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Case Series

Immediate Reimplantation at Failed Osseointegration Sites: A Drilling and Systematically Increasing Implant Width Protocol to Ensure Primary Stability

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Abstract

Despite their documented success, dentists will spend time, energy, and resources to determine if and how failed dental implants can be explanted and replaced with a new fixture. Failed dental implants can be devastating to patients, since dental implant removal and reimplantation typically spans 12 months or more, during which time they endure additional surgeries, bone/tissue grafting, and healing before reimplantation can occur. Furthermore, although reimplantation can be successful, their survival rates are lower than implants placed in fresh sites. Fortunately, there are implants that are specifically designed with incrementally increasing diameter sizes to replace failed dental implants. These implants can be incorporated as part of a systematic contingency plan for immediate reimplantation in the unlikely event of osseointegration failure. This article reviews the implant characteristics that contributes to a successful reimplantation in sites that have previously failed, presenting two cases in which immediately placing implants two width sizes larger (e.g. HexaPlus™, OsseoFuse®; SinusFuse®, OsseoFuse®) in the original osteotomy site reached optimal primary stability.

Keywords: *Reimplantation; Osseointegration; Drilling; Implant*

Introduction

Despite their documented success for restoring edentulous spaces and completely edentulous arches, the reality is that-over time-biological and technical issues may result in dental implant failures [1]. In fact, research has demonstrated that 10% of implants fail [2], with causes attributed to peri-implantitis, crestal bone loss, fracture, and poor implant positioning [2,3]. As a result, dentists will spend time, energy, resources performing clinical examinations, radiographic evaluations, and patient consultations to determine if the affected implant and restoration(s) are hopeless, require replacement, and if so, what protocol should be followed for explantation and reimplantation [1].

This can be devastating not only to patients-who historically must endure at least 12 months or more of additional treatment time to accommodate additional surgeries, bone/tissue grafting, and healing before reimplantation in the same site-but also to clinicians, whose time and reputation are also at stake [2,4]. Fortunately, research suggests that the traditional 1-year waiting period prior to reimplantation may not be necessary when the replacement implant is larger in diameter than the original implant and sufficient bone is present for primary stability [4].

In fact, it is confirmed that the success of dental implant replacement at the site of previously failed implants may be enhanced when wider implants are placed [5]. Furthermore, other research has shown that dental implants placed in the sites of previously failed implants had a lower survival rate than implants placed for the first time when the replacement implants were the same diameter and shorter length [6]. Leading to the idea that perhaps for a successful reimplantation, strong primary stability of the replacement implant is the essential key factor.

However, upsizing to a wider implant for reimplantation may present clinicians with the challenge of fitting the previous abutment and restoration complex to the new implant, which could pose biologic and esthetic concerns. For example, although implants and their components are available in a variety of widths, the incrementation by which different dental implant product manufacturers increase the sizes of the implants and/or their components can be arbitrary. This can make it difficult to replace a failed implant in a site with a limited amount of restorative space to accommodate an abutment and restoration, while still respecting and preserving bone, soft tissue, and resistance against occlusal forces [7,8]. In such instances, an implant that supports platform switching would help to maintain treatment esthetics, prevent peri-implant bone loss, and contribute to long-term survival [9,10].

Systematic contingency planning

Just as it behooves clinicians to perform a patient risk analysis prior to undertaking implant cases, it is also imperative to incorporate a contingency plan mindset when selecting dental implants for placement [11,12]. Understandably, no clinician wants to undertake implant treatment on the assumption that it will fail. However, being prepared to systematically handle an implant failure, should one occur, can help to alleviate patient discomfort, prevent hard- and soft-tissue damage, and otherwise "rescue" the treatment in an immediate and predictable way [11].

To follow a systematic contingency plan, some implant systems are intentionally designed with incrementally increasing diameter sizes (e.g., HexaPlus™, OsseoFuse®; SinusFuse®, OsseoFuse®), rather than a range from small to extra-large. The rationale behind the logically developed width increments is ensuring that in the unlikely event of osseointegration failure, an implant two width sizes larger could be placed immediately into the original osteotomy site for optimal primary stability and reduced patient discomfort (Figure 1) [13].

Figure 1: *The rationale behind the logically developed width increments of the OsseoFuse® implants are ensuring that in the unlikely event of osseointegration failure, an implant two width sizes larger could be placed immediately into the original osteotomy site for optimal primary stability.*

Through the authors' clinical experience and observation, they have noticed that thoroughly cleaning out the fibrous integrated or infected site of a dental implant fixture that fails to osseointegrate creates a circular space (i.e., not oval, square, or otherwise irregularly shaped) of approximately 1.5 mm to 2 mm from the circumference of the original implant. For this reason, OsseoFuse® implants present deep and sharp side-cutting grooves that enables the implant the ability to lock into the original osteotomy site with optimal primary stability. The combination of the deep and sharp side-cutting grooves and a replacement implant two sizes wider (1.5 - 2 mm wider) will allows for an immediate replacement, excluding the need for a separate bone grafting procedure [13,14].

In addition to the deep and sharp side-cutting grooves and an incrementally wider implant size, the platform switching incorporated into the implant's design (HexaPlus™, OsseoFuse®; SinusFuse®, OsseoFuse®) allows for one abutment to fit all implants (Figure 2). This further contributes to the immediate nature of rescuing failed implant treatments, since the original abutment and provisional restoration can be reseated onto the new implant without jeopardizing the interim or final esthetic or functional outcomes.

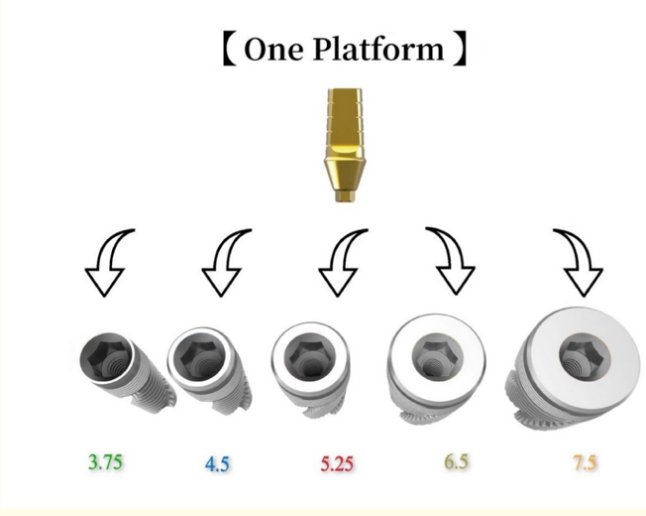

Figure 2: *The platform switching incorporated into the design of OsseoFuse® implants allows for one abutment to fit all implants, which further contributes to the immediate nature of rescuing failed implant treatments.*

Case Presentation #1

A 42-year-old woman presented in September 2011 with a chief complaint of persistent pain and pressure at tooth #7 for approximately 6 months. A thorough examination was performed, including radiographs (Figure 3), and a complete health history was taken. The woman was a non-smoker, with nothing remarkable in her health history. The examination revealed that the crown on #7 was broken; there was a vertical fracture; and severe localized periodontal disease with a compromised mobility of grade 2 was present. In consultation with the patient, the decision was made to extract tooth #7 and immediately place a dental implant (e.g. OsseoFuse® HexaPlus™ dental implant) and provisional restoration.

Extraction

Local anesthesia was administered. Care was taken to atraumatically extract tooth #7 with forceps, as well as clean out all residual root fragments and debris from the socket. A curette was used to remove the diseased tissue, and the bone was sounded using a periodontal probe.

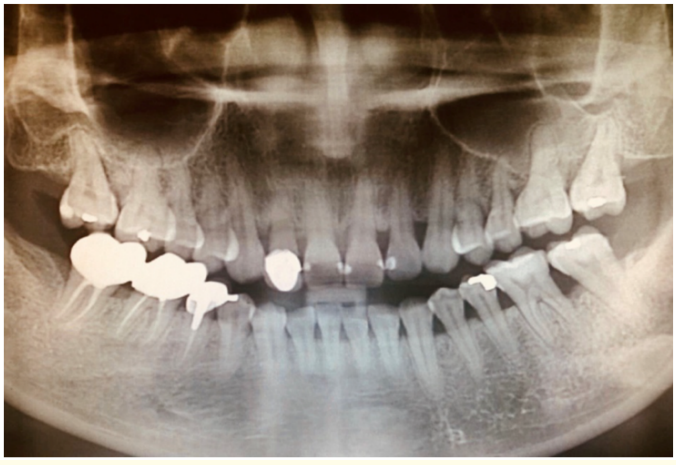

Figure 3: *Preoperative panoramic radiograph of tooth #7 prior to extraction and immediate implant placement.*

Osteotomy and implant placement

The proper size implant was chosen, after which the corresponding size of the appropriate high-efficiency fluted, side-cutting drill (Onedrill®, OsseoFuse®) was also selected (e.g. 3.75 mm x 14.5 mm). By combining all the components and functions of traditional multiple-sequence drills into a single drill-including site marking, drill guiding, increasing diameter width, and safeguarding against violating ideal osteotomy depth-this drill would enable rapid dental implant placement in crestal bone during a shortened procedural time [13].

In particular, the Onedrill® has a small diameter at the apical end continuing with a step incrementation of increasing diameter with each step all the way up to the stopper; colored to match the diameter of the selected implant (i.e. from smallest diameter to largest) (Figure 4). Therefore, there would be no need to interchange drills during the procedure, which would help to prevent error while simultaneously raising the predictability of the implant treatment success.

Figure 4: *Illustration of the OsseoFuse® Onedrill®, which combines all the functions of multiple drills into a single drill, thereby allowing the dental implant surgeon to place implants in a shorter amount of surgical time.*

The osteotomy was immediately created, and the corresponding implant was placed and torqued up to 50 ncm to achieve predictable primary stability. Contributing to this primary stability was the concept of "step-locking" established between the bony osteotomy wall "steps" created by the Onedrill®, and the sharp active threads on the outer body portion of the implant fixture [13]. Then, a minimal amount of bone grafting material (Bio-Oss®, Geistlich Pharma North America, Inc.) was placed to fill any gaps between the implant and the boarder of the extraction socket.

A provisional abutment was placed; the patient was provided with an immediate provisional full-coverage crown restoration for the #7 site (Luxatemp, DMG); and an immediate postoperative radiograph was taken (Figure 5). The patient was dismissed with home-care instructions. At the one-week follow-up appointment, the patient reported no pain or discomfort; the provisional restoration was solid; the surrounding gingival tissue was healthy; and all clinical and biological parameters were within normal limits.

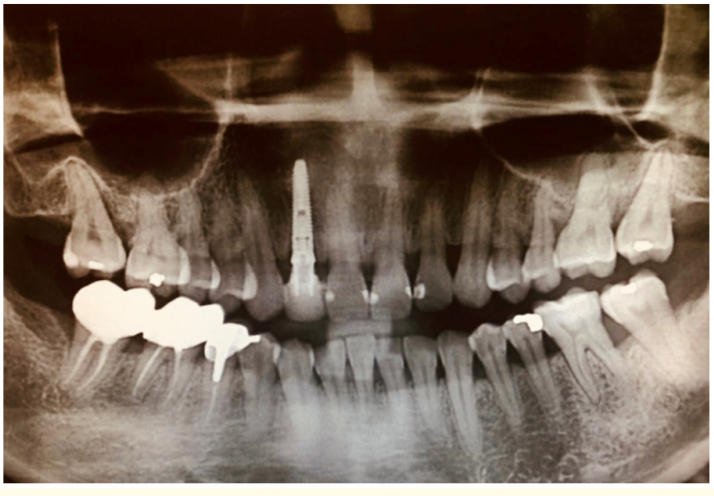

Figure 5: *Immediate postoperative panoramic radiographic following extraction of tooth #7 and immediate placement of an OsseoFuse® HexaPlus™ implant and provisional restoration.*

Explantation after trauma

Unfortunately, three weeks after the postoperative follow-up, the patient returned after sustaining a traumatic injury at the #7 site. Her infant nephew had accidentally kicked her front tooth and she had been experiencing pain and looseness at the implant site. An intraoral and radiographic examination was performed, and it was determined that the traumatic event had compromised the osseointegration of the implant (Figure 6).

Re-implantation planning

It was decided that the original 3.75 mm implant (Figure 7) would be removed and immediately replaced with a wider-diameter two sizes up, 5.25 mm implant (OsseoFuse® HexaPlus™) from the same product line (Figure 8). Addressing the trauma-induced osseointegration failure in this manner would provide the patient with several benefits.

From a clinical perspective, placing an implant two sizes larger would help to promote optimal primary stability and osseointegration in the failed site, according to literature [4,5,15,16]. In this case, the larger diameter implant would still demonstrate the same physical and mechanical characteristics as the originally placed implant, it would establish primary stability in combination with the osteotomy.

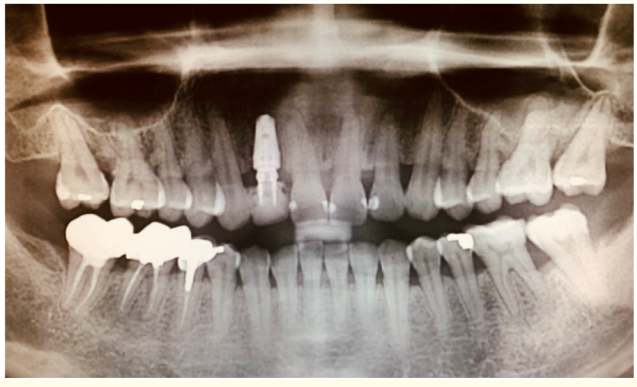

Figure 6: *Four weeks postoperatively, the patient sustained an accidental traumatic injury that compromised the osseointegration of the implant at the #7 site.*

Figure 7: *In this case, the 3.75 mm diameter implant failed to osseointegrate due to accidental trauma.*

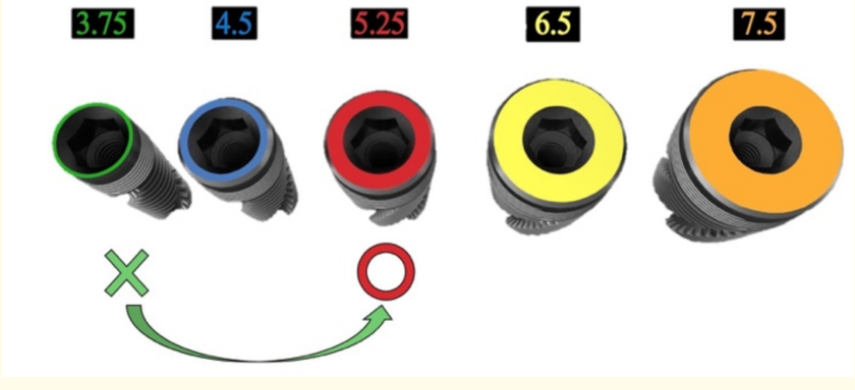

Figure 8: *The poorly integrated implant was removed and immediate replaced with a wider diameter, 5.25 mm implant, without any further preparation or delay.*

Secondly, because the connection of the selected implant incorporated a platform-switch design, the originally placed, smaller provisional abutment and restoration could still be used immediately to provide the patient with esthetics and function [17,18]. Furthermore, because the platform-switching design shifts the perimeter of the implant-abutment junction towards the center of the implant body, the contact angle is reduced and the force distribution is enhanced [19], which contributes to greater crestal bone preservation than traditional, non-platformed switched dental implants [20-22].

Clinical technique

Local anesthesia was administered. The failed dental implant at the #7 site was removed from the socket by counterturning, after which any residual soft tissue and/or bone grafting material was also removed. Note that research has demonstrated that reverse torque is the most conservative method for removing failed implants and has been advocated as the first method of choice for explantation [3].

After cleaning out the fibrous tissue of the poorly integrated implant, we selected an OsseoFuse® implant two sizes wider (5.25 mm) than the previous OsseoFuse® implant (3.75 mm). The replacement implant was immediately placed with precision and without the need of further drilling and achieved optimal primary stability. A minimal amount of bone grafting material was again placed to fill any gaps between the implant and the extraction socket.

The original immediate provisional abutment and full-coverage crown were placed, which ensured patient comfort, function, and esthetics. A postoperative radiograph was taken (Figure 9), and the patient was dismissed. The patient returned after three months of healing for the final impressions of the permanent restoration.

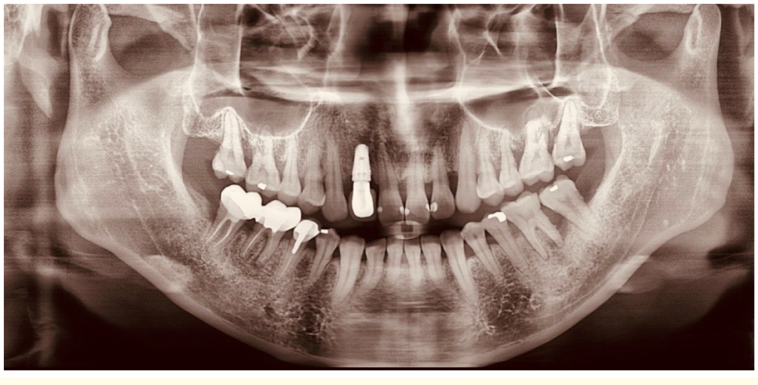

Figure 9: *Immediate postoperative radiograph of the re-implantation that has been restored and functioning well for more than 8 years.*

Addressing the accidental traumatic implant osseointegration failure in this manner enabled the clinician to provide the patient with a time-sensitive, comfortable, and esthetic alternative to the conventional dental implant retreatment options. There was no need for her to wait months for retreatment or to undergo multiple uncomfortable surgeries. Additionally, after a recent follow-up with the patient, the retreatment with an implant two sizes larger, and the use of OsseoFuse® dental implants (HexaPlus™, OsseoFuse®; SinusFuse®, OsseoFuse®) has proven its long-term predictability, having been functioning successfully for more than 12 years (Figure 10).

Case Presentation #2

A 55-year-old male smoker presented with generalized moderate and severe localized periodontal disease in the maxillary and mandibular posterior areas, in addition to multiple missing teeth (i.e. #4, #5, #12, #14, #16, #17, #18, #30, #31, and #32). A thorough clinical

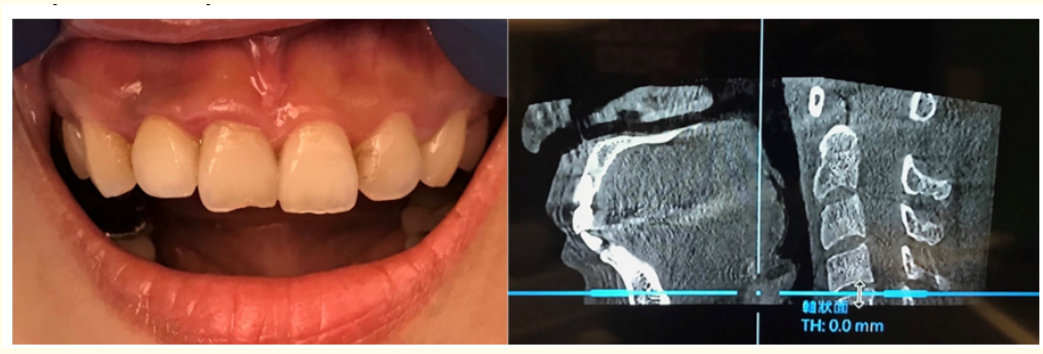

Figure 10: *Clinical photographic and CBCT views taken 8 years after replacement of the failed implant and delivery of the final restoration.*

and radiographic examination was performed that revealed severe periodontal infection, fractured teeth, extensive root decay, and recurrent endodontic infections on teeth #1 through 3, #13, #15, and #19, which were diagnosed with a poor/hopeless prognosis (Figure 11). Aside from being a smoker, the patient's medical history was unremarkable.

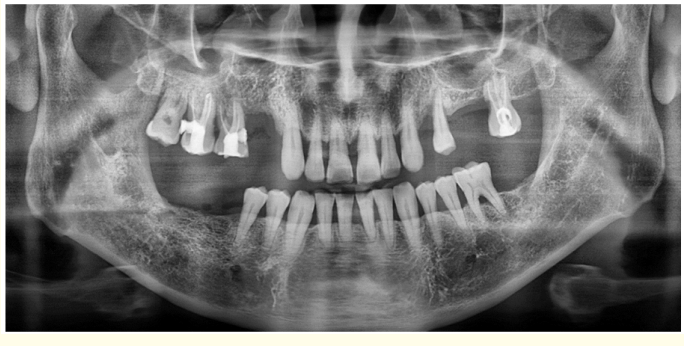

Figure 11: *Preoperative panoramic radiograph revealing the hopeless nature and extent of infection and disease surrounding teeth #1 through 3, #13, #15, and #19.*

Following a thorough consultation with the patient about the overall health and oral health benefits of smoking cessation, as well as the short- and long-term prognosis for dental implant treatments for patients who smoke [15], it was decided to extract the unrestorable teeth and simultaneously place 12 implants. The mandibular teeth (i.e. #18 and 19, and #30 and 31) and maxillary teeth #2 through #5, and #12 through #15 would be replaced with platform-switching, OsseoFuse® dental implants [14].

Extraction and implant placement

After anesthesia was administered, the affected teeth were extracted. All residual root fragments and debris from the sockets were cleaned out; diseased tissue was removed with a curette; and the bone was sounded using a periodontal probe.

The proper size of the OsseoFuse® implants was chosen, after which the corresponding size of the appropriate Onedrill® (OsseoFuse®) was also selected (e.g. 3.75 mm x 14.5 mm) and the osteotomies were immediately created. The respective implants were then immediately placed and torqued to achieve optimal primary stability.

In the maxillary and mandibular arch, the selected OsseoFuse® implants were specifically chosen based on their suitability[14]. The implants were placed and a minimal amount of anorganic bovine bone grafting material was placed to fill any gaps between the implant and the socket walls; provisional abutments and provisional full-coverage crown restorations were then placed.

An immediate postoperative radiograph was taken (Figure 12), and the patient was dismissed with home-care instructions. All implants demonstrated proper healing during regularly scheduled follow-up appointments.

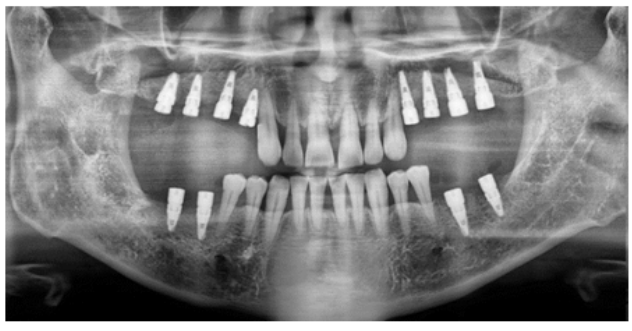

Figure 12: *After the OsseoFuse® Onedrill® was used to create the osteotomies, 12 implants (i.e. sinus implants for maxillary arch; platform switching for mandibular arch) were immediately placed and provisionalized.*

Explantation due to osseointegration failure

After four months of healing, the patient returned for final impressions, at which time all implants were sound and osseointegrated (Figure 13), apart from the implant at #13 site. At that site, the patient reported experiencing slight pain upon palpation, as well as pressure compared to the other 11 implants. It was decided that the original 3.75 mm implant would be removed and immediately replaced with a wider-diameter, 5.25 mm implant (OsseoFuse® SinusFuse®) from the same product line. Doing so would provide this patient with the same benefits as outlined in case presentation #1.

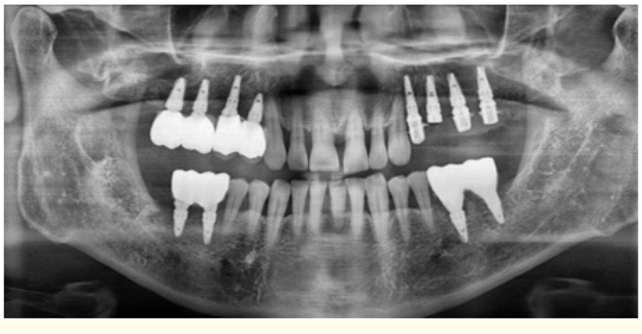

Figure 13: *After four months, 11 implants demonstrated successful osseointegration, except the implant at #13, at which the patient reported experiencing slight pain upon palpating and percussion.*

Local anesthesia was administered to infiltrate both the buccal and palatal areas, and the poorly integrated dental implant at the #13 site was removed from the socket by counterturning (Figure 14), after which any residual soft tissue was also removed from the socket.

The replacement OsseoFuse® implant was selected, which was two sizes larger in diameter (5.25 mm). The implant was placed immediately (Figure 15) and torqued to over 60ncm to achieve optimum primary stability, without any further drilling (Figure 16). A minimal amount of anorganic bovine bone grafting material was again grafted, and the original immediate provisional abutment and full-coverage crown were then placed again. A postoperative radiograph was taken (Figure 17), and the patient was dismissed in anticipation of receiving 11 final implant-supported restorations the following week.

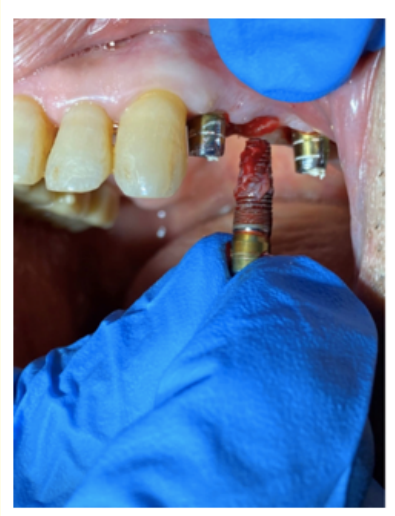

Figure 14: *The 3.75 mm SinusFuse® at the #13 site was removed by counterturning.*

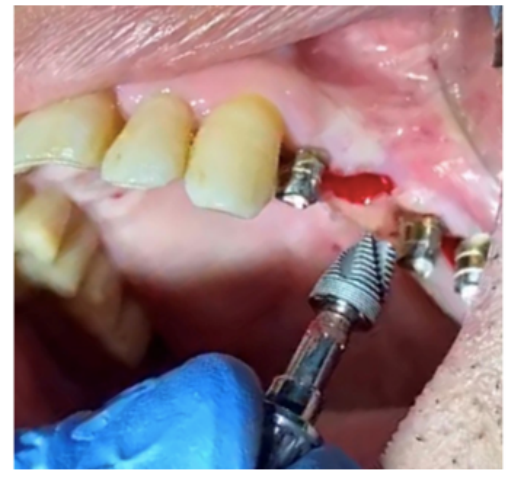

Figure 15: *The implant at #13 was immediately replaced with a 5.25mm wide SinusFuse®, without the need for any further drilling or widening of the osteotomy.*

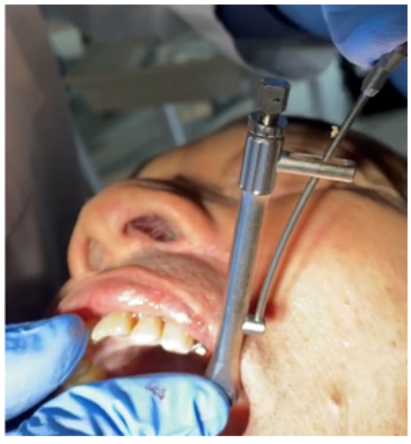

Figure 16: *After the 5.25 mm SinusFuse® was placed, it was torqued to more than 60 ncm to achieve primary stability.*

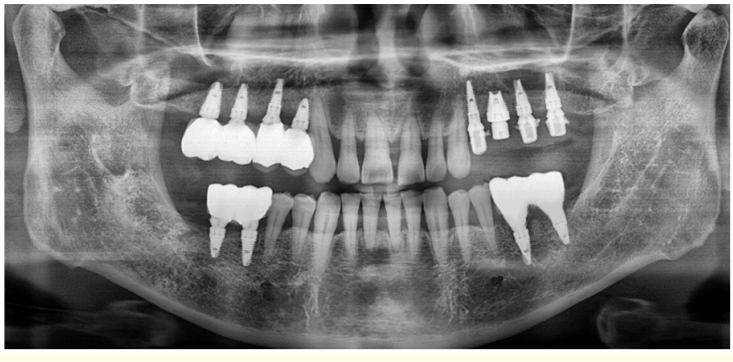

Figure 17: *Postoperative panoramic radiograph following immediate reimplantation of #13 following removal of the failed implant.*

In this case, the patient was satisfied with receiving 11 final implant-supported restorations after only four months, since this reestablished his full occlusal function, despite the need for an additional three months of healing/provisionalization for the one implant at the #13 site. The patient returned after three months of healing for final impressions and final restoration (Figure 18). For him, this protocol was much more acceptable than undergoing multiple surgeries and bone grafts.

Discussion and Conclusion

Traditionally, reimplantation in the sites of failed dental implants is undertaken 12 months after removal of the failed implant, during which time multiple surgeries, bone grafts, and lengthy healing periods are required. This can be devastating to patients. Although reimplantations can be performed successfully, their survival rate appears to be lower than that of implants placed at fresh sites [1,6,15], with the average reimplantation survival rate shown to be 71% or higher [5].

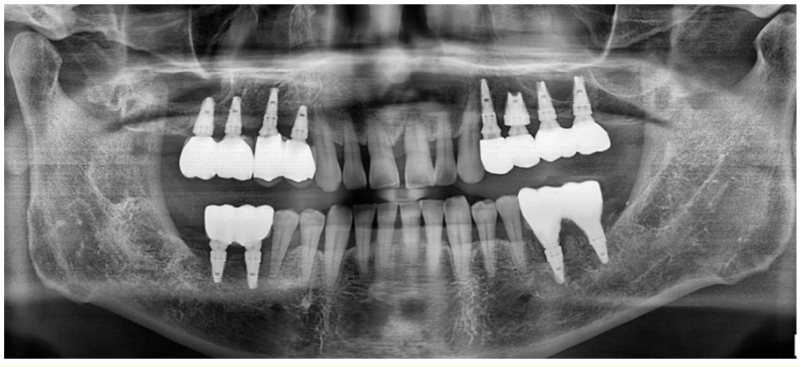

Figure 18: *Panoramic radiograph four months later with final restorations.*

In fact, existing research evaluating the success of dental implants placed in the sites of previously failed sites had an overall survival rate of 83.5% for reimplantation [15]. One characteristic of the successfully reimplanted implants included a wider diameter than the previously failed implants [15]. In general, the literature cites effective clinical outcomes when wider-diameter implants are placed, with factors such as reduced or no crestal bone loss indicating clinical success when implants wider than 3.75 mm are placed [15]. Therefore, implants intentionally designed with incrementally increasing width sizes (e.g. HexaPlus™, OsseoFuse®) can be incorporated as part of a systematic contingency plan for immediate reimplantation in the unlikely event of osseointegration failure.

Additionally, when comparing replacement implants with a machined surface or smooth surface versus those with a roughened surface, researchers found that replacement implants with a roughened surface experienced fewer failures under the same circumstances [23,24]. It is worth noting that OsseoFuse® dental implants feature a roughened, resorbable biocompatible calcium phosphate ceramic media, which increases available surface area by up to 250% compared to smooth machined surfaces [13].

Reimplantation into the sites of failed dental implants is unquestionably a tremendous service to patients, one that can restore the function and esthetics of their smile by supporting fixed or removable prostheses [1]. When the procedure can be performed immediately after the removal of the failed implant, it is of even greater service and comfort to patients who would otherwise be subjected to months of discomfort.

Fortunately, studies evaluating immediate and delayed reimplantation at the sites of previously failed implants found no significant difference in failure rate between immediate and delayed replacement techniques [25].

If on rare occasions that an OsseoFuse® implant was poorly integrated, it can be salvaged immediately by using an implant two sizes larger to achieve predictable/optimal primary stability and long-term treatment success, without the need of any further drilling. OsseoFuse® implants may be the only company to purposefully utilize/design the diameters of their implants to purposefully be used to immediately replace poorly integrated implants.

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