases, extraction, implant placement, and provisionalization can be advocated using delayed placement, delayed placement–immediate provisionalization[5], or immediate placement–immediate provisionalization[6] approaches.

Provisionalization of dental implants at placement, following minimally invasive surgical protocols; and properly contoured esthetic provisional, has shown to aid in the sculpting and preservation of esthetic soft tissue contours around dental implants in the esthetic zone prior to fabrication of the definitive restoration .[7-10]

Grunder[11] et al reported that peri-implant soft tissue levels are determined by the level of bone, the volume of the connective tissue, and proximal support of the implant crowns. The bone is the limiting factor. If a site is properly developed, the potential for optimal soft tissue is high.

Predictable immediate implant placement and restoration of single maxillary teeth has been documented in the literature[12] . This could be attributed to advances in dental implant technology such as enhanced surface technology, thread designs, implant collar designs, and soft tissue seal in the implant/abutment interface, which helped preserve bone and soft tissue after the implantation process[13-15].

The reduction of healing time by immediate implant placement into fresh extraction sockets has been described in several studies. It has been shown that good primary stability of these implants can be achieved, and comparable survival rates to implants placed according to the original protocol may also be expected[5, 16.]

This case presentation demonstrates how a right maxillary central incisor was extracted with minimal hard- and soft-tissue trauma, followed by placement and provisional restoration of a dental implant in the prepared socket. The purpose of immediate provisionlization using the patient's own extracted crown was to create a natural appearing soft-tissue architecture that would permit esthetic replacement of tooth #8 using a single tooth implant restoration.

CASE HISTORY

A 30 -year-old male in excellent general health condition presented to the office as an emergency case after being in an accident seeking treatment for his broken anterior teeth. The patient also desired esthetic enhancement of his upper anterior teeth.

Clinical Data and Diagnosis

The patient received a comprehensive clinical examination, which revealed horizontal fracture of the root of # 8 at the coronal third and large class IV fractures of # 7 and # 9 involving both enamel and dentin (Figure 1). Tooth # 8 had hopeless restorative prognosis and required extraction and prosthetic replacement. Radiological examination showed good alveolar bone support around the maxillary incisor teeth with no periapical lesions in relation to any of the teeth (Figure 2). Occlusal, and temporomandibular examinations were unremarkable.

Smile analysis showed that the patient's original smile was not esthetically pleasing. The maxillary midline was canted and shifted to the patient's left. There was also no central dominance.

Treatment plan

Different treatment options were presented to the patient and it was decided that the best treatment is the extraction of tooth # 8 and the immediate placement of an implant before any gingival recession would complicate the esthetic factor of the case. The patient was offered rehabilitation with endosseous implant immediate placement and provisionalization and then 3 to 6 months later; the implant would be restored with its final crown. It was determined that class IV incisal edge fractures of teeth # 7, and #9, would be restored with feldspathic porcelain veneers. Tooth # 10 would also be veneered to provide the symmetry and harmony required to esthetically enhance the patient's smile.

Treatment

A complete set of records was taken which included full radiographs, study models and digital photographs. Diagnostic casts were mounted on a semi-adjustable articulator and analyzed for occlusal factors influencing the case. A diagnostic wax-up was fabricated to assess the effects of the proposed treatment and the upper wax- up model was duplicated in stone in order to create a vacuum formed stent (Schofu; San Marcus, CA). The stent was used as veneer preparation guide for teeth #7, # 9 and # 10, to help preserve as much tooth structure as possible. Prior to tooth preparation, the wax up was shown to the patient and his approval was obtained.

TOOTH PREPARATION FOR VENEERS

After administration of an appropriate local anesthetic, Teeth#7, # 9 and # 10 were prepared for veneers. Stump shade was recorded with a digital photograph for the laboratory. Provisional restorations were fabricated using temporary crown material (Luxatemp, DMG/ Zenith; Englewood, NJ) in a clear matrix material. The provisionals were trimmed, and polished.

Before extraction, the crown of tooth # 8 was etched and bonded to the temporary veneers of teeth # 7, # 9 and # 10 and the palatal posterior retainer that the patient was already using was kept in place to maintain the position of the coronal portion of tooth # 8.

EXTRACTION AND IMPLANT PLACEMENT

Tooth # 8 was then removed by a flapless atraumatic technique. The corwn was first removed (Figure 3) and the root was then luxated using a periotome (Salvin Dental Specialist). A hole was drilled into the pulp chamber of the luxated root, and a post was drilled and cemented to the root canal. With the handle screwed onto the post, the root was removed (Figure 4).Thus, preserving the natural emergence profile of the surrounding gingival tissues as well as the labial and interproximal bone.

A tapered root-form implant fixture (tapered groovy 4.3 x 16 implant, Noble Biocare) was then placed into the extraction site, which had been sized and extended following the long axis of extracted tooth to provide immediate fixation.

When approximately two thirds of the implant fixture's length had been placed, bone graft material (Mixture of Purous allograft, Zimmer Dental, Carlsbad, CA and Bio-Oss, Geistlich Pharma North America, Inc., Princeton, NJ) was placed between the fixture and the socket wall, and the fixture was advanced a few turns. This sequence was repeated until the fixture was fully seated to the level of the bony crest, approximately 3 mm below the gingival margin as measured on the labial. This technique causes the particles to be slightly compressed into the defect and results in excellent primary implant fixation.

The undersurface of the coronal portion of extracted tooth # 8 was modified for passive seating over the implant (Fig 5). Cementum was removed and flowable composite (Esthet Xflow,Dentsply) was bonded to the undersurface to prevent adhesion of gingival tissues around the implant during the healing phase.

The provisional veneers being splinted to the coronal portion of tooth #8 (Fig 6) were then cemented with temporary cement (Temp- Bond, Kerr USA, Romulus,

MI) and adjusted to clear all contacts in centric occlusion and during eccentric movements. Immediate provisionalization using the patient's own crown helped support and maintain the soft tissue contour, creating a natural emergence profile for the provisional crown (Figure 7). The teeth were splinted with palatal orthodontic wires.

The patient came in two weeks later for postoperative check- up and the soft tissues around the implant showed no recession (Figure 8). The patient was monitored over the following three months to allow soft tissue healing and to ensure stability of gingival margin around the implant abutment.

When the implant site has healed well and the emergence profile has been perfected, the provisional restorations were removed and the final impression was then performed. Due to the fact that tissues can easily collapse in a few minutes, two impressions must be taken. First, a standard impression technique is used to make impressions of the implant and prepared teeth and a second impression of the provisional crown is taken to capture the final provisional implant crown shape.

For the first impression, a fixture-level implant impression was taken with polyether impression material (3M Espe; St. Paul MN) which takes excellent impressions of soft tissue in a custom tray (open tray implant impression technique).

The impression was made of the maxillary arch using suitable impression coping (Nobel Biocare AB, Sweden) and master casts were poured (Type IV dental stone, Ultrarock) with implant replica (NobRpl, Nobel Biocare AB, Sweden).

The second is an impression of the cervical portion of the provisional for #8 using silicone putty. After filling a receptacle with PVS putty, the provisional restoration is inserted into the putty halfway, coronally, replicating the exact emergence profile of #8. This will become the silicone matrix the technician will use to make the final Zirconia abutment and implant crown to exactly match the provisional restoration. After the impressions were taken, the provisionals were re-polished and cemented.

It was very important that the implant abutment be waxed to the correct subgingival contours in order to give the identical tissue support as the provisional had done, and to ensure that contours led to a maximum distance of 5 mm from bone to interproximal contact. This would give good papilla support and prevent black triangle from developing.

Patient's teeth were bleached with Zoom2 Whitening System (Discuss Dental; Culver City, CA) and shade selection was made few days later (Figure 9).

Two weeks later, the custom-made zirconium abutment was tried onto the implant fixture and a radiograph was taken to confirm complete seating of the abutment. The abutment screw was torqued down to 32 N cm (manufacturer's recommendation, Nobel Biocare) with a torque driver.

LAB COMMUNICATION

The laboratory can use the provisional restoration as a blueprint for the subgingival and supragingival contours that must be achieved .[17] This information can be relayed to the laboratory by several methods: the provisional restoration itself can be impressed, [18] impression copings can be modified to duplicate the subgingival contours of the provisional restorations, [19] or digital images of the soft-tissue profiles can be sent to the laboratory.

A laboratory prescription was prepared with a detailed description of the requested restorations, including a shade map, specification of crown form and length, surface texture, and incisal edge treatment. This was sent to the laboratory along with preoperative photographs, photographs of the preparations and provisionals, and the impressions and models. In the lab, a wash bake of dentin was added onto the abutment until the shade was identical to that of the stump shade of the prepared veneers of teeth #7,# 9 and # 10, then the Lava Zirconium crown of tooth # 8 and the Feldspathic veneers were layered simultaneously to mimic each other (Figure 10).

SEATING APPOINTMENT

The veneers were bonded to teeth #7, #9 and # 10 and the Lava Zirconium crown for #8 was tried in the patient's mouth. A new shade selection was made for modifying the color of the Zirconia crown to match the veneers and the photograph of the shade tab was sent to the lab along with the crown (Figure 11). A new temporary crown was made for # 8 and it was temporarily cemented. Few days later, the patient came back for seating of the final Zirconia crown, it was cemented with ImProv (Nobel Biocare) and a post-treatment digital radiograph and photograph were taken then (Figures 12 and 13). Note the perfect matching between the final restorations (with white striations) and the natural dentition.

The patient was happy with the treatment outcome – a natural-appearing replacement for his extracted central incisor (Figures 14 and 15). He was particularly pleased that at no time during the course of the treatment did he

require a removable appliance. He also appreciated that other teeth did not require preparation as bridge abutments.

Discussion

The preservation of perfect, natural soft and hard tissue morphology around dental implants presents a challenge, especially preventing the recession of the labial soft tissues .[20]

Immediate implant placement and restoration of single maxillary teeth has been predictably employed for the last few years. Favorable implant success rates, peri-implant tissue responses, and esthetic outcomes had been achieved with immediately placed and provisionalized maxillary anterior single implants.[21]

Potential advantages demonstrated with immediate implants include alveolar bone preservation following extraction and also the patient is not compromised aesthetically and functionally during the healing period.

Successful implant treatment outcomes depends on a number of key factors, such as thorough diagnosis and treatment planning, implant position (buccal/lingual/ incisal), gingival biotype, tissue contours, restoration emergence profile, and laboratory/clinician communication. An appropriate indication with a good surgical technique and prosthodontic protocol are essential for the success of immediate implantation.

Although, the use of dental implants in the esthetic zone is well documented in the literature, placing dental implants in the anterior maxillary area could occasionally be a challenge when the extraction alveolus complicates implant placement.

The development of 3-D scanning such as cone-beam computed tomography (CBCT) [22] instead of planar films has led to improved visualization and comprehension of the anatomy in the areas in which implants are being planned for placement.[22]

The accuracy of CBCT data can be used to fabricate a surgical guide that transfers the implant planning information to the surgical site to facilitate implant placement.

Based on the fact that the patient came in with pain as an emergency case, tooth # 8 had to be extracted immediately and thus, there was no room for planning using CBCT. Periapical radiographs were used in radiographic evaluation of alveolar bone in the maxillary central incisor area before extraction .The implant was placed following the axis of the extraction socket and due to excessive tilt of the natural root; the resulting implant position was less than ideal, where the apex of the #8 implant was angulated mesially causing the long axis of the #8 implant to be angulated towards tooth #7.This made immediate temporization difficult, thus the extracted tooth was used as an ovate pontic to maintain the papilla and guide the soft tissue.

To overcome this angulation, an angled custom made abutment[23] was fabricated and a favorable prosthetic/ esthetic result was able to be achieved.

The precise planning using CBCT, implant planning software and a surgical guide can avert recognized and concealed treatment problems and could have optimized the angulation and emergence of the #8 implant, abutment and crown.

Atraumatic extraction is one of the most important keys of the process as this will define the amount of bone remaining in the alveolar socket to place the implants, which determines the initial stability, as well as the cervical level at which they should be placed. This will determine the position of the interdental papilla, and the emergence profile of the crown, and thus directly affects esthetics.

Techniques such as ovate pontic site development can be successfully applied in augmenting peri-implant tissue height and width. The patient's extracted crown of # 8 was used as an ovate pontic, which helped in molding the papillary height and the gingival embrasure form [24] .It provided excellent esthetics and emergence profile [25].

In the esthetic zone, the preferred restorative choice is with a custom-milled abutment. This enables the clinician to idealize esthetics, idealize the implant orientation with the presenting bone topography, and provide healthy supported soft tissues. Additionally, the bone-level placement creates the opportunity to transition the shape of the implant fixture into the shape of the emergence profile of the missing tooth.

The custom-milled abutment provides a soft tissue scaffold for the gingival tissues and establishes a controlled margin design that follows the contours of the peri-implant tissues for the resulting restoration. Moreover, the cemented abutment crown eliminates the screw access opening, thereby providing greater optimization of occlusal form and functionality.

Immediate implantation and provisionalization provide the potential to maximally preserve hard and soft tissues, which may be beneficial to the esthetic treatment outcome. As there is only one surgical phase, postextraction healing and healing from implant insertion coincide.

Conclusion

Replicating nature with implants in the esthetic zone can be a challenging goal.

Optimal placement of implants in well-developed sites provides the clinician with the potential to redevelop the soft-tissue to normal sulcular form with implant-level provisional restorations. Duplicating the support established with the provisional prostheses in the subgingival form of the implant abutments and crowns helps preserve the peri-implant anatomy and can provide naturally appearing definitive implant restorations.

Figure 1: Pre-treatment clinical frontal retracted view showing fractured teeth ## 7, 8 and 9

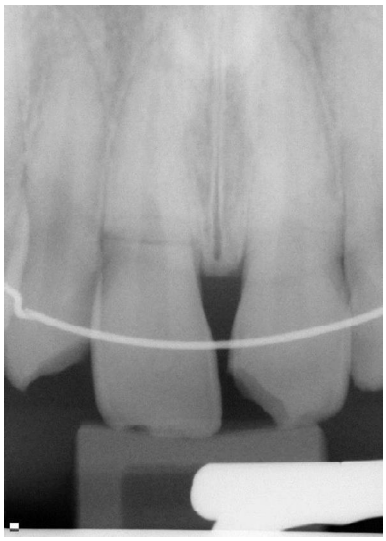

Figure 2: Pre-treatment digital periapical view revealing horizontal fracture of the root of # 8 at the coronal third

Figure 3: The coronal portion of tooth # 8 was removed first.

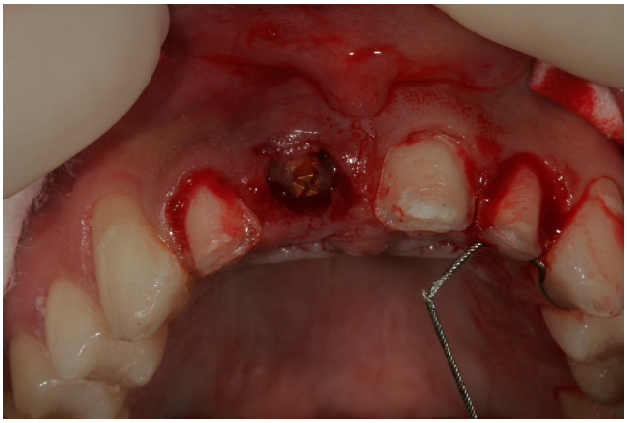

Figure 4: A post was drilled, cemented to the root canal, and used to remove the luxated root of tooth # 8. Note the veneers preparations for teeth ## 7, 9 and 10.

Figure 5: The patient's coronal portion of tooth #8 was placed immediately on the implant.

Figure 6: Frontal view of the provisional restoration showing the coronal portion of tooth #8 being splinted to the provisional veneers for teeth ## 7, 9 and 10

Figure 9: Shade selection for the porcelain veneers and the Zirconia crown for # 8 was recorded with a digital photograph for the laboratory**.**

Figure 7: Clinical frontal retracted view showing the patient's coronal portion of tooth #8 being placed immediately on the implant and splinted to the provisional veneers on teeth ##7, 9, and 10. Note the natural emergence profile for the provisional crown.

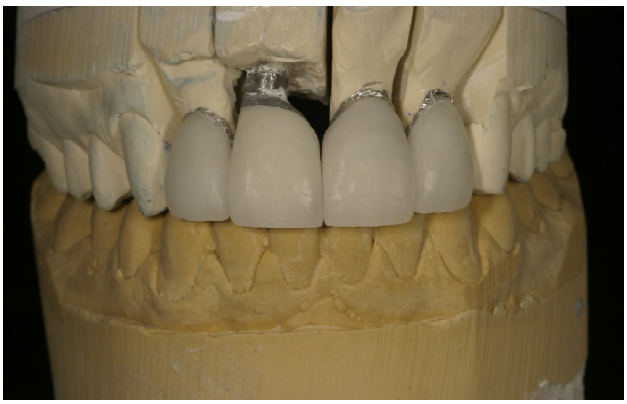

Figure10 : Final restorations on the model - Frontal view.

Figure 8: Clinical frontal retracted view 2 weeks after implant placement showing perfect emergence profile and gingival architecture around the implant.

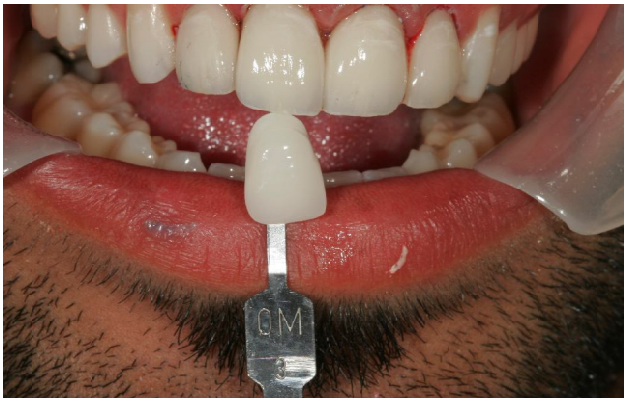

Figure 11: Shade selection for modifying the color of the Zirconia crown to match the veneers.

Figure 12: Postoperative digital Radiograph; Marginal bone levels that are critical to soft-tissue form remained stable following implant placement and restoration.

Figure 13: Finished porcelain veneers and Zirconia implant crown, excellent porcelain match on ##7, 8, 9 and 10.

Figure 14: Preoperative full smile.

Figure 15: Postoperative full smile.

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