

Contour Management of Implant Restorations for Optimal Emergence Profiles: Guidelines for Immediate and Delayed Provisional Restorations



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Adequate management of the implant-supported restoration has become an important task when trying to obtain optimal esthetic outcomes. The transgingival area must be developed to maintain or influence the final appearance of the peri-implant soft tissues. Two distinct zones within the implant abutment/crown can be identified: the critical contour and the subcritical contour. Their design and subsequent alteration may impact the peri-implant soft tissue architecture, including the gingival margin level and zenith, labial alveolar profile, and gingival color. Defining these two areas helps clarify how to process soft tissue contours and may additionally improve the necessary communication with the laboratory. Since there are many protocols for placing implants, it is worthwhile to determine similarities in the contouring and macrodesign of their corresponding provisional restorations. Therefore, the purpose of this paper is to discern the general characteristics of the critical and subcritical contours for provisional restorations made for immediate and delayed implants in order to obtain guidelines for daily clinical practice. Int J Periodontics Restorative Dent 2020;40:61–70. doi: 10.11607/prd.4422

An implant-supported restoration in the esthetic zone is successful when imperceptibly integrated with the adjacent teeth.¹ The extraction challenges this goal due to the associated ridge resorption.² Surgical techniques have been proposed that maintain the volume of the ridge as much as possible or enhanced it if defective.³ Furthermore, correct implant-positioning guidelines have been documented to help produce a favorable esthetic outcome.¹

Equally important as the surgical phase is the prosthetic phase. In fact, careful lab work is necessary to replicate the adjacent tooth shape and shade, and the mere placement of the restoration affects the buccal ridge profile.⁴ At the level of the crestal bone and mucosa, an implant differs significantly from a tooth in terms of possessing a smaller diameter with a circumferential shape instead of the triangular cross-section observed in natural incisor teeth.⁵ Therefore, thoughtful and appropriate management of a temporary restoration may help to develop the shape of the peri-implant soft tissue so that a correct dental emergence profile can be mimicked. Currently, the use of a temporary restoration is a well-accepted means of predictably creating a natural-looking implant-supported restoration in clinical practice.⁶ Several anecdotal reports have suggested workflows

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for the creation of temporary restorations. Bichacho and Landsberg⁷ recommended the use of a cervical contouring concept utilizing a customized temporary restoration to reshape the soft tissue around implants with a main focus on the marginal soft tissue level and the facial zenith position. Rompen et al advocated the use of a concave transmucosal profile in order to minimize facial gingival recession.⁸ More recently, Su et al⁹ defined two different areas within the transgingival zone based on the response of the peri-implant gingival tissues to abutment/crown contour modifications: the critical and subcritical contours. The critical contour is the most superficial area and will influence the gingival level and zenith location, whereas the subcritical contour corresponds to the deeper area and influences the peri-implant soft tissue support and, consequently, the gingival color. The two areas are linked as the apical or coronal displacement of the critical contour will have an effect on the length of the subcritical contour.

Despite the utility of this concept, detailed literature on how to shape the contour of provisional restorations on immediate or delayed, two-stage implants is scarce. In the first scenario, the provisional aims to support the soft tissue architecture. In the second scenario, the aim is generally to place pressure on the soft tissues and guide their remodeling so that the dental emergence profile may be optimized. Depending on the clinical dimensions of the soft tissues, the tridimensional implant position and the timing of

placement, temporary restorations may require different shapes.

This paper aims to analyze the determining factors and to define guidelines with respect to the range of possible provisional contour modifications in different clinical scenarios. Their application will be illustrated through an example case.

Immediate vs Delayed Implant Provisional Restoration

In both immediate and delayed scenarios, 3 to 12 months of conditioning with temporary crowns have been advocated for soft tissue maturation and stabilization before final impression. This period may depend on the soft tissue quality and the extent of conditioning needed.^{10,11} Since sequential adjustments may be required to reach the final shape of the temporary crown, a material that is easy to modify by addition or subtraction, such as composite resin, is recommended.

Besides these similarities, different strategies for the immediate and delayed scenarios will be proposed.

Immediate Provisional on Immediate Implant

Placement of a provisional restoration at the same time as insertion of an immediate implant has been advocated to help preserve the gingival tissue height and profile.¹² This is becoming increasingly popular as advances in surgical techniques and developments in implant macro-

geometry facilitate the achievement of primary stability necessary for immediate implant placement and function.^{13–16}

The current rationale is based on the idea that the temporary restoration will support the soft tissue contours, thus avoiding collapses of the buccal and interproximal tissues.^{12,17–19} An alternative technique includes the use of a transitional custom abutment in conjunction with the placement of a provisional restoration.²⁰ Despite widespread clinical application, very few guidelines have been proposed in the literature regarding the ideal configuration for this type of restoration. The main objectives of temporary restorations at immediate implants, besides patient comfort and esthetics during healing, are:

- Maintaining the existing soft tissue architecture: Immediate implant placement with an immediate restoration is mainly indicated when the existing architecture is adequate or shows minor discrepancies. On the contrary, an immediate implant could still be considered in conjunction with regenerative techniques when a large defect associated with a hopeless tooth is present, but connecting an immediate implant-supported restoration may be risky and difficult to manage, leading to suboptimal results.
- Avoiding soft and hard tissue compression: Following the same surgical principle of avoiding buccal and interproximal compression

forces to the bony housing when planning the implant placement, soft tissues should not be compressed by the restoration. Furthermore, consideration must be given to the inflammatory process associated with the extraction, grafting procedure, and implant placement, which—in conjunction with undesirable compression from the temporary restoration—may lead to ischemia of the peri-implant soft tissues and further recession or undesirable healing.

- Allowing space for the regenerative process: The space created between the surface of the restoration and the supra-crestal gingival complex should permit the formation of a stable blood clot alone or in combination with soft tissue graft and/or bone substitutes. Following maturation, it would become bone and/or soft tissues (Fig 1). Failure to achieve a stable coagulum or inability to maintain the regenerative space may result in soft tissue collapse and insufficient volume.

To accomplish the desired soft tissue stability and architecture, the transgingival zone of the immediate provisional restoration should be shaped according to the following guidelines (Fig 2):

- A critical contour supporting the existing gingival margin and papilla height. The original tooth outline is maintained palatally and interproximally,
- A subcritical contour as concave as possible to allow space for the coagulum and grafting material to stabilize and potentially reconstruct the bony ridge.
- A smooth and polished surface will help create a gentle transition and minimize contamination during healing. Selection of adequate temporary

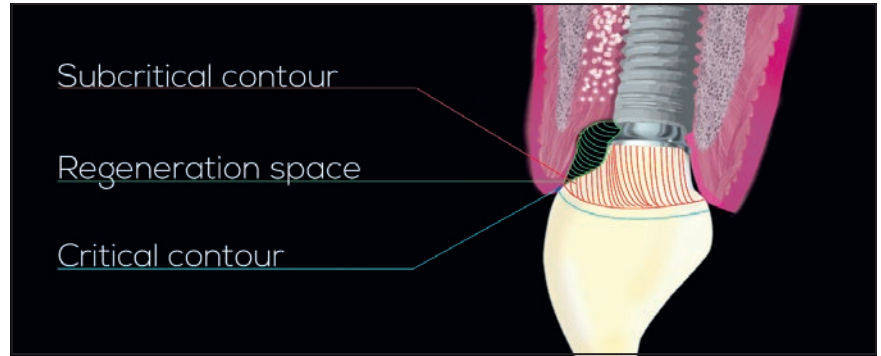


Fig 1 Maintenance of a regenerative space while avoiding soft and hard tissue compression is mandatory when placing a provisional restoration on an immediate implant.

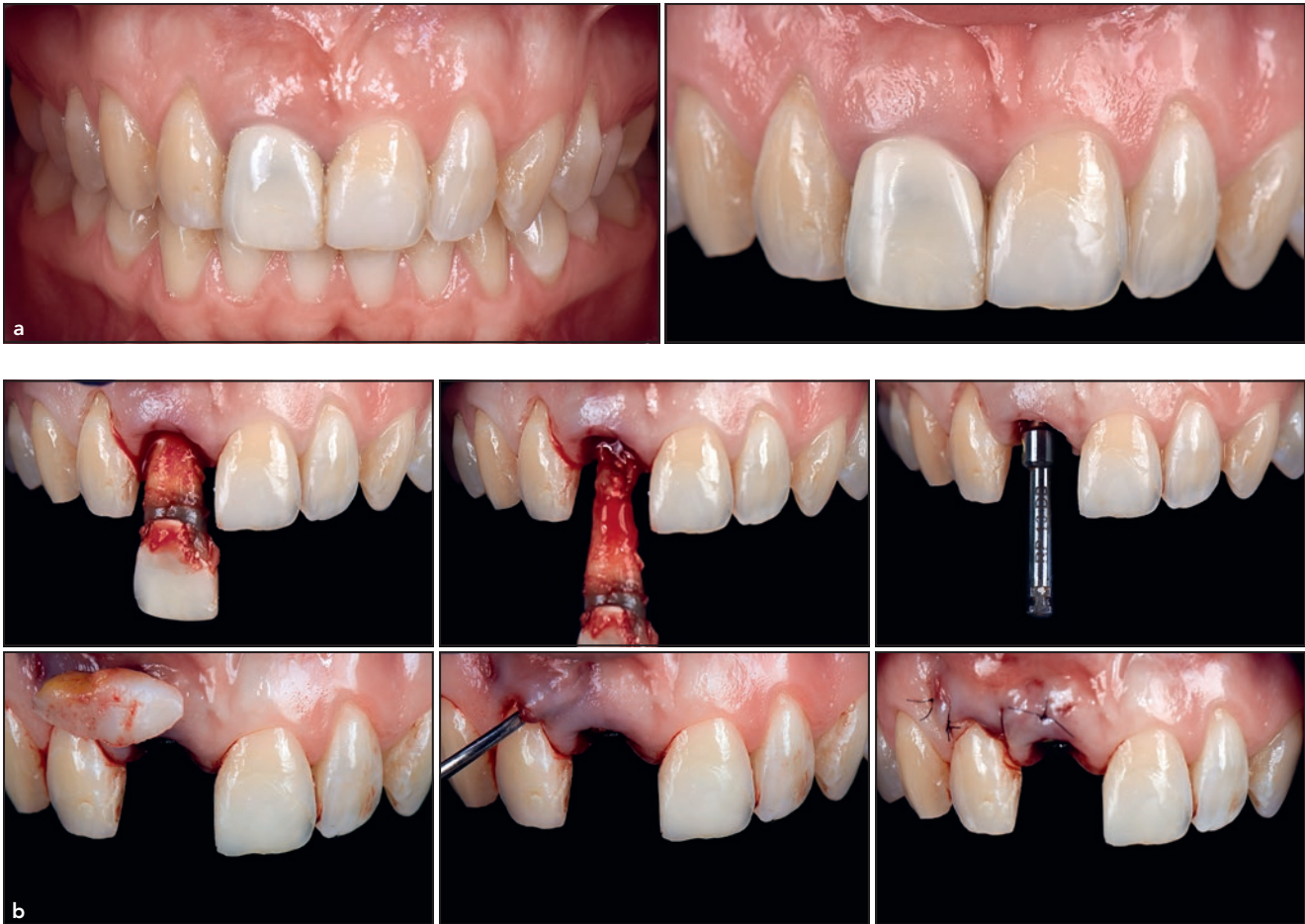
Contour	Facial	Interproximal	Palatal
Critical	Reduce 0.5–1 mm compared to the natural tooth	Equal to the natural tooth	Equal to the natural tooth
Subcritical	As concave as possible	As concave as possible	As concave as possible

Fig 2 Clinical guidelines for contour management of immediate provisional restorations.

whereas facially it could be trimmed down 0.5 to 1 mm to favor a slight coronal shift of the gingival margin after the healing process. This is especially applicable where the tooth shows a preoperative shallow recession.

dimensions is key to obtaining an optimal result. A balance between the need of space for peri-implant connective tissue and the space to create a smooth subcritical contour profile is not always easy; implant depth, buccal lingual position, and platform height must be carefully evaluated due to their influence on the potential configuration of the prosthetic design.

From a practical perspective, the restoration can be fabricated by adapting the patient's own anatomical crown, modified with composite resin bonded to



Figs 3a and 3b (a) Patient presenting with a hopeless right central incisor and gingival disharmony. Replacement of the central incisor with an immediate implant and provisional is planned. The treatment will also address lack of gingival harmony. Plastic periodontal surgery was also planned to coronally reposition the gingival margin of the lateral incisors, as well as manipulation of the implant socket crown to match the gingival level of the pristine left central incisor. (b) After careful extraction of the right central incisor, the alveolar socket is thoroughly debrided and evaluated. An immediate implant is placed in the lingual portion of the socket with a high insertion torque. A connective tissue graft from the tuberosity is used to increase the soft tissue volume around the implant and to correct the recession on the right lateral incisor. Xenograft bone substitute was used to fill the gap between the implant and the buccal wall of the socket (regeneration space).

a screw-retained temporary abutment by means of flowable resin. A stock resin crown or a custom computer-aided design/computer-assisted manufactured polymethyl methacrylate crown matching the cone beam computed tomography profile of the tooth to be extracted can also be useful alternatives. An example case illustrating how these guidelines are clinically implemented is shown in Fig 3.

Delayed Provisional Restoration After Hard and Soft Tissue Maturation

Following osseointegration and soft tissue maturation, the soft tissue framework surrounding the implant is assessed. Four scenarios are commonly encountered: (1) an over-augmented ridge profile, (2) an ideal ridge, (3) a deficient ridge with less than 1.5 to 2 mm of horizontal dis-

crepancy, and (4) a deficient ridge with more significant contour discrepancy. Careful sculpting of the soft tissues with the help of a provisional restoration may allow a final optimal restorative result for the first two scenarios. For minor ridge discrepancies, the provisional may again aid in developing the proper profile as an alternative to soft tissue grafting; while for major discrepancies, surgical contour augmentation



Figs 3c and 3d (c) Following the described guidelines, a provisional restoration is placed the same day of the surgery: Critical contour supporting the existing gingival margin and papilla height, concave subcritical contour, a smooth profile, and a polished surface to provide adequate space for regeneration of thicker peri-implant soft tissues. (d) Reevaluation after 1 month of healing. The provisional adequately supports the gingival architecture, avoiding soft tissue compression and allowing space for the regenerative process. In this particular case, an over-augmented ridge with a facial soft tissue margin coronal to the ideal level is present. Once osseointegration is complete, an apical displacement of the facial gingival margin will be pursued by adding composite to the facial critical contour in a facial/apical direction according to the guidelines for delayed provisional restorations.

should have been required preliminarily to the provisional phase. The authors propose the following steps based on their observations:

Facial critical contour must be determined as the first step in the conditioning process. For over-augmented ridges where the preliminary facial soft tissue margin is coronal to the ideal level, the critical contour may be over-dimensioned in a facial/apical direction to promote an apical

relocation of the gingival margin (Fig 4). For an ideal ridge, the critical contour may be established equal to the natural tooth, as there would be no need to vary the height of the gingival margin. In case of a deficient ridge where the soft tissue margin is located apically to the ideal level, under-dimensioning the facial critical contour could be considered, as this could allow for coronal migration of the gingival margin. Similarly,

if a connective tissue graft together with provisional insertion is attempted to compensate for the deficient gingival margin, the reduction of the facial critical contour would be important to allow space for the grafted soft tissue without causing undue compression. The palatal and interproximal critical contours are generally kept equal to those of the natural tooth as long as the soft tissue profile is not deficient. In cases

Fig 4a After 4 months of osseointegration and maturation of the peri-implant soft tissues, the critical contour will be evaluated first. In this particular case, an apical displacement of the gingival margin was desirable in order to achieve a harmonious result. The addition of flowable composite to the critical contour area will displace the gingival margin to a level matching that of the adjacent natural tooth. White dotted line = implant platform; blue dotted line = critical contour; blue arrow = vertical dimension of the subcritical contour.

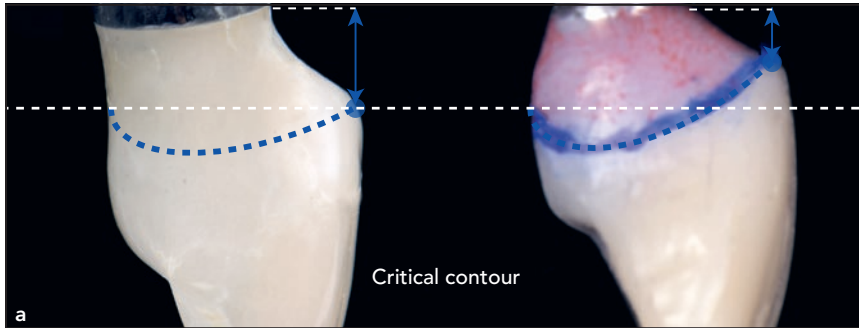


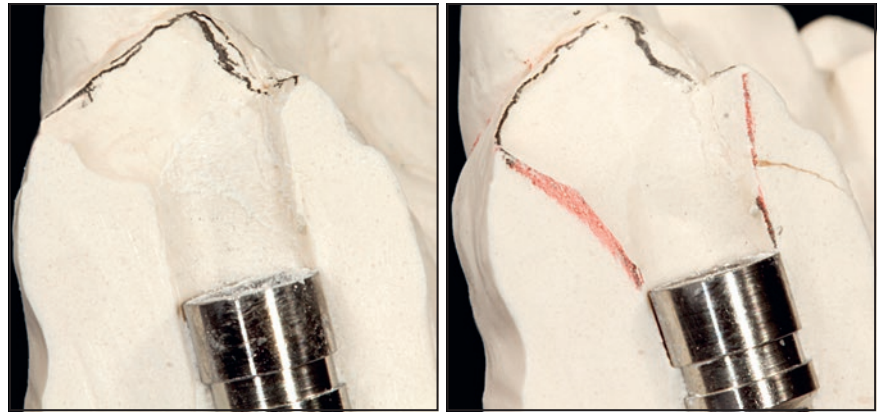
Fig 4b Once the modified provisional is tried in, any blanching should disappear within 10 minutes. Otherwise, it is necessary to remove some of the added composite to avoid excessive compression of the tissues. If subsequent modifications are required, these should be performed at a minimum of 15-day intervals to allow sufficient time for revascularization and soft tissue maturation.

Fig 4c After the gingival margin has reached the desired position, the volume and profile of the soft tissue is evaluated. Once the peri-implant architecture is deemed satisfactory, no further contour modifications are performed. A concave subcritical contour was therefore selected for the final prosthesis. Final impression using a customized impression coping is recommended to precisely replicate all contour modifications of the provisional restoration.



Fig 4d Comparison between the preoperative appearance and the final result. All the treatment objectives have been achieved.

Fig 5 Critical (gray) and subcritical (red) contours can be widened in cases of mild ridge deficiency, possibly improving the soft tissue profile by enhancing the support to the peri-implant facial mucosa.



	Facial tissue			Interproximal tissue		Palatal tissue
	Coronal to ideal level	At ideal level	Slightly apical to ideal level	Preserved	Slightly deficient	
Critical contour	Overdimension in facial/apical direction	Equal to the natural tooth	Underdimension in a facial direction	Equal to the natural tooth	Equal to the natural tooth	Equal to the natural tooth
Subcritical contour	Flat or slightly concave	Flat or slightly concave	Increase convexity	Equal to the natural tooth	Increase convexity	Equal to the natural tooth

Fig 6 Clinical guidelines for contour management of delayed provisional restorations.

where a loss of papilla height has to be compensated, an exclusive increase of the critical contour could be considered to promote coronal papillary displacement, thus creating long interproximal contacts instead of the naturally occurring contact points and a squarer tooth shape.

Facial subcritical contour will be flat or concave in cases where the ridge profile is over-augmented or ideal. Unnecessary soft tissue pressure will therefore be avoided. On the contrary, in the third scenario of minor/moderate ridge concavity, a prosthetic compensation limited to solely increasing the facial convexity of the subcritical contour can be considered (Fig 5). This compensation may enhance the soft tissue

profile without altering the shape of the implant crown for more favorable final esthetics. In fact, a more convex subcritical profile could improve the support to the soft tissues apical to the gingival margin and reduce shadowing effects around the facial gingiva. Interproximally, the subcritical contour can also be altered in case of loss of papilla height. This option can be considered provided 2 to 3 mm of interdental space is available to avoid impinging on the adjacent interproximal alveolar bone with the provisional. Increasing the convexity of the subcritical contour may squeeze the interdental papillae and may increase its height of 0.5 to 1.0 mm. With an adjustment exclusive to the

subcritical contour, a reduction of open embrasures may be achieved without resorting to a markedly squarer tooth shape (Fig 6).

If subsequent modifications are required, these should follow a precise timeline. An interval of no less than 15 days is recommended to allow for healing and revascularization of the peri-implant mucosa. Thorough polishing of the subgingival surface should always be performed to avoid risks of contamination and plaque accumulation.

It should also be noted that the facial subcritical contour may present a nearly horizontal convex configuration due to the three-dimensional implant position and abutment selection. Specifically, three aspects

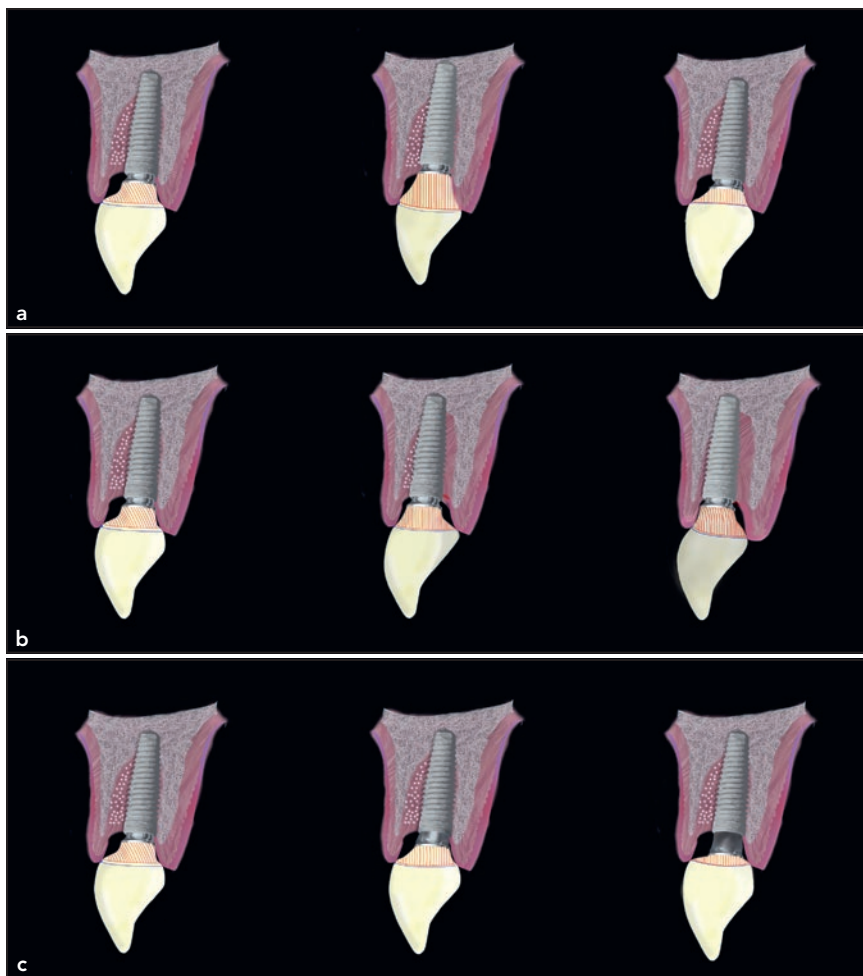


Fig 7 Implant (a) apico-coronal position, (b) buccolingual position, and (c) restorative platform height may present limitations to the design of the subcritical contour, consequently influencing the final abutment macrogeometry. The figure outlines the possible configurations according to the different scenarios.

may impact the subcritical contour configuration: the apico-coronal implant position, the buccolingual implant position, and restorative platform height. These influence the design of the subcritical contour and consequently impact the final abutment shape. It is a current trend to position immediate implants more towards the palatal aspect of the socket¹⁴ to compensate for future buccal resorption. This may be es-

pecially frequent for maxillary central incisors and canines. When the neck of the implant is located 3 mm lingual to the gingival margin and the implant platform is submerged only 1.5 to 2 mm below the margin, the potential to create a flat or concave prosthetic profile is limited, and a horizontal cantilever may result; in some cases, this may negatively impact access for cleansing procedures (Fig 7).

Discussion

There is growing interest in the ideal design characteristics of the supracrestal component of the implant restoration.²¹ Provisional restorations for immediate or delayed implants differ for objectives and management. Delayed-implant suprabony emergence is created by a healing abutment that is often smaller than the volume of the final crown.²² The ideal cross-sectional volume of the final restoration may be achieved through careful development of the restorative contours, which will significantly improve the ridge profile⁴ and its harmony and symmetry with the adjacent teeth. Soft tissue sculpting should be carried out at two levels: the critical and subcritical contour areas.

All surgical and prosthetic steps should aim to achieve at least 2 mm of soft tissue thickness (facially) to the final restoration. This may mask the underlying color of the abutment, leading to more favorable esthetics,²³ and prevent inflammation-mediated dehiscences.²⁴ It has been suggested that if the implant position is slightly labial, the profile of the initial abutment/crown would be concave; if it is centered in the crest, the profile would be slightly concave/flat; and in case of palatal positioning, a convex profile should be preferred.²⁵ These general observations do not always provide sufficient guidance for contour variables from the implant platform to the cervical third of the clinical crown, which are necessary to fulfill both esthetic and functional requirements.

It is generally accepted that an increase in the profile of the facial critical contour will result in apical migration of the gingival margin. Conversely, a decrease in the profile of the facial critical contour will cause the gingival margin to relocate coronally. The critical contour may be additionally fine-tuned to customize the curvature of the gingival margin as well as the position of the gingival zenith. Since these factors are essential when attempting to match the clinical crown of a contralateral tooth, ideal critical contour is esthetically nonnegotiable. Once the optimal gingival architecture has been achieved through ideal critical contour design, and provided that no additional tissue support is needed subgingivally, the subcritical area may be under-dimensioned to provide regenerative space that will lead to thicker peri-implant soft tissues.

These attempts to control the facial tissue level by increasing or reducing the dimension of the critical contour are largely anecdotic, and histologic studies are needed to clarify the effect of pressure increase or decrease to tissues. However, some useful indirect evidence is available. A study on the treatment of facial recessions at implants documented how a decrease in the facial volume of the restoration provided more room to be occupied by soft tissues with a possible spontaneous thickening, favoring subsequent surgical grafting.²⁶ On the other hand, in an animal model where maxillary teeth were orthodontically facially moved, an apical displacement of the marginal mucosa was seen, albeit of limited amount.²⁷ Modifications to the

critical and subcritical contours are also possible in the proximal areas. In particular, increases to the proximal subcritical contour may help squeeze the soft tissues, filling the embrasure space without or with limited areas of long contact.

Immediate implants present a different management of the emergence profile. Ideal soft tissues may already be present, and they need to be preserved to allow for an enhanced esthetic outcome.^{12,17,18} This is best achieved by an immediate temporary restoration or a custom healing abutment in case of low primary stability. To maintain the gingival margin form and level, the critical contour should support the marginal tissue outline. Equally important, the underlying subcritical contour should be as concave as possible to leave the widest "regenerative space" for healing and obtaining thick peri-implant tissues. This space is delimited by the buccal surface of the provisional, coronal buccal bone plate, and supra-crestal soft tissue, and it would be occupied by the blood clot and any bone and/or soft tissue grafted at implant placement.

The need to create a smooth and clean abutment surface must be further considered. Some evidence seems to suggest that polishing composite resins with pumice of decreasing abrasiveness and disinfecting with steam allows favorable epithelial cell adhesion *in vitro*.²⁸

Finally, repeated disconnections of the abutment may impact bone resorption compared to final abutment placement at implant surgery. However, a clinical study showed that this effect is minimal and clinically

negligible, and it does not contraindicate sequential abutment manipulation.²⁹

Conclusions

Modifications to the restorative emergence profile critical and subcritical contours are essential in optimizing the peri-implant soft tissue architecture. In case of immediate implants, the critical contour must support the gingival margin architecture while the subcritical contour may be designed to provide regenerative space by means of a concave configuration. These contours are dynamic areas that may be modified during conditioning of mature tissues in delayed cases. While the critical contour affects the gingival margin and level position, changing the convexity of the subcritical contour can optimize the soft tissue profile. Cases where an implant is placed towards the palate but not apically enough may still be restored with a crown contour that extends facially from the implant platform with a convex profile.

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