Aesthetic Implant Rehabilitation in Periodontally Compromised Patients: A Surgical and Prosthetic Rationale

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Abstract

Two cases of aesthetic implant abutment rehabilitation in the maxillary anterior area in periodontally compromised patients following conventional periodontal therapy and tooth extractions are presented. For the two cases of anterior tooth loss due to advanced periodontal disease progression, atraumatic flapless extractions were performed followed by the placement of immediate implants and provisional restorations. For the first case, lithium disilicate cemented over the abutment was used to achieve excellent aesthetic results. In the second case, custom zirconia abutments were used as prosthetic components. The results at the 3-year follow-up showed absence of inflammation and/or infection on the peri-implantar tissue with satisfactory aesthetic and excellent biological and clinical results achieved with reduced treatment time and morbidity for both patients. Total absence of infection and frequent plaque control after implant placement are mandatory before selection of the abutment material. The planning of the final treatment as specified by the concept of comprehensive dental care is outlined, and the final outcome is discussed in relation to the literature.

Key words: Aesthetics, dental implants, periodontitis, bone loss, bone graft

Introduction

Periodontitis is a chronic inflammatory condition caused by the host inflammatory response to plaque biofilm accumulation, which leads to tooth-supporting soft and hard tissue destruction (de Molon *et al*., 2014; de Molon *et al*., 2015c). When individuals lose their teeth as a result of periodontal disease, dental implants appear as an alternative to replace missing teeth. Such implants,

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mainly in the anterior maxillary area, have become one of the most important needs of patients attending clinics to restore aesthetics and/or function (de Molon *et al.*, 2015a). However, some studies have assumed that periodontally compromised patients present a potentially higher risk for implant failure than healthy individuals (Aguirre-Zorzano *et al.*, 2015; Mombelli and Decaillet, 2011). This assumption is due to the observation that similar pathological bacterial flora are present around both diseased teeth and diseased implants (Apse *et al.*, 1989). However, several mutual confounding factors for periodontitis and peri-implantitis have been identified, including smoking, uncontrolled diabetes (Levin *et al.*, 2011), genetic predisposition and oral hygiene (Levin *et al.*, 2011). In addition, a small number of periodontal maintenance patients seem to be refractory to treatment and continue to experience significant tooth loss. A history of periodontal disease is important information and different clinical implications regarding the proposed treatment for these types of patients must be respected. Because bacteria are responsible for initiating the inflammatory process, and surface attachment is the first step in biofilm development (Patrick and Kearns, 2012), the choice of the abutment design and material in prosthetic implant restorations is critical.

Abutment surfaces are typically prone to subgingival biofilm formation due to an increased contact area with peri-implant gingival tissues. Routinely, titanium abutments are the first choice of material. However, in recent years, ceramic surfaces have been introduced in prosthetic implant dentistry. Because of less discoloration at the gingival margin compared to metal abutments (Bidra and Rungruanganunt, 2013; Nakamura *et al.*, 2010), ceramic abutments were particularly favourable for anterior aesthetic restorations. Among the ceramic materials, zirconia and glass ceramic systems have been of growing interest because of their biological, mechanical and aesthetic properties. The initial adhesion of microorganisms to the substrate surface has been shown to have a relevant impact on the etiopathogenesis of infections related to biomaterials (Quirynen and Bollen, 1995) and, consequently, on the longevity of implant rehabilitation. Thus, an important question in relation to implant therapy in periodontally susceptible patients with tooth loss is whether these patients can be rehabilitated with aesthetic prosthetic components. Recently, investigations focusing on the aesthetic material substrate have reported encouraging data. According to a previous study (Grossner-Schreiber *et al.*, 2009), higher total rates of bacterial colonization were detected on titanium surfaces compared to zirconia. Concurrently, no significant differences were observed in the diversity of the identified bacterial species among all of the surfaces examined (Grossner-Schreiber *et al.*, 2009). Similar to these results, in a recent *in vivo* study, lower bacterial counts were detected on zirconia materials than on titanium components (Nascimento *et al.*, 2014). When treating patients at high risk for peri-implant disease, it is mandatory to identify implant and prosthetic component characteristics as well as patients' needs for aesthetic concerns to ensure periodontal health and patient satisfaction.

In the following context, we present two complex cases of implant rehabilitation in the anterior maxilla in periodontally compromised patients following conventional periodontal therapy and tooth extractions. Aiming for an optimal aesthetic rehabilitation, a single appointment combined approach was chosen. The treatment of a periodontally hopeless tooth involved the following: i) atraumatic tooth extraction, ii) immediate implant placement, iii) particulate bone graft, and iv) immediate restoration (de Molon *et al.*, 2015a; de Molon *et al.*, 2015b). Furthermore, the relation between type of implant abutment material and the success of the treatment defined by the longevity as well as aesthetic results and satisfaction of the patients are discussed in the presented cases.

Case descriptions

Case 1

A 66-year-old woman was referred for dental treatment because of mobility of the maxillary central incisor and presence of periodontal abscess. She had no relevant medical history and never smoked. Clinical and radiographic examinations revealed a central incisor with signs of Class III Miller mobility, 5 mm of probing depth, abscess, and the absence of buccal bone wall, creating a functional defect requiring bone augmentation (*Figure 1A-E*). The initial treatment was a local curettage to allow abscess drainage. Then, standard disinfection was accomplished, and the Widman flap surgical technique was performed to provide improved visual access to the periodontally involved tissues. The vertical periodontal defects were filled with Osteogen® (resorbable hydroxyapatite, granulated to 300 to 400 microns), a bone regeneration material, followed by interrupted silk sutures (*Figure 2A-D*). To minimize postoperative tooth sensitivity and improve bone repair, the patient was submitted to four sessions of laser therapy at a low frequency according to a previously published study (Gomes *et al.*, 2015) and the application of Duraphat® on the tooth. The patient was recalled every four months for plaque control (*Figure 3A*). However, after 5 years, the mobility of the maxillary incisors persisted and increased (*Figure 3B-D*), and based on clinical and radiographic examinations, immediate implant placement followed by regenerative procedures and immediate provisionalization of the crown were proposed and accepted by the patient. Written informed consent was obtained prior to the initial treatment.

In this specific case, the patient received prophylactic antibiotic with oral administration of amoxicillin 500 mg/clavulanate 125 mg, every 8 hours (three times a day), 7 days before the surgery, and one week post-surgery because of the deep periodontal pocket (Klinge *et al.*, 2015).

The maxillary incisors were atraumatically extracted under local anesthesia (2% mepivacaine and 1:100.00 epinephrine - Mepiadre®, DFL, Rio de Janeiro, RJ, Brazil) using a flapless technique to preserve the buccal bone architecture and osseous structures around the fresh socket (*Figure 4A*). After extraction of the teeth, the sockets were curetted, and two narrow dental implants (3.5 x 13.0 mm Cone Morse; Flash Porous NP by Conexão Sistema de Prótese) were immediately inserted (*Figure 4B*), respecting the minimum distances necessary to establish optimal aesthetic results. The initial stability of the implant was 60 and 45 N cm to the left and right maxillary incisor, respectively, allowing immediate provisionalization of the crown. In sequence, a temporary resin crown was placed over the provisional titanium abutments using RelyX™ Ultimate Adhesive Resin Cement [RelyX Temp NE - 3M ESPE, St. Paul, MN, USA; (*Figure 5A-D*)]. Because the buccal bone plate was lost due to the inflammatory process, the mesial and distal gap between the bone and implant was filled with Bio-Oss® (Geistlich, 7 Wolhusen, Switzerland) to allow bone remodeling (; *Figure 6A*. The patient was seen one week after surgery for suture removal and provisional resin crown adjustments (*Figure 6B*). Postoperative visits included oral hygiene instructions and plaque control every month for four months after surgery (*Figure 6C*). Four months post-operatively, periapical radiographs were taken (*Figure 6D*), the provisional restoration was removed, and the prosthetic procedures were initiated by transferring tissue architecture using a pick-up technique with modified squared impression copings (squared impression copings with 2 mm prolongations) created with autopolymerizing acrylic resin (De Santis *et al.*, 2011). A UCLA custom abutment overcast in cobalt-chromium (Conexão Sistema de Prótese, São Paulo, SP, Brazil) was selected to increase the contact between this component and the implant. A common method to mitigate the poor appearance of the peri-implant tissue caused by the cobalt-chromium metal is to alter the metallic color by applying porcelain to the component. To achieve this goal, Ivoclar Vivadent press ceramics were applied on the titanium abutment materials, followed by copings fabricated with IPS e.max Press (Conexão Sistema de Prótese, São Paulo, SP, Brazil). Next, the feldspathic porcelain crown IPS Empress II - lithium-disilicate glass-ceramic restoration (Ivoclar Vivadent) was fabricated and cemented with RelyX™ Ultimate Adhesive Resin Cement (3M ESPE, St. Paul, MN, USA) over the abutment to achieve excellent aesthetic results (*Figure 7A-D*).

Clinical evaluation of the soft tissue and radiographic evaluation were done to assess bone level at the implant site. The patient was seen monthly during the first year to evaluate the periodontal status (gingival index, plaque scores, and bleeding on probing), followed by professional prophylaxis and oral hygiene instructions. Maintenance visits every 6 months consisted of reinforcement of oral hygiene instructions and professional prophylaxis.

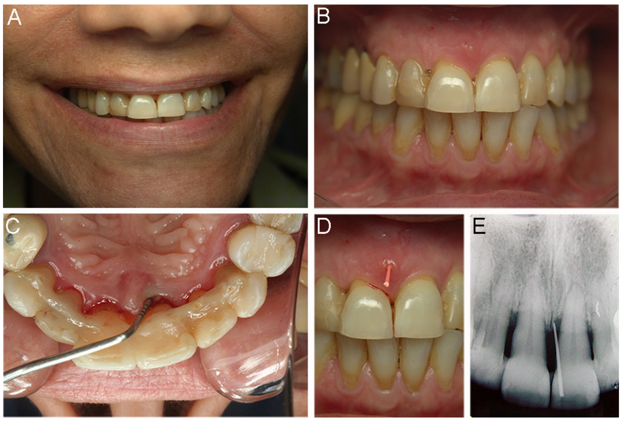

Figure 1. ***A) Initial clinical aspect of the maxillary central incisors; B) Periodontal probing showing 5 mm loss of palatal bone; C-D) Presence of fistulae between the right and left central incisors; E) Periapical radiography showing generalized bone loss.***

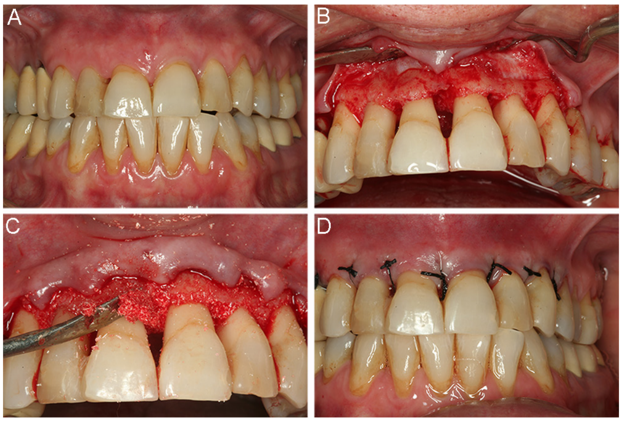

Figure 2. ***A) Clinical view after basic periodontal therapy; B) Widman surgical flap to allow adequate scaling and root planing followed by (C) xenogenous bone graft to fill the vertical bone defect; D) Uninterrupted silk suture to maintain the flap in an apical position.***

Figure 3. ***A-C) Clinical view of the maxillary teeth showing the progression of the bone loss over time and migration of the gingival tissue to an apical position after the Widman surgical access; D) 5-year clinical and radiographic outcomes after surgery.***

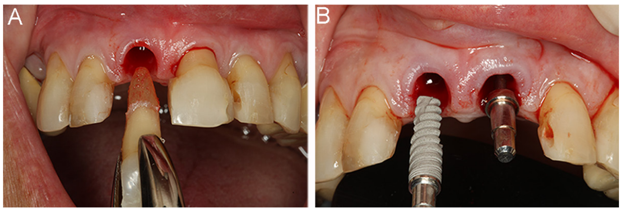

Figure 4. ***A) Atraumatic tooth extraction preserving the reminiscent buccal bone followed by immediate implant placement (B) following the rule of restorative-driven 3-dimensional placement.***

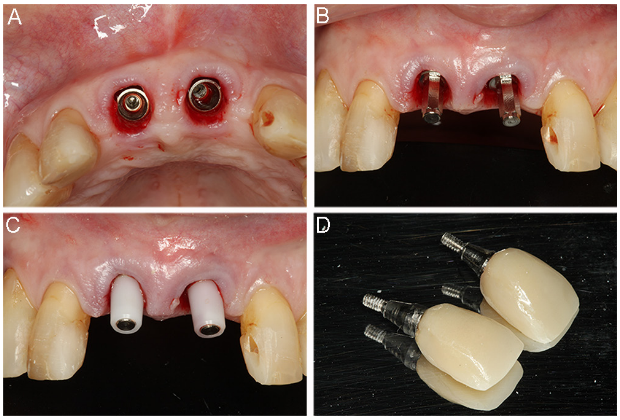

Figure 5. ***A) Occlusal clinical view of the implants placed in an ideal position; B) Provisional abutment installation followed by (C) provisional coping for immediate crown provisionalization; D) Provisional crown immediately constructed after implant placement.***

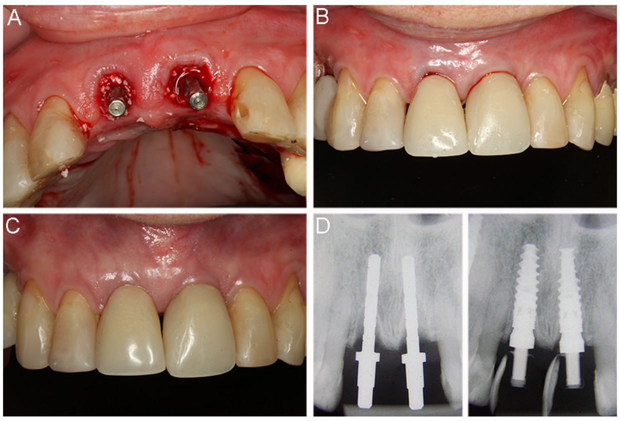

Figure 6. ***A) To fill the gap between the implant and the bone defect, particulate xenogenous bone was placed in position; B) Immediate crown installation after bone graft. C-D) Four months postoperatively, clinical and radiography images showing optimal aesthetic results and absence of infection and bone loss.***

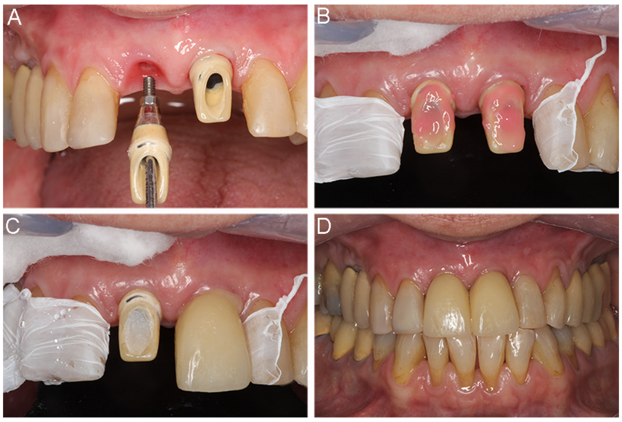

Figure 7. ***A-C) Installation of the definitive abutment and crowns; D) Clinical view with the final prosthesis installed.***

Figure 8. ***A-B) Three-year follow-up revealed optimal aesthetic outcome without probing depths or gingival recession; C) The periapical radiograph showed the correct position of the implant in relation to the adjacent teeth and an increase in vertical bone formation, completely filling the osseous vertical defect without marginal bone loss.***

The 3-year follow-up results demonstrated an improved clinical situation, allowing an optimal aesthetic outcome without probing depths or gingival recession (*Figure 8A-B*). Additionally, there was no bleeding on probing. The periapical radiographs showed the correct position of the implant in relation to the adjacent teeth and an increase in vertical bone formation completely filling the osseous vertical defect without marginal bone loss (*Figure 8C*). The functional and aesthetic expectations of the patient were achieved relative to the pretreatment situation. It is important to mention that the patient was seen frequently for oral hygiene instructions and plaque control.

Case 2

A 71-year-old woman was referred for dental treatment because of periodontal disease. She was also disappointed with her teeth and complained about the aesthetics of the maxillary central incisor (*Figure 9A-B*). With regard to the occlusal relationship and because it was impossible to obtain an adequate crown-root ratio after tooth treatment, it was decided to extract the roots orthodontically and replace them with a dental implant (de Molon *et al.*, 2013b). It is important to note that this case report was planned with a multidisciplinary team, *i.e.,* an orthodontist, a periodontist, and a prosthodontist. The initial phase of treatment consisted of the reduction and control of plaque accumulation, oral hygiene instructions and reinforcement of the patient's hygienic efforts, followed by supra- and subgingival scaling and root planing. The periodontal treatment and oral hygiene instructions were performed over 4 months according to a previously published protocol (Gkantidis *et al.*, 2010). The orthodontic treatment was initiated using brackets (Abzil-3M, São José do Rio Preto-SP, Brazil). The central incisor brackets were positioned cervically and extrusion degrees, introduced in the 0.018" stainless steel wire, were used to allow tooth extrusion (*Figure 10A-C*). Periapical radiographs were obtained to monitor the bone profile progress (Korayem *et al.*, 2008; *Figure 10D*). The orthodontic extrusion was completed after 8 months and the implant procedure was planned considering the bone gain obtained from orthodontic treatment.

The extraction was initiated by incision of the buccal and lingual soft tissues around the teeth, as well as on the contralateral aspect of each adjacent tooth (*Figure 11A*). The implant placement treatment was successful using Flash Porous NP® 3.5 x 13.0 (Conexão Sistema de Prótese; *Figure 11B*). Due to an initial implant stability of 60 Ncm, immediate provisionalization of the crowns was possible. The gap between the vestibular bone and implant was filled with Bio-Oss® (Geistlich, Wolhusen, Switzerland), and, in sequence, the provisional crowns were cemented using RelyX™ Ultimate Adhesive Resin Cement (St. Paul, MN, USA), taking great care with the removal of excess cement, which may lead to peri-implant inflammation in this region (*Figure 12 A-D*). The reason for the choice of cemented crowns can be explained because this type of restoration provided superior accessibility and had better porcelain fracture rates than screwed crowns, according to previous studies (Shadid *et al.*, 2011; Torrado *et al.*, 2004). Additionally, cemented crowns have shown lower rates of peri-implant diseases in comparison to screwed crowns (Nissan *et al.*, 2011). The definitive prosthesis was constructed at 3 months after the surgical procedure. To achieve this goal, an impression technique with squared, splinted copings using metal drill burs and pattern resin was chosen to copy the peri-implanter anatomy (de Avila *et al.*, 2014). Two custom zirconia abutments were constructed using computer-aided design and computer-aided manufacturing (CAD/CAM) and cemented on the Cone Morse System (*Figure 13*).

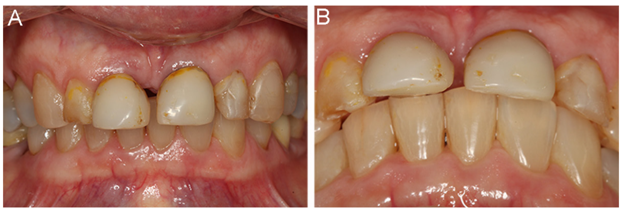

Figure 9. ***A-B) Frontal and occlusal clinical views of the maxillary central incisors and the occlusal relationship.***

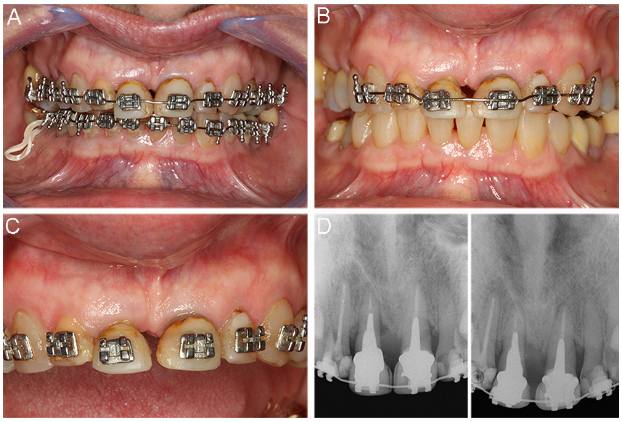

Figure 10. ***A-C) Orthodontic treatment for teeth extrusion allowing vertical bone gain prior to extraction; D) Periapical radiography showing the initial situation (left) and after 8 months of active orthodontic treatment (right).***

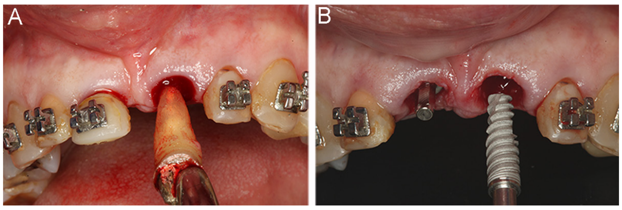

Figure 11. ***A) Atraumatic teeth extraction followed by (B) immediate implant placement.***

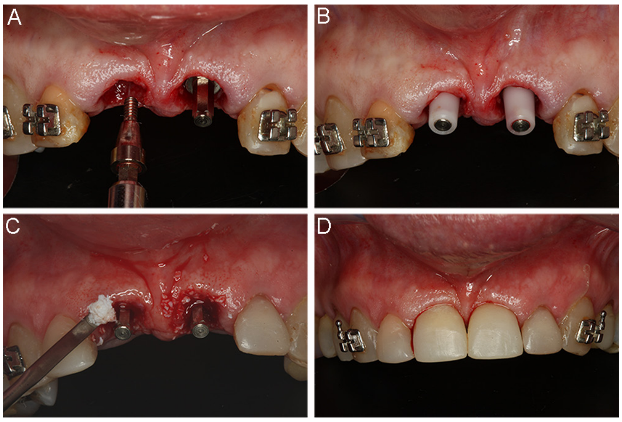

Figure 12. ***A-B) Provisional abutment and coping installation; C) Bone graft was placed over the implant to fill the gap between the defect and the implant; D) Installation of the provisional crowns.***

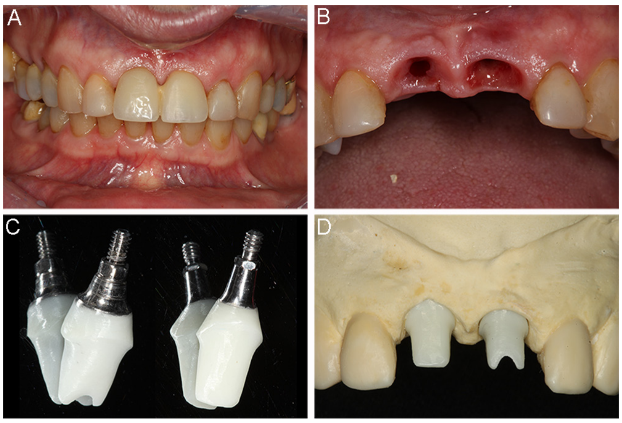

Figure 13. ***A-B) Clinical view 3 months postoperatively; C-D) Two custom zirconia abutments were confectioned using CAD/CAM system.***

This case has been followed up for 3 years, and the clinical and radiographic examinations showed no signs of inflammation. Optimal aesthetic results (*Figure 14A-B*) and patient satisfaction were achieved. Through a multidisciplinary approach, this case was successfully rehabilitated and showed stable results after 3 years of follow-up. It is important to emphasize that plaque control was performed every 4 months during the 3 years.

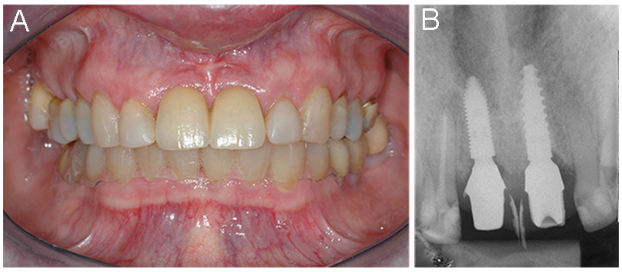

Figure 14. ***A) Final clinical aesthetic outcomes and B) periapical radiography after 3 years of follow-up.***

Discussion

Oral rehabilitation of a periodontally compromised partially edentulous patient requires special attention, considering biologic, aesthetic and technical aspects. The reduced periodontal support around the prospective abutment teeth, and potential transmission of periodontal pathogens from the teeth to the implants, may affect the long-term survival and success of the prosthodontic treatment. In addition, the decision to use either titanium or ceramic abutments must be based on the available scientific evidence, skill/experience of the operator, oral and systemic conditions, and patient preference. Using two case reports, the present study attempted to demonstrate evidence-based conclusions for oral rehabilitation of periodontally compromised partially edentulous patients with aesthetic abutment implants. Healthy and stable clinical conditions were seen after 3 years of follow-up.

The scientific literature shows a high long-term survival rate of implants in implant-supported restorations in periodontitis patients, given that adequate infection control and an individualized hygienic program are provided. However, minimal information is available for the long-term survival rates with regard to abutment material in periodontally compromised patients (Dhingra, 2012). Previous studies investigating biofilm formation on abutment materials have demonstrated differences among these materials, with alloys featuring thick biofilms with low viability, and ceramic materials featuring thin biofilms with high viability (Busscher *et al.*, 2010). However, other investigations have demonstrated no differences or less biofilm adhesion on titanium material surfaces (Nascimento *et al.*, 2014). Further, soft tissue responses to ceramic materials using well-controlled *in vivo* studies in humans are lacking (Klinge *et al.*, 2006). The inconsistencies of the results provided by the scientific literature are critical for professionals who must make clinical decisions. The clinician is often confronted with difficulties related to selecting the appropriate treatment to ensure long-term successful outcomes in terms of function and aesthetics.

In the first case, lithium disilicate glass ceramic covering metal abutments were used due to the low cost in relation to zirconia materials. The advantage of this material is its superior optical properties. In terms of mechanical characteristics, it is known that, in general, ceramics are inherently brittle materials and prone to breakage under inadvertent bending forces (Charlton *et al.*, 2008). In contrast, the structure of monolithic lithium disilicate can resist masticatory stress by dissipating it throughout the restoration (Kang *et al.*, 2013). The molecular structure of lithium disilicate has demonstrated good biological results that encourage its use in anterior areas. However, its application requires further study because, to the best of our knowledge, only one report has discussed biofilm formation using this type of material (Bremer *et al.*, 2011). In this study, the authors demonstrated that the biofilm formation on various types of dental ceramics differed significantly *in vivo*, with zirconia accumulating lower plaque than that identified with the lithium disilicate glass-ceramic. The limited number of participants and the short *in vivo* growth period analyzed restricts the information on the marked differences found in the study (Bremer *et al.*, 2011). In the second case, a zirconia abutment was selected as a prosthetic component. Zirconia implant abutments have been used for anterior aesthetic restorations for more than 10 years, and in relation to mechanical considerations, this material can be considered as a viable treatment in the maxillary anterior area for single unit crowns (Passos *et al.*, 2014). The presented cases showed excellent aesthetic results after 3 years of follow-up and are supported by previous clinical investigations that evaluated zirconia implant abutments from 1 to 5 years in anterior and posterior regions. In those studies, the authors identified good technical and biological performances of this material over a short-term period (Passos *et al.*, 2014; Zembic *et al.*, 2013).

In both cases, atraumatic flapless extraction of the hopeless teeth was performed to preserve the remaining bone and to improve the functional and aesthetic outcomes, as described previously (de Molon *et al.*, 2015a). The advantages of flapless surgery allow maintenance of the soft tissue architecture with conservative tissue manipulation, leaving an intact periosteum to preserve the blood supply and increase the predictability and success of the implant. Moreover, flapless implants are feasible, and the scientific literature has described excellent results (de Molon *et al.*, 2015b). A recent systematic review showed that implants placed immediately in fresh extraction sockets yielded a low annual failure rate of 0.82%, translating into a 2-year survival rate of 98.4% (Lang *et al*., 2012). However, a number of factors may affect the outcomes of procedures other than the timing of implant placement alone, including the type of bone, the dimensions of the edentulous area and the history of oral and systemic diseases. Here, a narrow diameter implant was chosen because of the limited bucco-lingual width of the alveolar bone. In addition, provisionalization of the crown was performed to provide immediate implant loading, which is possibly accompanied by an increased bone remodeling, as demonstrated in an animal experiment (Romanos *et al*., 2002).

Extensive loss of tooth supporting structures, e.g., bone dehiscence and fenestrations, as a consequence of periodontal diseases may impede prosthetic rehabilitation (de Molon *et al*., 2013a; de Molon *et al*., 2014). As an attempt at restoring the original anatomy and hence improving the aesthetic results of implant therapy, such defects should be corrected. Therefore, in the second case, orthodontic extrusion was planned to increase the amount of available vertical bone and/or gingival tissue and to avoid a bone graft procedures. During the orthodontic extrusion, mechanical stresses exerted onto the alveolar bone led to activation of angiogenic growth factors, which would contribute to the formation of new support tissue (Shiu *et al*., 2005). Because tooth movement occurs in the coronal direction, the gingiva and bone attached by the periodontal ligaments migrate in the same direction of the movement, resulting in a coronal shift of the bone at the base of the defect (Sterr and Becker, 1980; de Barros *et al*., 2013). The criteria required for the satisfactory application of this procedure are as follows: the apical third of the root must maintain an intact fiber apparatus, and the patient should not present systemic problems (de Molon *et al*., 2013c; Salama and Salama, 1993). Overall, the literature recommends that in patients with periodontal disease, the orthodontic treatment should be initiated 2-6 months after periodontal therapy to allow periodontal healing and stabilization (Gkantidis *et al*., 2010). Based on these observations, orthodontic extrusion was initiated at 4 months after conclusion of initial periodontal treatment and when absence of inflammatory processes was confirmed by clinical and radiographic examinations.

Research has provided evidence that those patients with a history of periodontitis present with an increased risk for peri-implantitis (Aguirre-Zorzano *et al*., 2015; Lindhe *et al*., 2008). Early studies have shown that the microbiota around failing implants and periodontally involved teeth yield similar compositions (Aguirre-Zorzano *et al*., 2015). Therefore, periodontal patients who wish to replace lost teeth with implants should be informed that the scientific literature supports the impact of this risk factor on the onset of biological complications related to implants over time. Another example of risk to develop this infection is due to submucosal cement persistence (Wilson, 2009). It has been reported that residual excess cement after placement of fixed dental prostheses has been associated with clinical and radiographic signs of peri-implant disease. To control the risks of peri-implantitis, increased frequency of supportive periodontal care appointments has been proposed as a part of an ongoing periodontal maintenance program. Additionally, the clinicians should establish an early diagnosis and intervention, which will contribute to more effective management of peri-implant diseases .

The success of implant restoration in anterior aesthetic areas is the result of a harmonious relationship between the implant and peri-implant tissue and the remaining natural teeth. Thus, to achieve aesthetic results it is necessary that there be complete absence of biological, technical and aesthetic complications. Therefore, the choice of the prosthetic component material should be considered together with the total absence of any infection followed by frequent plaque control after implant placement.

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