

Principles of Combined Surgical Therapy for the Management of Peri-Implantitis

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Focused Clinical Question: The purpose of this technical note is to present the principles for combined therapy as well as to illustrate the step-by-step approach of this procedure to efficiently manage peri-implantitis.

Summary: Peri-implantitis is the primary threat that compromises the longevity of dental implants. This entity is regarded as a biofilm-mediated inflammatory condition. As such, the arrestment of disease is conditioned by the elimination of the etiological factor and the clinical resolution of inflammation by eliminating pathogenic pockets. It was suggested that the therapy of peri-implantitis relies upon defect configuration. In this sense, defect configuration is, in part, conditioned by the dimensions of the alveolar bone and implant position. In the clinical basis, it is frequent to identify combined defects exhibiting area(s) where reconstructive therapy is inefficient due to uncontained defect morphology. These situations represent clinical indications for combined therapy.

Conclusions: This therapeutic modality is based on the combination of reconstructive therapy in the infraosseous defect component and surface modification for the area of the implant within the supracrestal component or outside the reparative potential. *Clin Adv Periodontics* 2022;12:57–63.

Key Words: alveolar bone loss; dental implant; dental implantation; peri-implantitis; peri-implant endosseous healing.

Background

Peri-implantitis is regarded as a biofilm-mediated inflammatory condition that leads to progressive loss of support.¹ It represents the primary threat of dental implant longevity.² In fact, this disorder represents nowadays a large concern for clinicians worldwide given its alarming prevalence.³ Several factors—including systemic, local and habits, have been linked to peri-implantitis.¹

Over the last decade, research has endeavored to understand this entity and the strategies (primary and secondary) to prevent the disease; nevertheless, there is yet paucity of data on the efficacy of different therapeutic modalities for its management.⁴ Generally speaking, nonsurgical therapy was claimed to be ineffective to resolve inflammation. Therefore, surgical strategies are commonly needed to eradicate the pathology.⁴

Embracing the knowledge gained for roughly half a century on the surgical management of periodontitis, various alternatives have been proposed. These rely primarily on defect morphology⁵; even though other factors, such as the lack of keratinized mucosa⁶ or smoking habit⁷

may alter the decision-making process. As such, peri-implantitis exhibiting angular defects (i.e., defects with infraosseous components) are indicated for reconstructive measures with or without barrier membranes. Horizontal-defects (i.e., defects with supracrestal components), on the other side, are more prone to resolve by means of resective therapy with or without osseous recontouring measures.⁸

Interestingly, although early data indicated that peri-implantitis defect morphology often displays a circumferential well-contained defect,⁹ it was recently demonstrated that it often exhibits with a two-/three-wall defect configuration, where the buccal plate is commonly the missing bony wall.¹⁰ The reason for this feature may fall on the baseline alveolar bone dimension,¹¹ the insufficient critical buccal bone thickness,¹² or implant position¹³ in relation to the bony envelope. Moreover, it must be highlighted that approximately 25% of peri-implantitis diagnosed on the daily basis exhibit a combined defect configuration (i.e., combination of infraosseous and supracrestal components).¹⁰

Therefore, assuming that the management of peri-implantitis must be tailored according to defect configuration and that often may offer reconstructive potentials but not to sufficiently to reducing pocket depth (<6 mm), combined surgical strategies must be considered. The purpose of this technical note is to provide insight on the rationale, indications, and the step-by-step approach on the combined therapy of peri-implantitis to efficiently arrest the disease.

Rationale

One of the principles for successful bone regeneration falls in the achievement of stability of the wound within the

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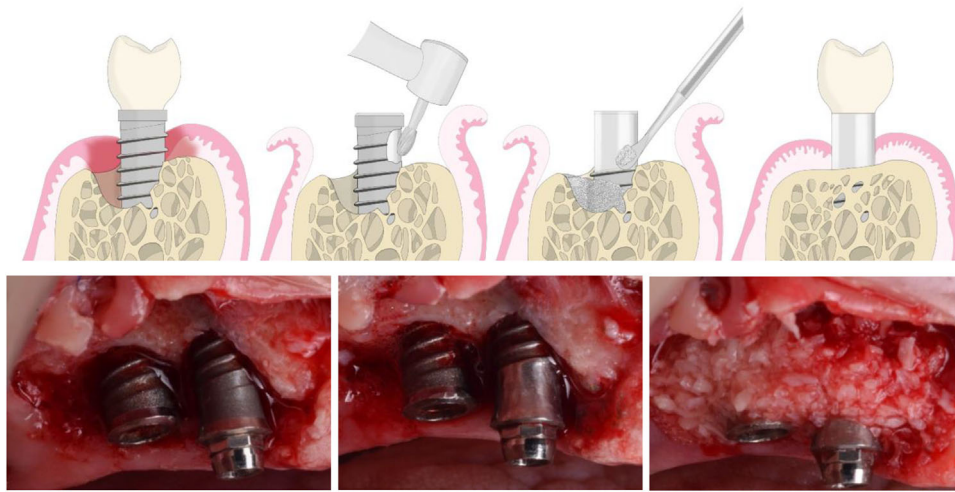


FIGURE 1 The protocol for combined therapy to manage peri-implantitis includes surface modification by means of implantoplasty of the area outside or above (supracrestal component) the reparative potential, implant surface detoxification performed by mechanical and chemical modalities, and hard tissue grafting of the infraosseous compartment.

defect to induce blood clot formation and uneventful healing events.¹⁴ Thus, it is understood that the potential of bone repair procedures by means of bone grafting alone or combined with resorbable barrier membranes is dictated by the presence and height of the adjacent bony walls.¹⁵ As such, the greater number of bony walls featuring the bone defect and the higher are the adjacent bony peaks, the more predictable the regeneration is.¹⁶ Hence, it is the key to identify the so-called “reparative potential.”¹⁷ The “reparative potential” is featured from the apical-most bony peak to the adjacent peak to define the area where bone repair is predictable. The area above the “reparative potential” is expected to be exposed to the oral cavity. Hence, surface modification by means of implantoplasty could be indicated to minimize implant roughness and, thus, to reduce the propensity to experience a secondary surface contamination after therapy.^{18,19} Furthermore, the potential of regeneration is limited by means of implant position with respect to the bony housing. Accordingly, the predictability of reconstructing the bone at the implant aspect outside of the bony envelope is low. Considering the risk that involves leaving the rough implant surface to the oral cavity or peri-implant sulcus, implantoplasty could be advised as adjunct measure of reconstructive therapy (Figure 1).

Indications

The clinical goal in the management of peri-implantitis is to reduce pocket depth to minimize the colonization of pathogenic flora. To achieve such endpoint, the surgical endeavor of contained defects must focus on reconstructing whenever bone offers containment and simultaneously limit bacterial recolonization of exposed implant surface areas in the defect component where bone gain is unpredictable due to uncontained defect morphology. Therefore, the indications for combined surgical therapy are listed below and illustrated in Figure 2:

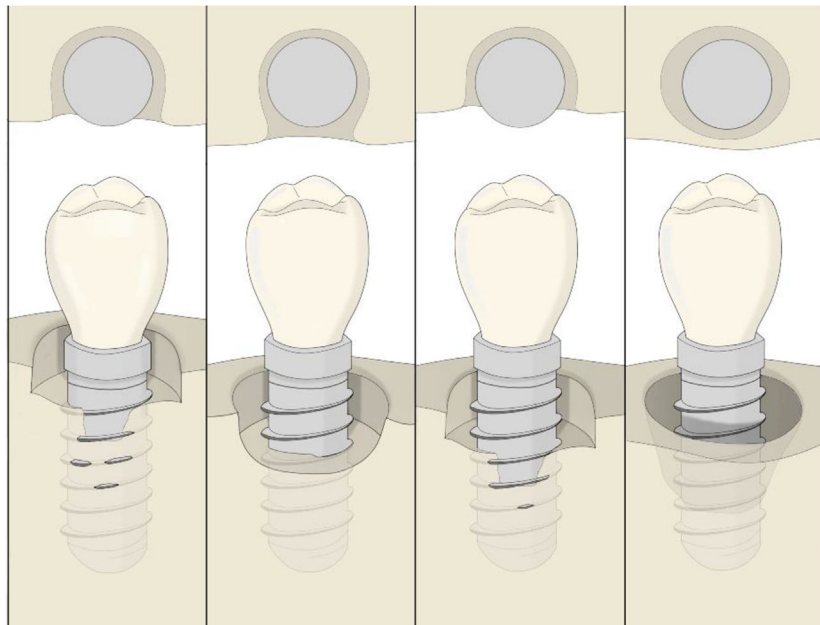
- Partially contained (two-/three-wall) peri-implantitis bone defect configuration with an area outside of the “reparative potential” due to inadequate implant position (often toward the buccal).
- Partially contained (two-/three-wall) peri-implantitis bone defect configuration with an area exhibiting uncontained morphology (i.e., supracrestal component) and the implant inside the bony housing
- Partially contained (two-/three-wall) peri-implantitis bone defect configuration with an area exhibiting uncontained morphology (i.e., supracrestal component) and with the implant outside the bony housing (often towards the buccal).
- Contained (four-wall) peri-implantitis bone defect configuration with an area exhibiting uncontained morphology (i.e., supracrestal component).

As aforementioned, implant position often contributes to defect configuration where combined therapy is indicated, in particular, too superficial implants or too buccal in relation to the alveolar envelope.

Technical Principles

The principles to tackle peri-implantitis by means of combined therapy involve the following steps (Figure 3):

- *Preoperative phase:* The surgical phase must be carried out after nonsurgical therapy (>6 weeks) proved inefficient. With the goal of gaining access, it is strongly recommended to remove the prosthetic component and place a healing abutment or cover screw to minimize damage at the connection during the procedure. In combined defects, it is rare that after prosthesis removal soft tissue ingrowth occurs.
- *Incision design:* Bone sounding for identifying defect morphology and severity is encouraged using a probe after the patient has been anesthetized. Obtaining



Feature	Infra-osseous 2/3 wall defect	Combined 2/3 wall infra-osseous defect	Combined 2/3 wall infra-osseous defect	Combined circumferential infra-osseous defect
Implant position in relation to the bony housing	Outside	Inside	Outside	Inside
Defect configuration Monje et al. (2019) ¹⁰	Ib	IIIb	IIIb	IIIc
Defect configuration Schwarz et al. (2007) ⁹	Ib	Ic + II	Ib + II	Ie + II

FIGURE 2 Indications for combined therapeutic modality in the management of peri-implantitis. The left image in the top panel corresponds to column two in the bottom panel; the middle left image to column three; the middle right image to column four; and the right image to column five.

access to the defect is accomplished using an intra-sulcular incision with the scalpel oriented parallel to the long axis of the implant aimed at isolating the lesion (granulation tissue). This can be supplemented by one or two vertical incisions at the buccal aspect (vertical incisions should not extend 2 to 3 mm beyond the mucogingival junction). Due to the circumferential nature of the defects, the access needs to be supported by one vertical releasing incision at the respective oral aspect. Consider soft tissue conditioning to compensate (1) a mucosal shrinkage in the esthetic zone by means of a concomitant soft tissue volume grafting using a connective tissue graft²⁰ or (2) an insufficient keratinized mucosa at the buccal aspect (<2 mm) by means of a staged-free epithelial graft.⁶

- **Debridement and granulation tissue removal:** Use stiff instruments to efficiently remove the debris such as scalers (including ultrasonic) and curettes. If sufficient visibility is achieved, implantoplasty in the supracrestal component is suggested before the removal of the granulation tissue to eliminate tita-

nium particles and debris embedded within the granulation tissue.

- **Identification of the “reparative potential”:** The “reparative potential” is featured from the apical-most bony peak to the adjacent peak to define the area where regeneration is predictable.¹⁷ The area above the “reparative potential” is expected to be exposed to the oral cavity. Hence, implantoplasty can be recommended. The “reparative potential” can also be featured in peri-implantitis exhibiting infraosseous compartments but in implants outside the bony housing.
- **Surface modification of the supracrestal compartment:** Implantoplasty is encouraged using tungsten carbide burs in high-speed hand-piece and Arkansas burs in low-speed hand-piece with abundant saline irrigation.
- **Surface detoxification for the infraosseous compartment:** For the mechanical surface detoxification, curettes, ultrasonic instruments, titanium or NiTi brushes, or air-abrasive devices can be used. Moreover, the use of lasers has been proposed, although

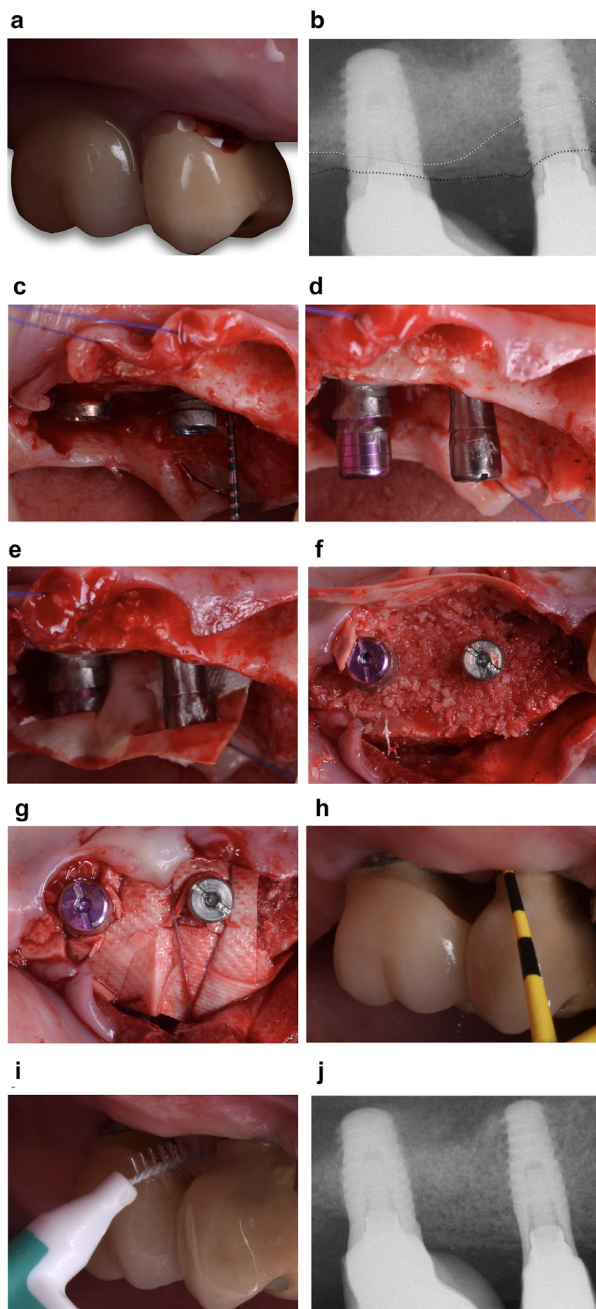


FIGURE 3 Combined reconstructive and resective approach for the management of peri-implantitis. **(3a)** Profuse bleeding on probing at two implant sites in the posterior maxilla. **(3b)** Baseline X-ray. White dots outline the lingual plate while black dots, the buccal bony plate. **(3c)** Moderate bone loss as consequence of peri-implantitis. The intrasurgical view demonstrates a combined defect morphology with a partially contained infraosseous and supracrestal compartments (class IIIb). Note that the lingual plate is missing and the implants extend beyond the reparative potential. **(3d)** Implantoplasty is performed by means of tungsten carbide bur in a high-speed handpiece in the area above the reparative potential. **(3e)** A cross-linked resorbable membrane is stabilized via a “poncho-like” approach. **(3f)** Mineralized allograft is used as bone substitute to fill the infraosseous component. **(3g)** The membrane is further stabilized using subperiosteal incisions. **(3h)** 12-month follow-up clinical examination yielded a significant reduction in pocket depth and resolution of clinical inflammation. Note mucosal recession that occurred as part of the therapeutic sequelae. **(3i)** One of the keys for long-term health is to provide sufficient access for self-performed oral hygiene measures. **(3j)** Radiographic examination at 12-month follow-up shows substantial bone gain at the infraosseous compartment.

evidence up to date concerning their clinical effectiveness is still unclear.²¹ After the visible calculus and biofilm have been removed, chemical detoxification must be carried out using citric acid, hydrogen peroxide, or ethylenediaminetetraacetic acid for a minimum of 2 min.^{22,23} Subsequently, irrigation with chlorhexidine 0.12% is optional.²⁴ It must be noted, anyways, that no absolute superiority has been demonstrated by any chemical and/or pharmacological agent.²⁵

- **Grafting procedure:** A resorbable membrane should be trimmed and adapted according to defect size. It is preferred a long-lasting resorbable membrane (i.e., cross-linked). The membrane should be placed following the “poncho-like” technique. This can be made before or after bone grafting. A variety of bone grafting substitutes have been investigated for this protocol including allografts^{22,26} and xenografts.¹⁷
- **Flap closure:** With the goal of achieving a tension-free flap closure, if needed, it is encouraged to outline a periosteal releasing incision. It must be kept in mind, nevertheless, that it is, in part, a pocket reduction procedure. Therefore, the mucosal margin should be embracing in close proximity of the grafted area to leave exposed the supracrestal component. It is suggested to use nonplaque attractant and non/slowly resorbable sutures such as nylon, polypropylene, or polytetrafluorethylene. Vertical mattress suture is recommended for the medial aspects.
- **Wound protection:** Periodontal dressings can be used to protect the wound. Morbidity can be slightly minimized. Nonetheless, delayed healing is expected when dressing is used as the wound is restricted from increased salivary epidermal growth factor in response to intraoral wounding.²⁷
- **Re-evaluation:** During the first 2 months, patients should be appointed on a 2-week basis after suture removal for professional-administered oral hygiene measures in the surgical site. Clinical and radiographic assessments should be carried out to assess the therapeutic outcome. If proper oral hygiene was precluded by the faulty restorative access with interproximal brushes, modification of the prosthesis design is suggested until the access is satisfying. It is safe to re-evaluate 6 months after the reconstructive intervention.
- **Supportive peri-implant maintenance therapy:** Clinical monitoring should be carried out during supportive peri-implant maintenance therapy (PIMT). It is suggested to program PIMT on a 3-month basis during the first year and on a 6-month basis thereafter. Nevertheless, PIMT should be tailored according to patients’ risk profile.²⁸

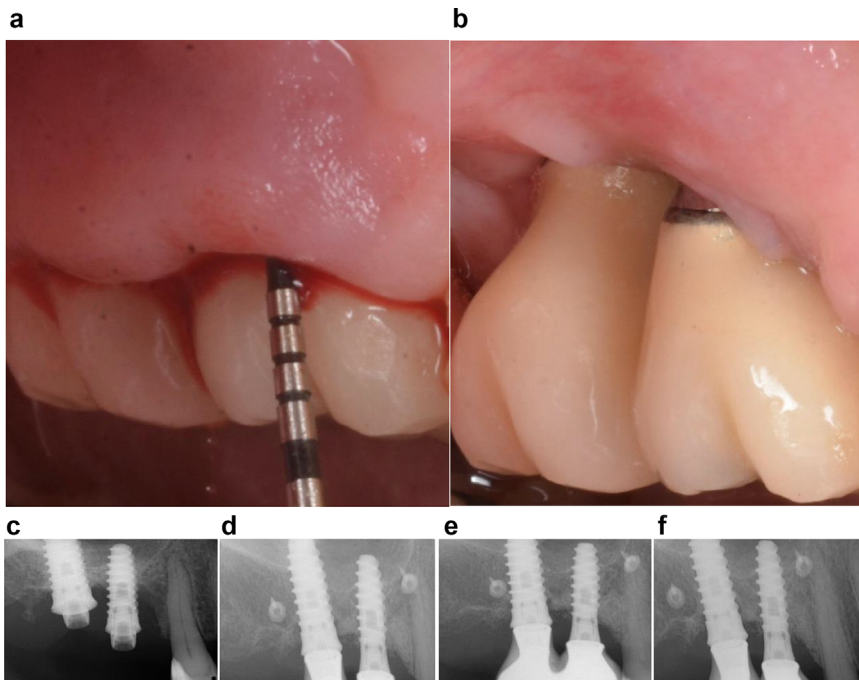


FIGURE 4 Clinical and radiographic outcome after combined therapy. (4a) Baseline clinical examination exhibiting deep pockets, in particular, in the buccal aspect and profuse bleeding. (4b) Clinical resolution of inflammation dictated by the reduction of pocket depth and mucosal recession. (4c) Periapical X-ray at baseline (2018). (4d) Periapical X-ray at 12-month follow-up (2019). (4e) Periapical X-ray at 24-month follow-up (2020). (4f) Periapical X-ray at 36-month follow-up (2021). Note that the adequate identification of the reparative potential is critical in attaining success.

Discussion

Peri-implantitis is, regrettably, a frequent finding on the daily implant practice. However, there is no standard of care to manage this disorder. It has been suggested that the selection of the surgical modality should be based on the characteristics of the peri-implant lesion. In this sense, it must be highlighted that the vast majority of peri-implantitis bone defects are not well-contained to be managed merely by reconstructive means, especially in implants placed in narrow alveolar ridges,¹¹ below the critical buccal bone thickness,¹² or outside of the bony housing (often too buccal) or too superficial.^{1,13} This technical note provides insight on the rationale, indications, and step-by-step combined approach for the management of peri-implantitis.

Schwarz et al. originally described the protocol for this approach using implantoplasty for the implant area within the supracrestal component (i.e., horizontal pattern of bone loss) and regeneration for the infraosseous compartment.²⁹ Years later (2013), the same group demonstrated in a 4-year report on advanced peri-implantitis that regardless the surface detoxification method at the infraosseous compartment, bleeding tended to reduce approximately 78% from baseline and clinical attachment level increases to approximately 1.4 mm.³⁰ The 7-year follow-up of the aforementioned study corroborated the stability of the outcomes.³¹ Schwarz et al. demonstrated that the combined approach in conjunction with soft tissue volume augmentation procedures was

effective in reducing bleeding on probing (~75%), probing depth (~2.5 mm), and in gaining clinical attachment (~2 mm).²⁰ More recently, Monje et al. demonstrated congruent findings with previous studies. In terms of implant survival, the rate yielded was 90% over approximately 24 months of follow-up. Disease resolution was 74% when a “flexible” definition of success (bleeding on probing ≤ 2 sites, probing pocket depth less than 6 mm, and stable bone levels) was embraced.²² In addition, the width of KM at the buccal aspect was found to be indicator of therapeutic success.¹⁶ Furthermore, from the clinical perspective it must be taken into account that surgical therapy to manage peri-implantitis often leads to soft tissue changes (i.e., mucosal recession) (Figure 4). Therefore, patient-reported expectations must be cautiously evaluated a priori to assign the therapeutic prognosis, in particular, in the esthetic area.³²

Few drawbacks/concerns of implantoplasty have to be disclosed. First, it is technically demanding and time consuming. It has been demonstrated that the mean time to achieve a smooth surface ($S_a = 0.1 \mu\text{m}$) is approximately 10 min.³³ Second, implantoplasty alters the integrity of the implant and, therefore, it may further impact upon the biomechanical resistance under loading. It was demonstrated that the mean bending strength of narrow implants (3.75 mm) was significantly reduced by implantoplasty, while implantoplasty did not affect the strength of wider implants (4.7 mm). Hence, cautiousness should be exercised when applying implantoplasty

on narrower, freestanding implants that are subject to greater occlusal force. Moreover, an increased risk to fracture of internal hexagon and conical connection implants has been noted.³⁴ In addition, implant/bone overheating was hypothesized as a potential threat of implants that undergo implantoplasty.^{35,36} This can be slightly reduced by using tungsten carbide ($\sim 1^{\circ}\text{C}$).³⁵ Last but not least, the presence of ions released to the medium from the implant surface during implantoplasty represents a subject of concern for many clinicians considering the potential cytotoxicity of nano-sized metal particles.³⁷

Conclusions

The potential and limitations of reconstructive therapy must be exhaustively explored based on defect configuration and implant position. Whenever the defect exhibits an area of the implant outside of the bony housing—represented by a supracrestal component or an area exposing buccally/lingually out of the bony plate, combined therapy is indicated. This consists in the performance of simultaneous resective and reconstructive therapy, including implant surface modification, with the endpoints of reducing pocket depth, gain in support, and limiting surface recontamination. ■

Author Contributions

Drs. Alberto Monje and Frank Schwarz participated in the conception and manuscript writing.

Conflict of Interest

The authors declare no direct conflict of interest. Dr. Alberto Monje holds royalties (Sanhigia, Zaragoza, Spain) for a kit that contains burs used for implantoplasty.

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