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Zirconia Implants in the Esthetic Zone

Immediate placement and provisional restoration

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The use of dental implants for tooth replacement procedures has become commonplace in the treatment planning process for dentists and dental specialists.[1,2] During the last 20 years, variations in the conventional, multistep process of implant reconstruction have begun to demonstrate the benefits of immediate restoration, especially in the esthetic zone.[3-8] These benefits include minimally invasive protocols, shortened treatment times, preservation of soft-tissue contours and emergence profiles, and delivery of a stable, esthetic, provisional restoration (instead of a removable temporary) that can begin the process of tissue sculpting and forming the final emergence profile.[9-11]

Ensuring the appropriate volume and quality of the peri-implant soft tissues, especially in the esthetic zone, is paramount not only for the peri-implant environment and long-term maintenance of bone levels but also for the long-term esthetic results achieved.[9-11]

In areas where there is a deficiency in the quality and quantity of attached keratinized tissue around a final implant restoration, peri-implant mucositis and peri-implantitis have a higher incidence of occurrence, not to mention the compromised esthetics that can result when dark colors from a titanium implant or abutment complex become visible through the soft tissues.[12,13] In these situations, premature tissue loss, bone loss, and eventual implant failure may ensue.[14,15] Numerous factors have been identified that can lead to the development of the previously mentioned peri-implant diseases.

The peri-implantitis disease state is generally caused by plaque and biofilm, which can accumulate on an implant surface in the same manner as on teeth.[16,17] Other factors that can contribute to peri-implant disease include a lack of oral hygiene that causes inflammation and bone loss around implants,[18,19] a lack of attached keratinized tissues,[20] and the effects of tobacco use[21]—all of which have been shown to negatively affect implant success rates. Genetic factors can also play a role in the development of peri-implantitis,[22,23] and corrosion of the base material of an implant can cause the destruction of osseous tissue, resulting in peri-implantitis.[24-27]

To address some of these issues associated with titanium dental implants, implants made from alternative materials have been introduced by the dental implant industry. In recent years, high strength zirconia has been shown to be a successful alternative to titanium for dental implant designs.[28-32] The use of zirconia dental implants prevents the discoloration of the peri-implant soft tissues that is oftentimes associated with titanium dental implants.[33-36] Zirconia also offers a high level of biocompatibility and fracture toughness.[37-39] In addition, the dental literature has shown that, when compared with titanium, bone resorption and the inflammatory response are reduced around zirconia dental implants and the development of biofilm and associated plaque levels is reduced around zirconia implants as well.[40-43] Blaschke and colleagues[44] demonstrated that the soft-tissue response of zirconia implants is superior to that of titanium, and both Gahlert and colleagues[45] and Hashim and colleagues[46] reported that the potential for zirconia implants with diameters of less than 3.25 mm to fracture as a result of lateral forces was approximately 10%. With one-piece zirconia implant designs, care must be taken to thoroughly debride any excess cement from the provisional and final prosthesis to prevent the early stages of peri-implant inflammation. Just as with titanium, this is still a potential issue for zirconia implants.

This article presents two cases that demonstrate the use of a one-piece, all-zirconia dental implant design with an immediate restoration protocol to replace the natural tooth system in the esthetic zone.

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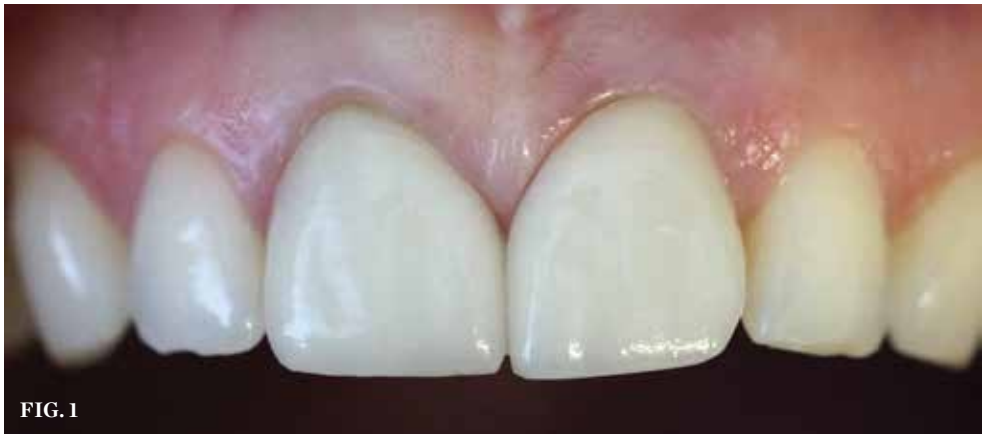

FIG. 1

(1.) Preoperative clinical view.

Case Report 1

A 34-year-old, nonsmoking female patient presented for replacement of both maxillary central incisors (Figure 1). The patient had experienced a past traumatic incident to the central incisors, which required root canal therapy for teeth Nos. 8 and 9 as well as post and core buildups and two different sets of final restorations. Figure 2 and Figure 3 show the serial computed tomography (CT) scan views of teeth Nos. 8 and 9, respectively. A lack of buccal bone plate was evident on both CT scan serial views. Esthetically, the patient was unhappy with the dark color of the facial height of contour of the thin, biotype gingival tissues, which included the emergence profile areas of both maxillary central incisors (Figure 1).

Due to the patient's chief concern of discoloration of the gingival tissues and high level of esthetic expectations (she was also considering enhancement of the adjacent natural dentition), the decision was made to utilize a one-piece zirconia implant for her restorations. One day before the procedure, the patient was given a preoperative antibiotic (Augmentin® 875 mg).

On the day of the procedure, an appropriate local anesthetic (Septocaine® and epinephrine 1:200,000, Septodont) was administered and teeth Nos. 8 and 9 were removed atraumatically, taking care to protect the natural soft-tissue architecture and emergence profiles present (Figure 4). Following an aggressive debridement of the peri-root areas to ensure that all remnants of the periodontal ligament, periapical granulomatous tissue, or infected tissue were removed, site preparation began. Using a surgical guide system (TempStent™ II)[47] allows for ideal placement of the zirconia implant fixtures and ease of conversion to an immediate, esthetic provisional restoration. Prior to implant insertion, an autologous blood draw was performed and the centrifugation process initiated for the fabrication of advanced platelet-rich fibrin (A-PRF). Once this process was complete, the A-PRF clot was mixed with a bioactive bone grafting material (Osseolive® DENTAL, Curasan Inc.) (Figure 5). This graft material has been shown to stimulate osteogenesis and facilitate total replacement with autogenous bone in the grafted area.

Two 4.0 x 12 mm zirconia one-piece tapered screw implants (Ceramic Implant System, Z-Systems) were placed with an initial stability of 45 Ncm (Figure 6 and Figure 7). Figure 7 demonstrates the depth of the margin and the implant platform placement, which was at the depth of the facial height of contour of the remaining/planned buccal plate of bone. Figure 7 also demonstrates the facial defect that was present after placement of the one-piece implants. The graft complex was inserted into this "pouch"[46] area to assist in the regeneration of the facial plate of bone (ie, buccal to the zirconia implants placed) (Figure 8). Next, conversion of the TempStent II surgical guide system allowed for the fabrication and immediate placement of an esthetic, nonfunctional provisional restoration.

The patient was recalled for a follow-up evaluation 7 days postoperatively (Figure 9). At the 14-day postoperative follow-up appointment, the natural soft tissue emergence profiles obtained during this early time period after the surgical placement procedure can be seen (Figure 10). The patient was allowed to follow a healing and maturation period of 3 months, which was uneventful, and then abutment level impressions were initiated.

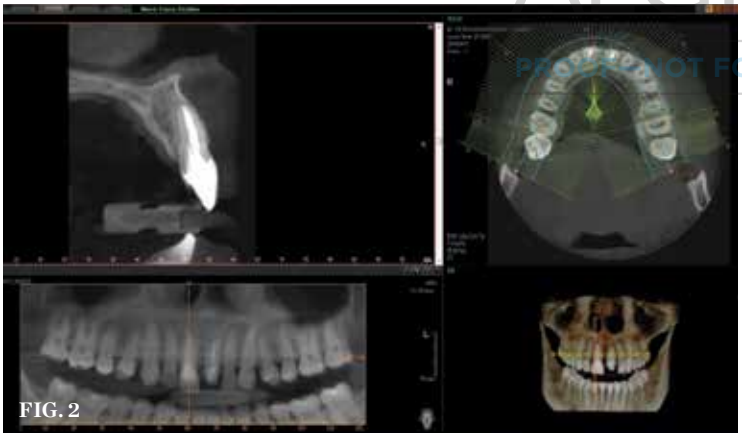
FIG. 2

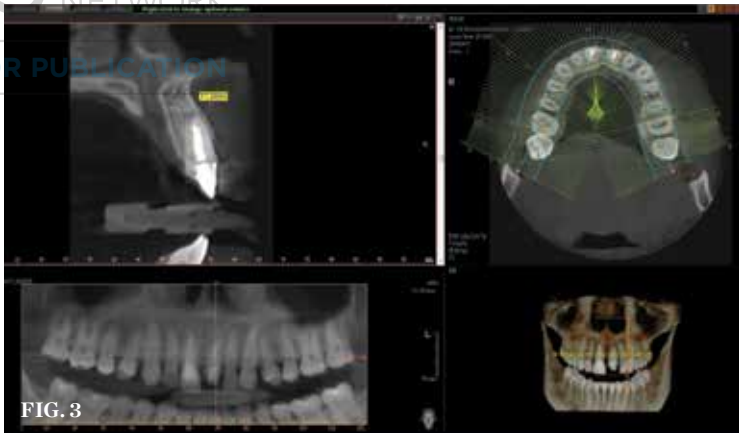
FIG. 3


FIG. 4

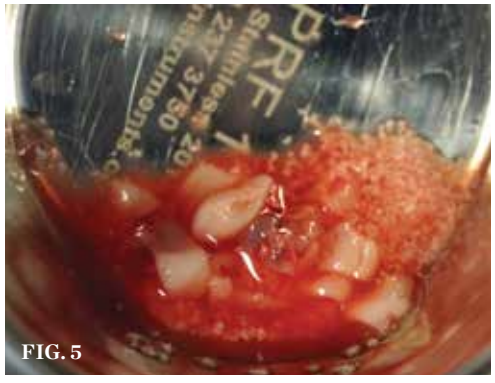
FIG. 5

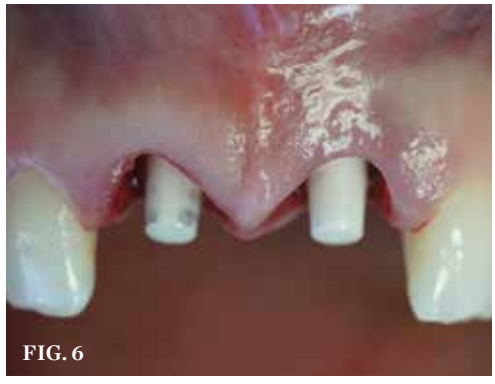
FIG. 6

(2.) Preoperative CT scan of No. 8 site. **(3.)** Preoperative CT scan of No. 9 site**. (4.)** No. 8 and 9 sites following atraumatic tooth removal. **(5.)** A-PRF/bone graft complex. **(6.)** Minimally invasive implant placement at No. 8 and 9 sites.

At the restoration seating visit, the final zirconia implant restorations were placed (Figure 11 and Figure 12). Three months after cementation, excellent tissue emergence profiles were achieved in the final all-zirconia implant complex (Figure 13). Postoperative CT scans of the implants at the sites of teeth Nos. 8 and 9, demonstrate the restoration of the facial-osseous structures buccal to the zirconia implant fixtures (Figure 14 and Figure 15).

Case Report 2

A 72-year-old, nonsmoking, female patient presented for treatment of a loose bridge complex that was occupying the right side of her maxillary anterior sextant (Figure 16 and Figure 17). Teeth Nos. 6, 8, and 9 had all been previously treated with root canal therapy, and several fixed bridges had been constructed throughout a period of more than 20 years. Recurrent decay on teeth Nos. 8 and 9 and compromised remaining bone support for teeth Nos. 5 and 6 necessitated their extraction. The patient stated that she did not want a removable prosthesis for the definitive restoration or at any stage of the treatment process. In addition, the patient was particularly susceptible to plaque and tartar accumulation—a concern that influenced implant design and material selection, considering the long-term potential for the development


FIG. 7

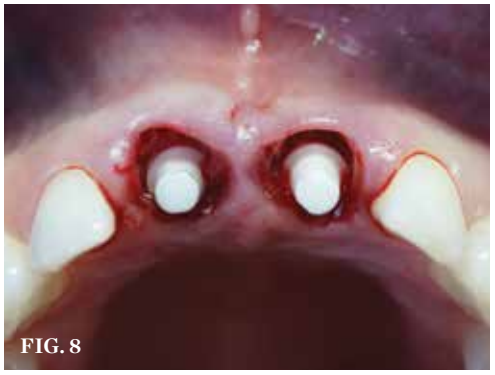
FIG. 8


FIG. 9


FIG. 10


FIG. 11

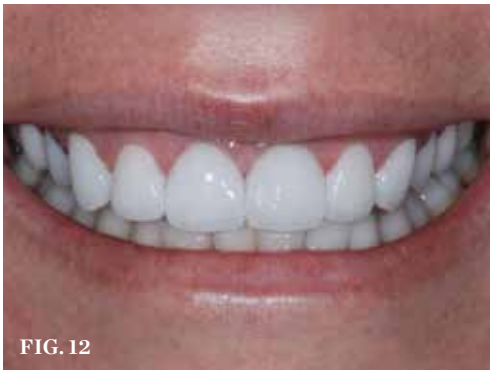
FIG. 12


FIG. 13

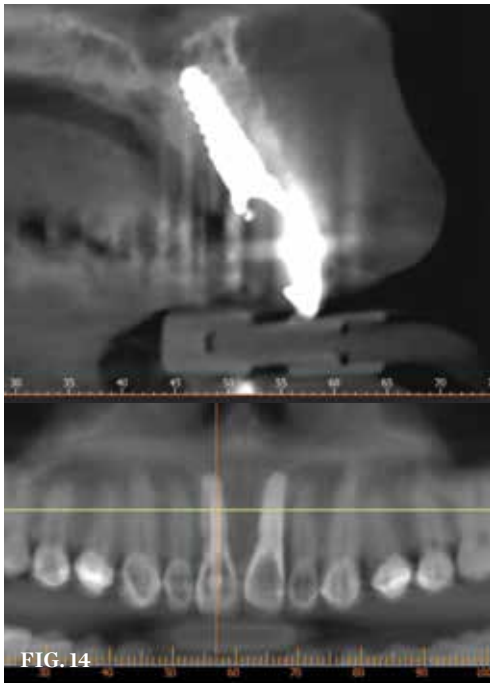
FIG. 14

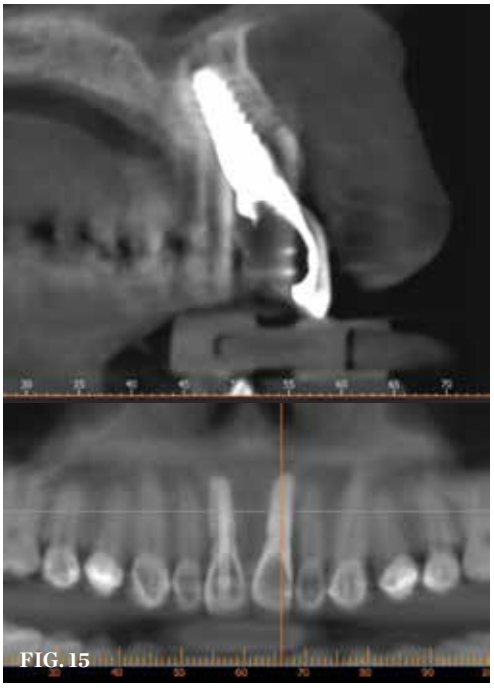
FIG. 15

(7.) Occlusal view of one-piece zirconia implant placement. **(8.)** Minimally invasive graft placement into No. 8 and 9 implant sites. **(9.)** Postoperative clinical view after 7 days. **(10.)** Postoperative clinical view of natural soft tissue emergence profiles after 14 days. **(11.)** Final all-zirconia restorations. **(12.)** Posttreatment full-smile photograph. **(13.)** Clinical view, 3 months after insertion. **(14.)** Postoperative CT scan serial view of No. 8 site after 3 months. **(15.)** Postoperative CT scan serial view of No. 9 site after 3 months.

of peri-implantitis. The patient also had significant esthetic concerns and noted that she had been unhappy with the appearance of her smile for many years.

The decision was made to proceed with dental implant reconstruction at the sites of teeth Nos. 5, 6, 8, and 9. Impressions, a bite registration, and midline records were acquired, and a diagnostic wax-up was completed. After the TempStent II surgical guide system was fabricated, the patient was scheduled for the surgical procedure and administration of preoperative antibiotics (Augmentin 875 mg).

On the day of the procedure, an appropriate local anesthetic (Septocaine and epinephrine 1: 200,000, Septodont) was administered and the failing bridge was removed (Figure 18). It was evident that the remaining supragingival tooth structures were compromised. After atraumatic tooth removal and debridement of the extraction sockets, insertion of the TempStent II surgical guide was followed by initial and final site preparation. Four zirconia one-piece tapered screw implants (Ceramic Implant System, Z Systems) were placed, including one 4.0 x 10 mm implant at the site of tooth No. 5 and three 4.0 x 12 mm implants at the sites of teeth Nos. 6, 8, and 9. All four implants achieved an initial stability of 45 Ncm (Figure 19). The buccal plate deficiencies and facial defects (ie, buccal to the implants) were managed by minimally invasive techniques using the patient's platelets (ie, A-PRF) and bone grafting material (Osseolive DENTAL, Curasan Inc.).

Following grafting of the implant sites, the nonfunctional provisional restoration was immediately placed (Figure 20) and a postoperative CT scan serial view was obtained (Figure 21). After 10 days, the patient was recalled for a follow-up evaluation, at which time there was a noticeable level of soft-tissue maturity present (Figure 22).

Discussion

Replacing the failing, natural tooth system with dental implants for sites involving single or multiple missing teeth has been well-documented in the dental literature. The provisionalization of titanium dental implants at the time of the fixture placement procedure is a predictable way to aid in the formation and maintenance of natural soft-tissue emergence profiles and has become the treatment protocol of choice for tooth replacement in the esthetic zone.[11]


FIG. 16

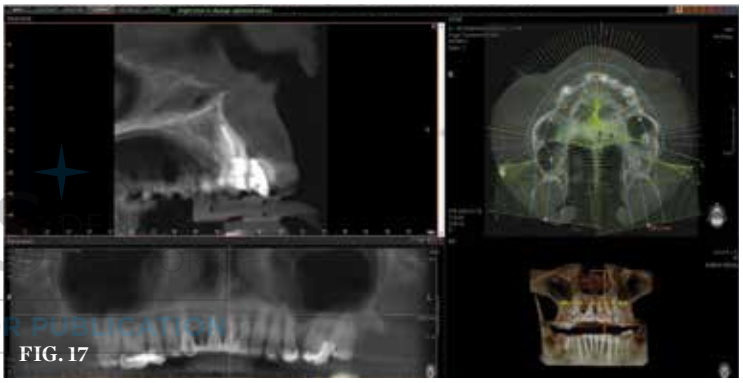
FIG. 17

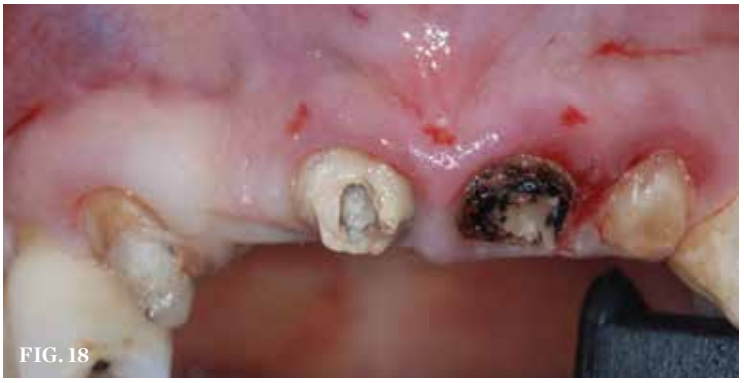
FIG. 18


FIG. 19

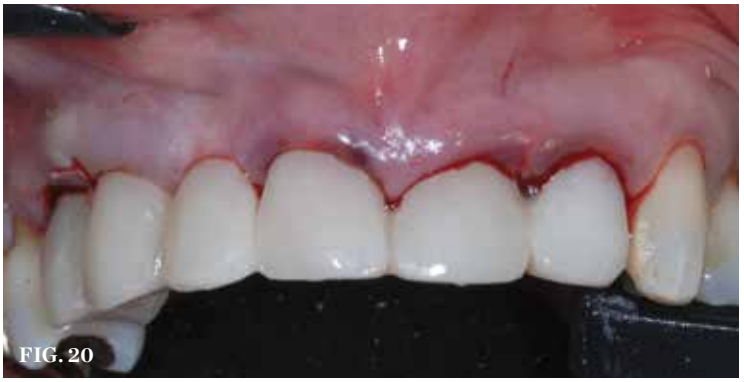
FIG. 20

(16.) Preoperative clinical view. **(17.)** Preoperative CT scan. **(18.)** Preoperative clinical view with bridge removed. **(19.)** Zirconia one-piece implants placed at the No. 5, 6, 8 and 9 sites. **(20.)** Immediate postoperative clinical view of the provisional restoration.

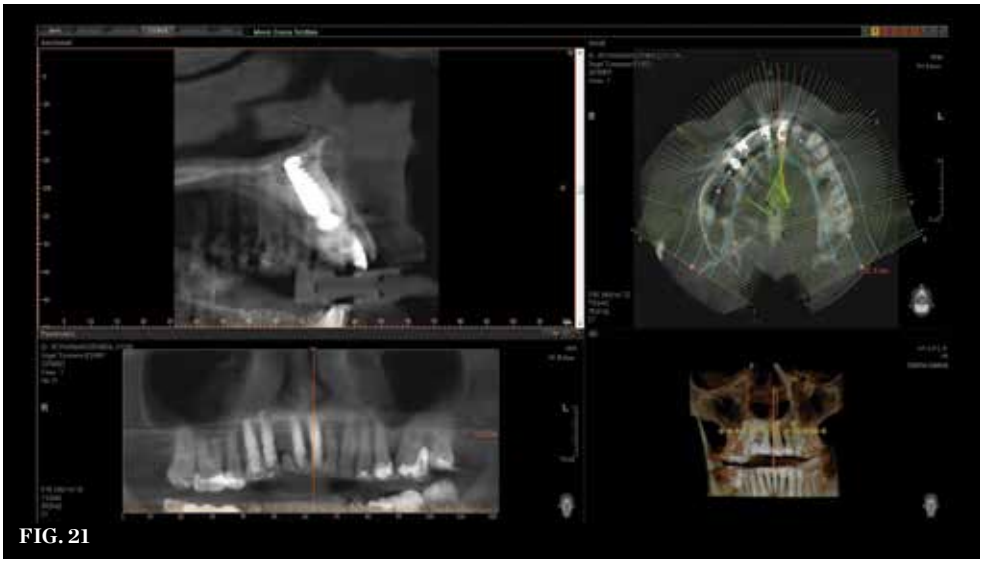

FIG. 21

FIG. 22

(21.) Immediate postoperative CT scan. **(22.)** Postoperative clinical view of the provisional restoration after 10 days.

As a result of complications observed in some clinical situations involving the use of titanium dental implants and the rising incidence of peri-implant mucositis and peri-implantitis affecting both the short- and long-term survival rates of titanium dental implants, the use of an alternative material, zirconia, has been shown to have similar integration success when compared with titanium,[40-43] offer a soft-tissue response that is superior to that of titanium,[44] and have less of an affinity to collect plaque or biofilm when compared with titanium surfaces.[40-43] It is important to note that when using any one-piece implant system, cement removal at the gingival margins of both temporary and final restorations is of paramount importance to prevent the initial development of peri-implant inflammation, which if present, can lead to the development of peri-implant bone loss around both titanium and zirconia implants.

In the esthetic zone, where soft-tissue complications have a higher incidence of occurrence, one-piece zirconia implants may offer an additional level of security and flexibility for the dental implant surgeon and restorative/esthetic clinician. Additional studies are necessary to continue to evaluate the effectiveness and success rates of zirconia implants both short- and long-term.

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