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CLINICAL ARTICLE

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Therapeutic alternatives for addressing pink esthetic complications in single-tooth implants: A proposal for a clinical decision tree

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Abstract

Objective: Esthetic complications in implant therapy today represent a clinical challenge, when the aim is to overcome the sequelae and obtain a pleasing result. The current scientific literature about this topic is scarce and often based on case reports and the personal opinions of clinicians.

Clinical considerations: The aim of this article is to introduce a decision tree for diagnosis and treatment of complications, focusing on the pink esthetic of single-tooth implants and based on three diagnostic pillars (3D implant position, peri-implant hard-tissue anatomy, and peri-implant soft-tissue anatomy). Different shortcomings have been identified for each of the three diagnostic areas.

Conclusions: Following this tree, the article proposes treatment alternatives including soft- and hard-tissue reconstruction, implant submergence, orthodontic extrusion, and implant extraction in order to help clinicians establish a logical therapeutic sequence.

Clinical Significance: Guidelines for adequate diagnosis and management of single implant-supported restorations with compromised esthetics is mandatory when attempt to overcome shortcoming in the pink esthetic result.

KEYWORDS

anterior implants, decision tree, esthetic complications, peri-implant tissue, pink esthetic

1 | INTRODUCTION

Commonly described as highly successful, dental-implant treatments provided to the general population can present complications over the longer term.[1,2] These complications are traditionally classified as functional/mechanical or biological[3,4] and they are likely to represent the main concern with rehabilitation. Esthetic shortcomings with the treatment represent a complication when the patient has a negative perception of the achieved appearance. It has been shown that most patients have a good acceptance even if the esthetic outcome is not perfect as judged by clinicians.[5] However, when esthetic complications with dental implants do present themselves, their resolution may be complex. In particular, the single-dental-implant situation presents a specific challenge because it should integrate imperceptibly with surrounding hard and soft tissues.

Although several studies have shown a survival rate of over 95% of implants when rehabilitating the anterior maxilla in non-compromised patients[6] and 97.9% in single teeth in the same area after 8 years of follow up,[7] other authors mention a 10% failure from an esthetic point of view.[8] Dealing with esthetic complications in implants requires more scientific evidence, because of the inherent methodological limitations in the definition of the research protocols. Most of the information available is based on a limited number of controlled studies and a succession of case reports derived from individual clinical experience.

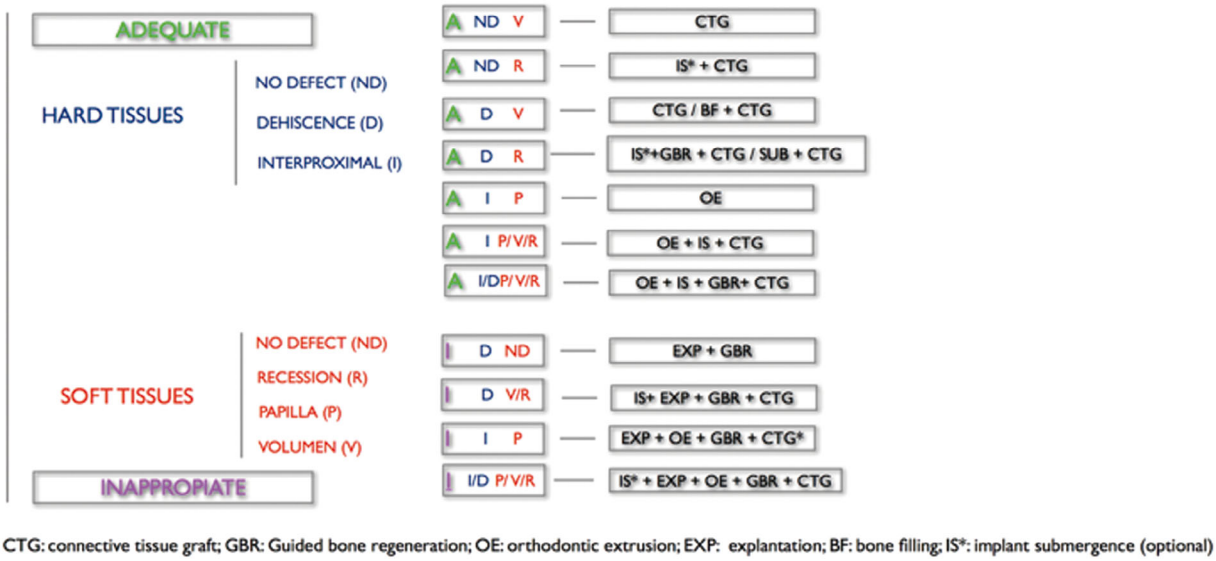

FIGURE 1 Proposed decision tree to treat esthetic complication in anterior implants. Three-dimensional implant position must firstly be defined as adequate (A) or inappropriate (I). After that, peri-implant hard tissue must be analyzed and classified as intact (ND), dehiscence/fenestration (D), or interproximal defect (I). Finally, the soft-tissue architecture is easily classified as Recession (R), papilla lost (P), or volume deficiency (V). Following the diagram, different therapeutic alternatives are proposed for each clinical situation

Esthetic complications can be classified into two groups: those affecting the "white esthetic," typically "shape and shade," and those affecting the "pink esthetic" or the so-called "transition zone," defined as the marginal soft-tissue interface around the cervical portion of the prosthesis. It is clear that the two types of problems may coexist in the same patient. The main shortcomings at the transition zone are associated with loss of papillae, marginal mucosal recession, dyschromia, and deficiency, and the lack of tissue volume. This group of problems is difficult to overcome and, when they are present, there are still many clinical limitations to attempts to restore an ideal and natural-looking appearance. The aim of this article is to present a decision tree for the diagnosis and management of single implant-supported restorations with compromised esthetics, focusing on the pink esthetic.

2 | ANALYZING KEY FACTORS IN MAKING DECISIONS

An appropriate treatment plan aimed at correcting esthetic problems includes a thorough clinical examination (visual analysis and peri-implant probing) and radiographic assessment (intraoral and 3D imaging). Clinical examination should evaluate the position and volume of the facial gingival margin and the papillae. Probing the implant may provide information about any bone loss that has occurred and about the presence of exposed threads (dehiscence), bleeding, and suppuration. It is also necessary to examine the adjacent teeth to evaluate the integrity of proximal structures. Understanding the location of the bone crest and the papillae is crucial for the decision about the choice of treatment to follow in each particular case and for its prognosis. Such a clinical examination is ideally best performed after removing the prosthetic crown.[9]

On the other hand, imaging technologies have become an important diagnostic tool. Intraoral radiographic evaluation identifies the implant characteristics (size and type) and the position of the interproximal bone crest. Computed-tomography scans may assist in the interpretation of the 3D position and help to assess the condition of the bone (presence of dehiscence/fenestration) and the volume of soft tissue around the implant.[10] However, it is imperative to understand that this tomographic analysis is complementary, because image artefacts caused by metal—that is, hard beaming[11]—may prevent accurate interpretation. Furthermore, facial bone may not be visible, especially when its thickness is below 1 mm.[12]

When planning treatment of an esthetic complication on a single implant, the presented decision tree is based on the analysis of three diagnostic pillars (Figure 1):

1. Three-dimensional implant position.
2. Peri-implant hard-tissue anatomy.
3. Peri-implant soft-tissue anatomy.

Among these three pillars, *three-dimensional implant positioning* is the most important factor in determining the future treatment of the esthetic problem because it is instrumental in establishing the treatment option, in addition to its strong influence on the other factors. So-called "comfort zones" have been described in reference to the three dimensions of the space for the correct placement of dental implants in the esthetic zone.[13] Although a minimal distance of 1-2 mm has been recommended from the implant neck to the adjacent teeth and to the buccal plate, in order to prevent vertical bone loss,[13-15] some recent studies may not agree with these particular distances.[15-18] Regarding the vertical position, the neck of the implant must be located in a correct apico-coronal position, which may vary

from one situation to another but which will generally fall within 3-4 mm apical to the future—or desired—mucosal margin. Failure to follow these principles will often lead to biological, mechanical, and esthetic complications and will compromise the prosthetic solution of the case. Following this principle, in the classification described in the present article, *Adequate (A) or Inappropriate (I)* implant position will be the starting point when analyzing the treatment options. Furthermore, it is usually imperative, as part of the analysis, to remove the existing crown in order to assess not only the implant direction but also any potential limitations on the abutment design. Adequate or inadequate implant position is related not only to the position of the implant in the bone housing but also to the capability of restoring the particular implant in an appropriate manner, permitting a correct implant abutment design and contour.[19,20]

Once the position of the implant has been interpreted, bone and soft-tissue status must be carefully analyzed. When focusing on the *peri-implant hard-tissue anatomy*, the presented classification defines three options: *no defect (ND), dehiscence (D), and interproximal deficiency (I).* Regarding bone dehiscence, the importance of the presence and thickness of the buccal bone is a matter of debate and there is still no consensus on its dimensions. As stated above, some authors have suggested the need for at least 2 mm of buccal bone[14,15,21,22]—or even more[23]—in order to avoid future problems. However, in a literature review, Teughels et al.[24] concluded that there is insufficient evidence to set a threshold for minimal buccal bone thickness to ensure an optimal esthetic outcome. In the same manner, it is stated elsewhere that even in thin-bone situations or in cases of dehiscence, a satisfactory esthetic and stable result can be achieved if there is a sufficient volume of healthy soft tissue.[18,25] It is imperative to mention that the assessment of the presence of dehiscence before the flap is elevated is not always a simple task: clinical analysis and CBCT imaging could be inconclusive when the bone that covers the buccal surface of the implant is thin.[14] This analysis is easier when determining the presence of the interproximal bone because the presence of papillae, the sounding of the interproximal bone peak of the adjacent teeth, and periapical radiography will usually help facilitate this diagnosis.

Finally, when focusing on the architecture of the *peri-implant soft tissue*, the decision tree defines four options: *no defect (ND), recession (R), papillae deficiency (P), and insufficient volume (V).* It is interesting to note that, in most of these cases, it is the shortcoming of the peri-implant soft tissue that will affect the esthetic result.

The presence of recession has long been considered a key factor because it implies a longer clinical crown as well as asymmetry/disharmony of the mucosal margin when compared to the adjacent tooth.[26] Even though the prevalence of recession at implants is difficult to estimate, several biological factors such as the dimensions or the absence of keratinized mucosa have been classified as potential risk indicators.[27] In addition, the physiological remodeling process following implant placement and/or abutment connection may contribute to the occurrence of mucosal recessions as well as to an extended facial positioning of the implant.[28] Although recent studies have showed that significantly less bone loss can occur around implants placed in naturally thick mucosal tissues, in comparison with a thin biotype,[29,30] experimental and clinical studies have indicated that the width of keratinized tissue does not influence the survival rate of dental implants and the occurrence of mucosal recessions.[14,15] Furthermore, in well-maintained populations, no association was found between an "inadequate" keratinized mucosa and soft-tissue health.[31] Accordingly, the treatment of soft-tissue dehiscence at implants and teeth is a common requirement, primarily because of esthetic concerns.[32]

On the other hand, the lack of the papillae will lead to an unpleasant black triangle that many patients will find a concern. It is necessary to remember that the interproximal bone level in combination with the contact point will determine the presence or absence of the papillae.[33]

Finally, the maintenance or reconstruction of a similar peri-implant soft-tissue volume will be a key factor when obtaining a natural appearance in the reconstruction. When lack of volume is present, defects ranging from loss of root prominence to grayish shadows and/or dyschromia may arise. As a result, an esthetic compromise might occur when a fixed implant-supported prosthesis is planned, especially in the anterior zone.[34]

3 | PROPOSED THERAPEUTIC APPROACHES

Several treatment options have been proposed in the literature when treating single-implant esthetic complications. Among the proposed treatment options, this decision tree considers:

- Reconstruction of hard tissue (GBR) and/or soft tissue (CTG).
- Permanent or temporary implant submergence (IS).
- Orthodontic forced eruption of adjacent teeth (OE).
- Explantation (EXP).

Through detailed analysis and the combination of all the above factors, the choice of recommended treatment can be made (Figure 1). The starting point is always to set the position of the implant (*adequate* A or *Inappropriate* I). Implants with an appropriate position must be maintained when they present two conditions: having no peri-implant infection and being capable of restoration in an optimal condition. It is usually mandatory to remove the existing crown and, in many instances, to replace it with a temporary one that allows for modification of the contours and facilitates removal during the subsequent surgical phase.

3.1 | Adequate implant position

Clinical situations with no obvious problems of positioning and no hard-tissue deficiency, but with the presence of marginal deficiencies related to volume limitation and/or the transparency of the tissue, may be treated with reconstructive techniques based on soft-tissue augmentation (CTG). In particular, when focusing on cases with lack of adequate volume (Figures 2 and 3), the use of a connective-tissue graft to increase the volume shows promising results in terms of obtaining optimal esthetic gingival convexity (Figures 4 and 5).

FIGURE 2 Initial clinical situation showing esthetic shortcoming around the implant in the left lateral-incisor position. Note the presence of marginal recession and tissue dyschromia because of a lack of vestibular tissue volume

Although some authors suggest approaches using connective-tissue grafts associated with a coronal-positioned flap with vertical releasing incisions,[35,36] some reports have demonstrated that conservative incisions or tunnel techniques may obtain an increase in volume without creating further tissue lesion (Figures 6–8).[9,37]

For those cases where clinical evaluation and CT did not suggest the presence of dehiscence and/or bone fenestration, and where the case presents a recession of the mucosal margin, there seems to be a clinical consensus on attempting coverage by means of a connective-tissue graft. Unfortunately, most systematic reviews on mucogingival therapy[32,38-40] have not presented information regarding the treatment of peri-implant soft-tissue dehiscence defects. One question under debate is about whether it is necessary to remove and replace the existing crown for temporary prosthesis with the correct contour[35,36,41] or whether it can be replaced with a cover/healing screw so that there is enough space to accommodate the graft or even to promote spontaneous closure of tissues in the coronal area of the implant before the mucogingival surgery (IS). Zuccheli et al.[35,36] proposed the elimination of the abutment/crown and making adjustments before the performance of the coronal-positioned flap

FIGURE 3 Existing implant-supported crown is removed. Implant impression is taken to evaluate the possibility of restoring the implant. A provisional restoration is made, paying special attention to the subgingival contours. Three-dimensional implant position must firstly be considered to be adequate (A), because the provisional restoration may be designed following correct contours and to be compatible with maintenance

FIGURE 4 Radiological examination showed no presence of hard-tissue defect (ND), while lack of volume and marginal recession is present in the soft tissues (V/R)

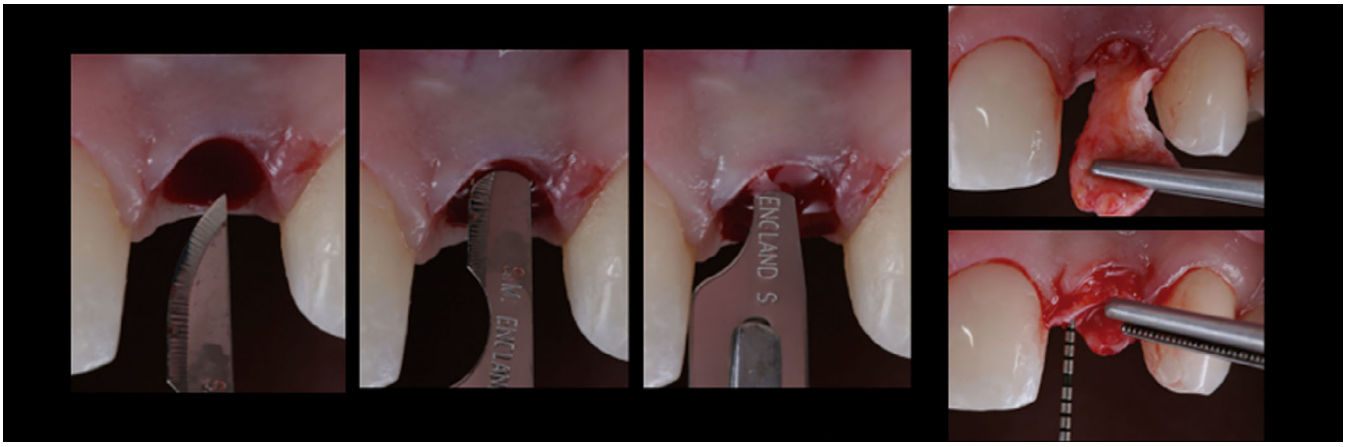

FIGURE 5 Following the presented decision tree (A, ND, V/R), soft-tissue grafting is performed to increase the volume of the peri-implant tissues

FIGURE 6 After suture, the graft in place, the provisional restoration will be screwed to adequately support the soft tissues

FIGURE 7 After 7-year follow-up. Notice the stability of the soft-tissue margin and volume. Also, the new prosthetic restoration

FIGURE 8 Evolution of the case before soft-tissue graft, 1 year after, and 7 years after

associated with the connective-tissue graft. The results after a one-year follow-up showed 96.3% average coverage with a complete coverage of 75% of peri-implant sites treated. On the other hand, some authors have considered the possibility of maintaining the existing crown.[42-45] Burkhardt et al.[43] showed only 66% coverage when keeping the crown. However, Rocuzzo et al.[45] also proposed removing the crown before surgery and achieved an average coverage of 89.3%, with complete coverage of nine out of 16 peri-implant treated sites. In the experience of the authors, attempting reconstruction while maintaining the permanent prosthesis complicates the accommodation of the graft and flap repositioning.

In cases associated with the presence of bone defects such as fenestrations, a combination of connective-tissue graft and bone reconstruction has been suggested. In particular, the use of inorganic mineral collagen matrix has shown some preliminary but promising results (BF). A similar approach has been recommended in cases of narrow dehiscence-type bone defects. In cases of extensive bone defects (width and depth), GBR—attaching bioabsorbable membranes to bone fillers—can be used. This approach typically requires a more invasive and extensive releasing flap to cover the regenerative area.[46,47]

It is important to note that, as mentioned above, the importance of the presence of buccal bone is still a matter of debate and there is not yet a consensus on the proper thickness. It has been stated that, even in presence of bone dehiscence, increasing the volume with a connective-tissue graft can achieve satisfactory and stable results.[25,37] Although combined reconstruction, involving the compensation of the two tissues (bone and soft tissues), appears to be the best course of action for cases with the presence of dehiscence-type defects, there is no conclusive published data. Schwarz et al. published a pilot study of dogs using three options—(a) coronally advanced-flap surgery + porcine-derived collagen matrix, (b) CAF + CTG, or (3) CAF alone—for the treatment of peri-implant dehiscence associated with recessions. The results after 12 weeks of follow-up showed that all the treatment procedures investigated were effective in covering soft-tissue recessions at titanium implants in the presence of peri-implant bone defects, and there were no statistical differences between the three groups in relation to the average percentage of coverage. In addition, Thoma et al.[48] published a systematic review on the effectiveness of procedures for soft-tissue augmentation around implants and concluded that the use of connective-tissue grafts promotes greater tissue thickness and good esthetic results. Despite the promising histological outcomes noted for the CAF procedures in the aforementioned study, it must be emphasized that residual dehiscence-type alveolar bone defects may be associated with a higher risk of developing peri-implant disease and an increase in mucosal recession over time, thus compromising the overall success and esthetic outcome of implant therapy.[49] Accordingly, from a clinical perspective, any surgical procedure to cover soft-tissue recessions at titanium implants should also take account of the presence of concomitant bony defects (Figures 9–15).

When the esthetic complication involves deficiencies of the papilla of the teeth adjacent to the implant, it may be worth considering a combination of the reconstructive therapies with orthodontic extrusion (OE) of the affected adjacent tooth.[50] Provided there are favorable periodontal conditions of the extruded tooth, this coronal tooth movement should be accompanied by the coronal displacement of the interproximal bone peak.[51] The coronal movement of teeth has been used to reduce pocket depth and change the architecture of both hard and soft tissues of the periodontium.[52] Such coronal repositioning of the bony ridge is very important for the nutrition of bone grafts and/or soft tissue; so, whenever possible, orthodontic traction must precede reconstructive procedures. The increased amount of soft tissue gained with orthodontic movement can be beneficial for subsequent periodontal regenerative techniques and also the increased amount of bone can eventually, simplify a GTR technique to regenerate soft tissues, creating new hard-soft tissue for adjacent teeth.[53] Also, orthodontic extrusion may follow the surgical reconstruction, helping to achieve the desired result. It is authors' experience that in the same ways that orthodontic extrusion has been proposed to treat isolated interproximal periodontal defects[54] and orthodontic therapy in conjunction with implant modalities is

FIGURE 9 Initial clinical situation showing esthetic shortcoming around the implant in the right canine position. Note the presence of marginal recession over the final crown

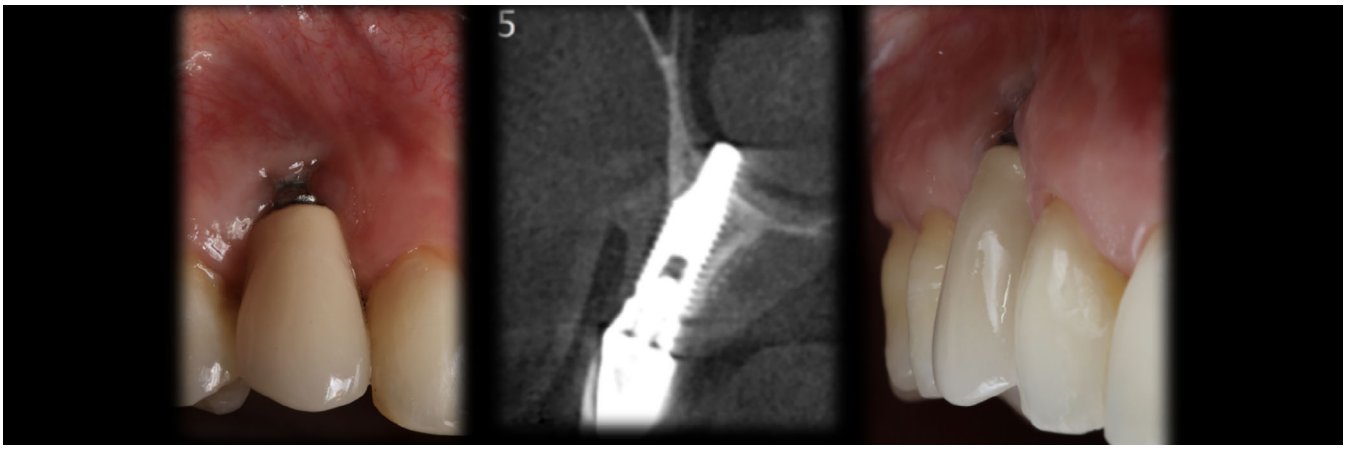

FIGURE 10 Initial clinical situation showing esthetic shortcoming around the implant and the radiological examination may be compatible with a buccal plate dehiscence (D) while a recession is presented in the soft tissues (R)

FIGURE 11 Following the presented decision tree (A, D, R), soft-tissue grafting is planned to increase the volume of the peri-implant tissues accompanied of a critical and subcritical contour modification/reduction of the prosthetic crown

beneficial, relevant, or necessary,[55] it seems beneficial to propose the coronal movement of an interproximal bone peak adjacent to an implant presenting a lack of papillae, in order to improve this particular area. Unfortunately, no well-conducted studies may support this particular application. On the other hand, it must be stated that a thorough evaluation of the clinical situation is mandatory prior to the orthodontic extrusion. Of special interest is to determine the type of bone deficiency affecting the interproximal area to fully understand the nature of the defect and the potential benefit of the coronal movement of the interproximal soft and hard tissues. Moreover, the extrusive movement of the adjacent tooth implies, in the majority of the cases, an occlusal/incisal reduction of the extruded tooth and this may bring the need of an endodontic treatment consequently. Finally, it is imperative to also focus in a correct prosthetic abutment and crown design in order to optimize the position of the interproximal contact point but also the soft tissue conditioning.[19] So, although

FIGURE 12 A soft tissue grafting from the tuberosity using a tunnel access is performed

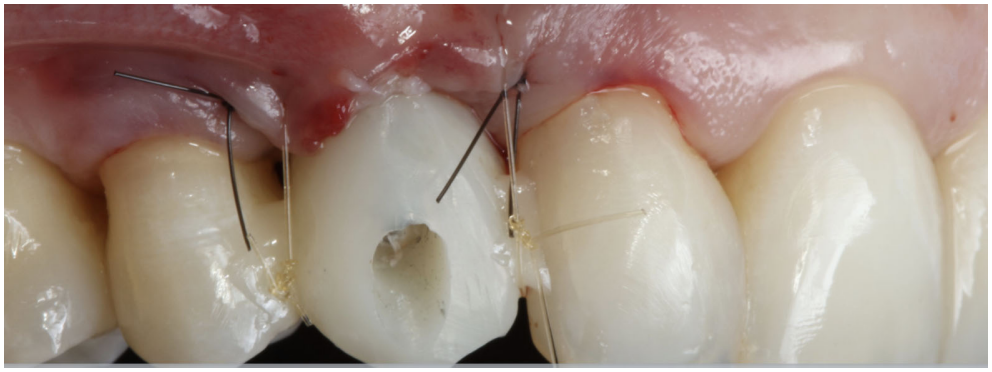

FIGURE 13 A suspensory with a moderate tension suture technique to coronally position the flap is helped by composite close of the interproximal contact points

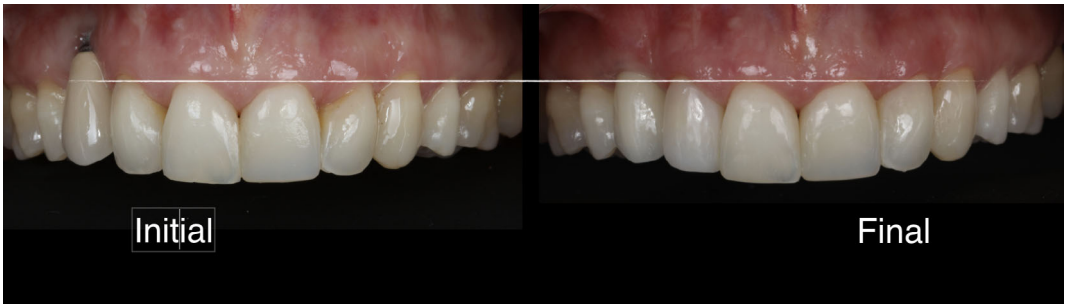

FIGURE 14 Occlusal view after 2 years follow up

FIGURE 15 Evolution of the case before soft-tissue graft and 2 year after with the new final crown

orthodontic forced eruption may be a viable option to optimize the papilla deficiency around implants, it is mandatory to observe the clinical situation of both, affected implant and adjacent tooth, to optimize the abutment design and to measure the clinical consequences on the extruded tooth such an endodontic treatment and prosthetic restoration (Figures 16–18).

FIGURE 16 Initial clinical situation showing esthetic shortcoming around the implant in the left central position. Lack of distal papilla is clearly observed

FIGURE 17 Radiological examination showed presence of interproximal hard-tissue defect (I), while lack of distal papilla is present in the soft tissues (I/R)

3.2 | Inappropriate implant position

The position of the implant is considered inadequate when it will not allow correct maintenance and/or is not able to be restored in an optimal way. Under these circumstances, although explantation may seem to be the most radical strategy, in many cases it is the best alternative for resolving the issue. Removing an implant, of course, always creates great frustration and additional operating costs. However, it is understood that healthy tissue reconstruction presents biological limits. The use of counter-clockwise recovery devices has become an excellent alternative. In addition to reduced morbidity and less surgical time, the main benefits of this technique are related to the preservation of

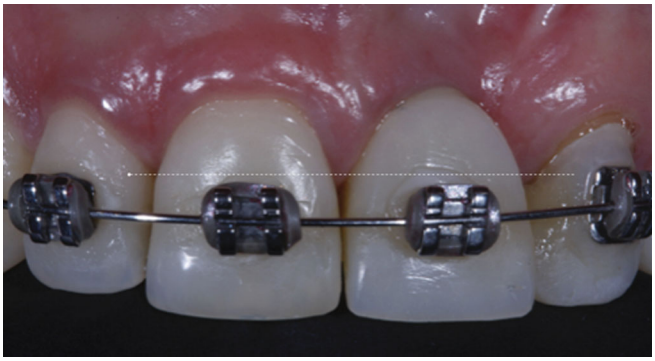

FIGURE 18 Following the presented decision tree (A, I, P), orthodontic forced eruption may help to coronally displacement of the interproximal bone peak adjacent to the implant and therefore to improve the soft tissue of the papilla

the tissue around the implant and the adjacent tooth. This flapless approach, associated with minor bone destruction, often allows simultaneous reconstruction or even installing another implant at the same time if there is remaining bone available. Unfortunately, a small percentage of explantation cases using these devices fail because of implant fracture, fracture of the device, or because of inability to access the key and lock at the inner portion of the implant. In these cases, we must utilize conventional respective methodologies. It is important to note that, in many circumstances, there may be different deficiencies associated with an inadequately positioned implant, and so several treatments may be recommended to be combined during the implant-removal procedure. It is worth noting that the removal of a fully osseointegrated implant could cause fracture within the surrounding bone and a larger defect, which would make a PFM or Resin-Bonded Fixed Dental Prostheses (RBFDPs) and soft-tissue graft covering the implant another option to be considered.

Other therapeutic alternatives for treating inadequately positioned implants—such as the surgical repositioning of the implant and the surrounding block into a more favorable position—are technically complex, mainly in relation to the risk of compromising adjacent teeth in reduced prosthetic spaces. They could be indicated only in cases of poorly positioned implants that have a sufficient distance between the implant and the roots of adjacent teeth, which would allow safe

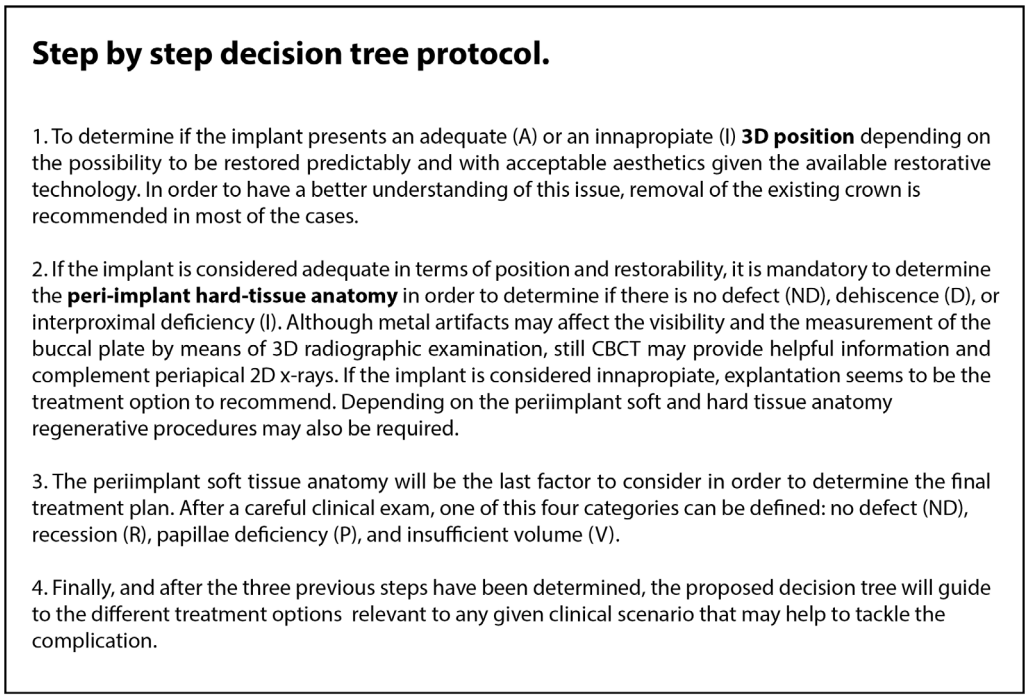

FIGURE 19 Step by step decision tree protocol

osteotomy. Given the complexity and the scarce literature supporting this surgical option, it has not been included in this decision tree. In addition, the use of gingival prosthesis is a widely used alternative in implant-supported prosthesis to compensate for soft-tissue deficiencies and to recover a more esthetic appearance. The limiting factor of this approach is related to the difficulty of maintenance, because of the lack of accessible-space cleaning devices. This type of prosthesis is better indicated in cases of multiple teeth replacement (avoiding the need for advanced reconstructive therapies), in patients with systemic involvement, in cases of severe maxillomandibular discrepancies, and in cases with a high smile line where the esthetic needs are incompatible with reconstructive surgical possibilities and conventional prosthesis—with its use limited to single-implant situations (Figure 19).

4 | CONCLUSIONS

In conclusion, from detailed analysis of the factors described above, the choice of the best treatment must be based, first, on the interpretation of the implant positioning (including single-crown removal to obtain a better diagnosis) and, secondly, on the presence and extent of the peri-implant hard- and soft-tissue defects (assessed clinically and radiologically) that are involved. Implants considered to be adequately positioned and presenting defects associated with the loss of soft-tissue volume may be treated with soft-tissue grafts. When there is associated gingival recession, submergence before the connective-tissue graft may be an option. When there is a bone defect, the use of bone regeneration using collagen matrix (fenestration defect type) or associated bone substitute and resorbable barriers (dehiscence defect type), often combined with the soft-tissue reconstruction, and may be used. In situations that present proximal defects, orthodontic eruption should always be considered. Finally, when dealing with implants with an inappropriate position, explantation alone or in combination with other adjunctive techniques must be prioritized.

The authors wish to note that this classification is based on the scarce literature pertinent to the treatment of esthetic complications. In addition, it is worth mentioning that future scientific evidence or novel approaches will come to modify the treatments proposed here, although the diagnostic analysis may remain unchanged.

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DISCLOSURE STATEMENT

The authors do not have any financial interest in the companies whose materials are included in this study.

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