Intentionally Exposed d-PTFE Membrane and Guided Bone Regeneration after Malpositioned Dental Implant in Anterior Area: A Case Report with 1-year Follow-up

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ABSTRACT

This article describes the removal of a malpositioned dental implant, using an implant retriever, followed by guided tissue regeneration with the use of an xenogeneic graft and a dense polytetrafluorethylene membrane that remained partially exposed for 28 days, and the post-surgical prosthetic and orthodontic treatment until conclusion of the oral rehabilitation procedure. The patient, 50 years of age, presented to a private clinic for evaluation of an implant supported fixed crown, with unsatisfactory esthetic appearance and function. The treatment plan involved the removal of this implant, guided bone regeneration, and placement of a new implant in a better 3D position. Subsequently, the patient received a provisional dental prosthesis, orthodontic treatment in order to realign the gingival margins, and additional rehabilitation with the application of some ceramic veneers to enhance the patient's esthetic appearance, improve function, and show the 1-year follow-up of the case.

The treatment plan was shown to be appropriate for this case, in which soft and hard tissue were adequately regenerated, and resulted in good oral rehabilitation with tissue stability around the teeth and implant.

Keywords. Dental Implant, Removal, Guided Bone Regeneration, d-PTFE

Introduction

Implant supported restorations have been shown to be a predictable treatment for replacing teeth (Del Fabbro *et al.*, 2019). The survival rates of dental implants are high (Howe *et al.*, 2019). However, the real success rates of implants are lower due to various circumstances, including inadequate three-dimensional positioning. Implant failures may occur in several situations and some factors can jeopardize implant stability and then lead to implant failure. These failures are often related with inadequate implant width and length, implant loading (early or late), infection, use of biomaterials, periodontal diseases, systemic factors such as diabetes, and others (Castellanos-Cosano *et al.*, 2019; Kang *et al.*, 2019; Meza Maurício *et al.*, 2019; Mayta-Tovalino *et al.*, 2019).

To remove dental implants, trephine burs, bone chisels or piezo-surgery techniques are commonly used (Marini *et al.*, 2013). These methods may not only be destructive, in terms of bone and soft tissue loss, but they also lead to significant problems and may leave large empty spaces in the bone, which may subsequently cause problems with regards to bone grafting (Gehrke, 2014). In some cases the bone defect may be too large to allow the placement of another dental implant, if this were necessary. There may also be problems if the adjacent teeth or anatomic structures are next to the margins. Therefore, the use of techniques that do not remove large amounts of surrounding bone tissue with the dental implant, such as counter-torque techniques, must be used, particularly in the esthetic areas (Anitua *et al.*, 2020).

Preservation of the hard and soft tissues after removal of the implant is of considerable importance. The presence of an adequate keratinized tissue zone has been associated with more stable implant-mucosa seal (Moon

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et al., 1999; Jeong *et al.*, 2008, Kan *et al.*, 2009; Furze *et al.*, 2016). Moreover, a recent study has shown that patients with a thin gingival phenotype had 4.5 times more probability of developing peri-implantitis (Casado *et al.*, 2013).

Guided regeneration techniques with d-PTFE (dense polytetrafluoroethylene) membrane have been applied successfully for socket preservation and vertical bone regeneration treatments, in order to preserve or regenerate the original volume of the alveolar ridge. This approach has been investigated in many human and animal studies, especially prior to implant placement (Fotek *et al.,* 2009; Cucchi and Ghensi, 2014; Ronda *et al.,* 2014; Laurito *et al.*, 2016; Laurito *et al.*, 2017; De Carvalho Formiga *et al.*, 2019; Faciola *et al.*, 2019; Wen *et al.*, 2020). In all these studies, the d-PTFE membrane remained intentionally exposed to the oral cavity, with no negative effect on bone regeneration. It was also noted that such procedures increased the amount of available keratinized tissue. Exposed d-PTFE membranes have demonstrated resistance to degradation, and have a low risk of infection (Ronda *et al.,* 2014; Eskan *et al.*, 2017; De Carvalho Formiga *et al.*, 2019). Therefore, in certain clinical situations, large horizontal flaps and vertical incision are not necessary for completely covering the membrane, because D-PTFE membranes provide covering for particulate graft materials in relatively intact extraction sites.

In this case report, we show a less invasive method for removing a dental implant, which involves the use of an implant extractor, in the least traumatic manner, and allows immediate placement of a new implant. This procedure was followed by guided bone and soft tissue regeneration procedures with the use of an intentionally exposed d-PTFE membrane and xenograft bone substitute.

Case Presentation

The patient, a 50-year-old woman, who was systemically healthy and a non-smoker, requested a consultation about rehabilitation of an implant already inserted in the region of the maxillary right canine (Figure 1). Her main complaint was focused on esthetic dissatisfaction with this tooth that was shown to be excessively elongated with a change in proportion in relation to the other teeth. The patient also reported frequent mobility of the implant-supported crown and constant bleeding during oral hygiene. Anamnesis was performed, and in the clinical examination, a metal-ceramic crown cemented on a metal post with a loose retainer screw of an implant that replaced the canine tooth was noted. In addition, mucositis, food remnants and a disagreeable odor were associated with this implant. In the tomographic exam, the implant was observed to be in an inadequate three-dimensional position; it was shown to be too far bucally placed. Approximately one year later, the patient returned to our dental office, and agreed to accepting the previously proposed treatment plan, because the clinical situation continued to be unacceptable.

Figure 1. Rehabilitation of an implant previously placed in region of tooth 13.

Before planning the new prosthetic rehabilitation, a work protocol was established with digital diagnostic tools: including initial photographic documentation for the purpose of evaluating the proportions of the teeth. From this procedure, digital planning was established with the photographs, and we reached the conclusion that there were other problems. The proportions of the canine and lateral incisor were all wrong, cervical alignment was incorrect and the smile line was inverted. In addition, the crowns showed evidence of tissue hyperplasia (Figure 2a).

In view of the problems found, it was proposed that the poorly positioned implant be removed (Figure 2b), followed by immediate placement of a new implant in

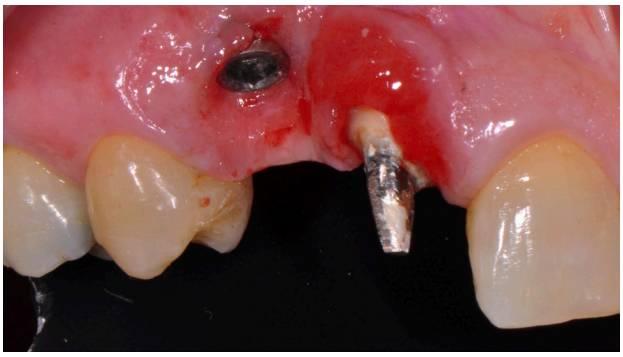

Figure 2a. Presence of tissue hyperplasia

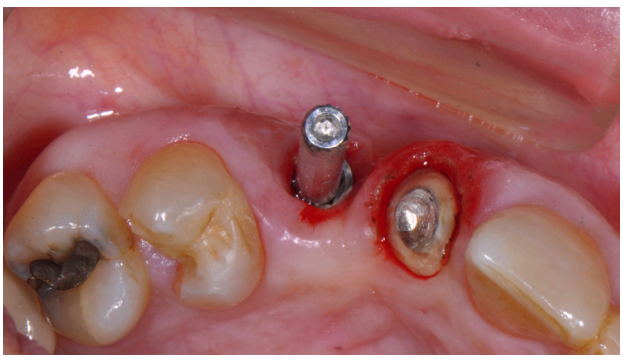

Figure 2b. Poorly positioned implant may be noted

a correct three-dimensional position, and guided bone regeneration (GBR) with a d-PTFE membrane and a xenograft particulate bone (Lumina Porous, São Carlos, Brazil). After this, orthodontic treatment would be performed for alignment and leveling of the teeth and controlled extrusion of left lateral incisor.

In the first stage of treatment, the patient was anesthetized with 2% Articaine and a palatinized incision was made for access to the implant, seeking to take a little more keratinized tissue to the vestibular region of canine. The implant was then removed in an atraumatic manner using an implant Retrieval Instrument (Implacil De Bortoli - São Paulo, Brazil) (Figure 3). A new implant, 3.5 x 10 mm long, with a morse taper connection and platform switching design was placed in a better position immediately after removing the poorly positioned implant (Figure 4a, 4b). The decision was made to place a morse taper connection with a switching platform to improve the clinical outcomes as previously reported. In the alveolus where the implant had been removed, and in the entire vestibular region, a xenograft particulate bone material was placed (Figure 5a). In addition a d-PTFE membrane was positioned and intentionally left exposed to the oral environment (Figure 5b and 5c). The following medications were prescribed: 100 mg Nimesulide twice a day for 3 days, 750 mg Paracetamol 3 times a day (if necessary, for pain control), and 500 mg Amoxicillin 500, every 8 hours for 7 days; in addition to 0.12% chlorhexidine gluconate rinse for mouthwash 3 times a day for 14 days. The patient was instructed to eat only soft foods, put ice bags on the surgical area for 48 hours, and avoid exercises for 7 days. The sutures were removed after 7 days.

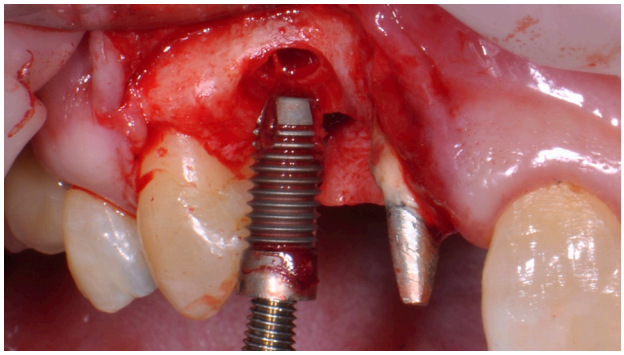

Figure 3. Implant removal with the retriever

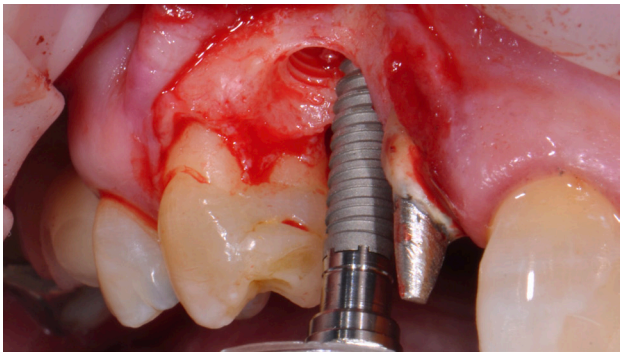

Figure 4a. Placement of new implant in a better position

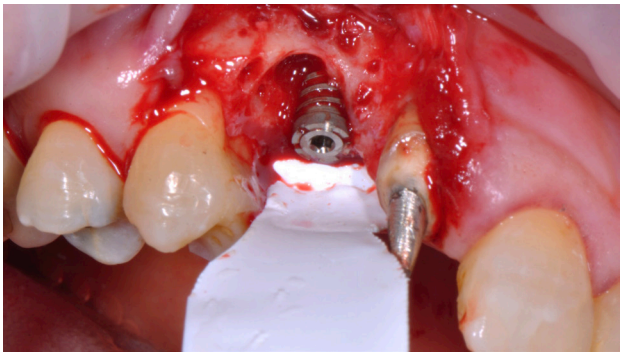

Figure 4b. New Implant in position

Figure 5a. The area filled with xenogenic bone graft

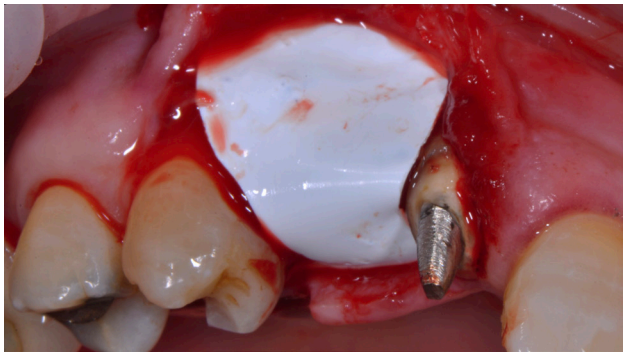

Figure 5b. Dense PTFE membrane over the xenogenic bone graft

Figure 5c. Dense PTFE membrane intentionally exposed under the temporary

After 28 days the GBR membrane was removed without anesthesia or open flap, and the orthodontic treatment was commenced. A bracket was bonded 4.0 mm above its correct position to the right lateral incisor to enable controlled extrusion of this tooth (Figure 6). Alignment and leveling of the teeth was attained after 180 days, coinciding with exposure of the implant (Figure 7). At the time of implant exposure, an interim restoration was placed on the implant to enable an enhanced emergence profile to be achieved. Through this temporary crown, the dynamic compression technique was performed to allow papillae to form and to shape an adequate emergence profile (Figure 8).

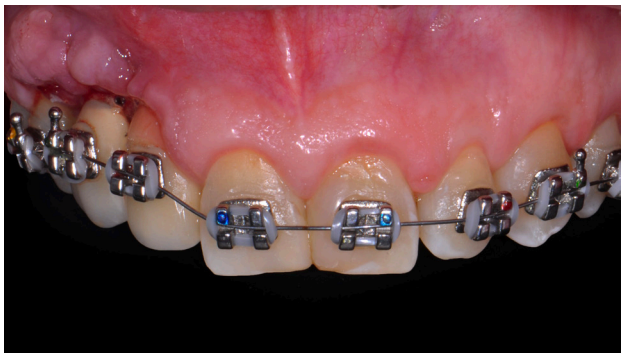

Figure 6. Orthodontic extrusion of tooth 12 to enhance the condition of the papilla between the tooth and implant.

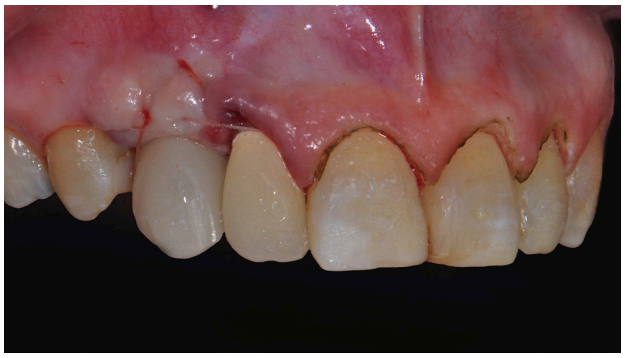

Figure 7. Temporary fixed crown installed on the implant of tooth13 and the clinical crowns of the remaining anterior teeth were augmented

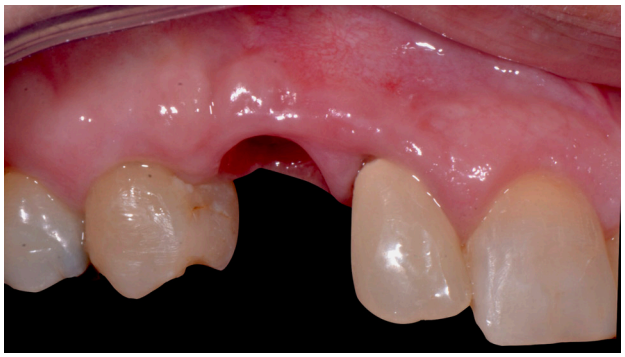

Figure 8. Emergence profile after 60 days

After 180 days had elapsed, personalized shaping of the implant and adjacent tooth were performed, and new lithium disilicate crowns were fabricated, thereby achieving an esthetic and functional result of the case. Twelve months after conclusion of this treatment the patient returned for a clinical, and radiographic follow-up (Figures 9 and 10).

Figure 9. Final aspect of the new rehabilitation one year after the surgical procedure.

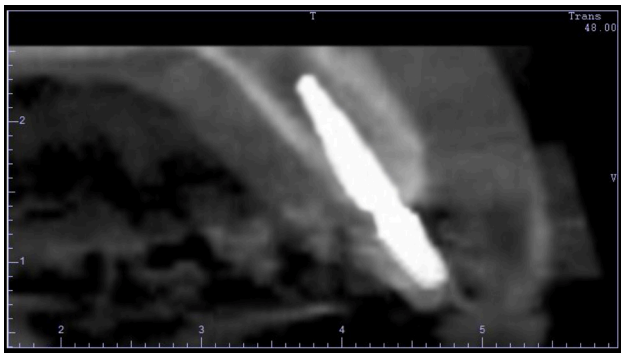

Figure 10. 12 months CT showing peri-implant bone stability

Discussion

This case report demonstrates that removal of a poorly positioned dental implant and new implant placement in an optimal 3D position may be a good choice for the treatment to improve esthetics.

The use of d-PTFE membranes for socket preservation usually does not require large flaps and vertical incisions to be performed to divide the periosteum, achieve complete closure of the area and grafting materials, preserve the architecture of the hard tissues and increase in soft tissues (Bartee, 1998). In the present case report, a large soft tissue flap was needed to provide surgical access to the buccal bone area for the purpose of bone regeneration. The increase in the keratinized tissue zone was clinically evaluated, using d-PTFE membranes without primary closure of the posterior mandibular extraction alveoli. The intentionally exposed d-PTFE membrane was removed 28 days after surgery. This protocol was based on several studies

(Simion *et al*., 1994; Bartee, 1998; Bartee, 2001; Barber *et al*., 2007; Hoffmann *et al.,* 2008) in which the membrane removal ranged between 21 and 28 days after placement. However, the ideal time interval for removing the membrane is still controversial. In an animal study, no significant difference in the regenerative results was reported, when the non-resorbable barriers were removed after 1 month and when they were removed after longer periods of time (Vergara *et al*., 1997).

Another advantage for the use of intentionally exposed d-PTFE membranes is that the high density of this material facilitates removal of the membrane, avoiding the need for a second surgery. Removal is simplified by the fact that the membrane is already exposed and visible at the surgical site, and no local anesthesia or flap elevation are required. In this study, the membrane was easily removed without any effect on the subjacent newly formed tissues or discomfort to the patient. The results of this report are in agreement with previous studies that have demonstrated a high level of predictability with the use of d-PTFE membranes in the maintenance of the alveolar crest with concomitant increase in the keratinized tissue zone (Barber *et al*., 2007; Hoffmann *et al*., 2008; Barboza *et al*., 2010). Furthermore, d-PTFE membranes have the capacity of cellular occlusion, allowing the exclusion of epithelial and bacterial cells from the healing site, and thus improving bone regeneration underneath them (Laurito *et al*., 2016; Laurito *et al*., 2017).

The lack of keratinized mucosa around an implant has been associated with a larger amount of plaque accumulation, tissue inflammation, mucosal recession and clinical attachment loss (Lin *et al*., 2013). The procedure of maintaining the crest using intentionally exposed d-PTFE membranes leads to keratinized tissue formation, preparing post-extraction sites for implant placement with lower risk of infections.

Although several studies have shown different clinical approaches to managing malpositioned dental implants (Duff and Razzoog, 2006; Stacchi *et al*., 2008; Kassab, 2010; Stacchi *et al*., 2013), the implant removed in this repot and new implant placement in the same appointment, allowed good implant positioning into pristine bone. The reason for the alveolar ridge reconstruction was to gain bone volume similar to that of the adjacent areas. In addition, this present case report showed the use of xenograft bone substitute and a d-PTFE membrane. While there are several materials and techniques that may lead to similar results (Crespi *et al*., 2009; Crespi *et al*., 2011; Maiorana *et al*., 2011; Herford *et al*., 2012; Poli *et al*., 2014; Cicciü, 2017), in this case, the materials used were selected due to availability and subject to clinical decision.

Conclusion

Within the limitations of this case report, the use of a d-PTFE membrane with a xenograft bone substitute to reconstruct the alveolar ridge after removal of a malpositioned implant and placement of a new implant in an optimal 3D position was a feasible treatment option, that resulted in a gain in keratinized tissue. The clinical procedures used resulted in good esthetic and functional results for an implant-supported prosthetic rehabilitation.

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Ethics approval and consent to participate

The patient approved the proposed clinical treatment and consented to allowing the authors to take photographs of the procedures for the purposes of documentation and publication.

Consent for publication

The patient consented to allowing the authors to submit this case report for publication.

The authors declare that they have no competing interests

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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