


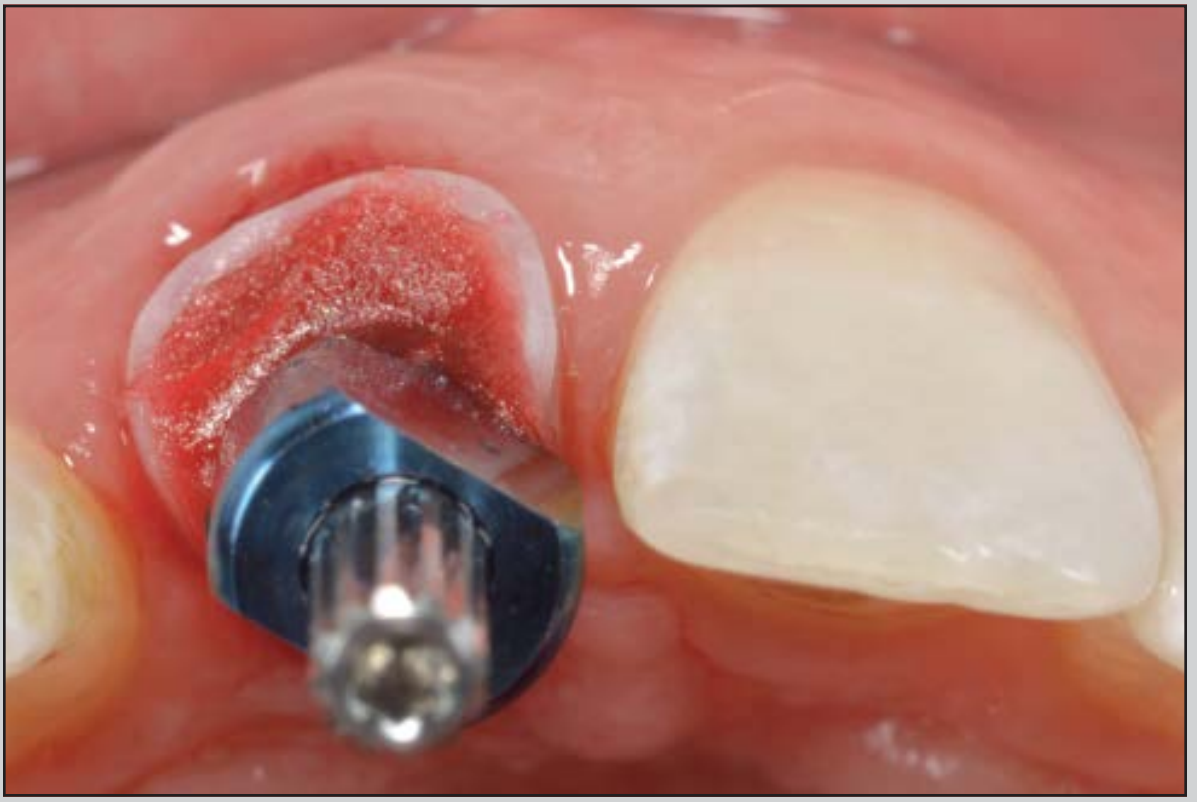

A Novel Prosthetic Device and Method for Guided Tissue Preservation of Immediate Postextraction Socket Implants

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Preservation of the surrounding hard and soft tissues associated with an immediate postextraction socket implant to replace a nonrestorable tooth in the esthetic zone is one of the greatest challenges facing the dental team. Several studies have documented the biologic and esthetic benefits of bone graft containment with either a custom healing abutment or provisional restoration. Use of a prefabricated shell that replicates the extracted tooth at the cervical region can help achieve guided tissue preservation and sustainable esthetic outcomes in an easy, simple, consistent, and less time-consuming way. The following case report of a hopeless maxillary right central incisor in a female patient possessing adjacent teeth with a thin periodontal phenotype illustrates this new treatment device, method, and concept. (Int J Periodontics Restorative Dent 2014;34(suppl):s9–s17. doi: 10.11607/prd.2129)

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Placement of implants into anterior postextraction sockets has gained popularity since the introduction of this approach in 1989.[1,2] It condenses treatment procedures at the time of tooth removal, decreasing the overall treatment period and enhancing the total patient experience. When immediate postextraction implant placement (with or without provisional restoration) was compared to delayed protocols, equivalent survival rates were reported.[3–9] The esthetic ramifications of immediate implants, especially for single anterior teeth in the esthetic zone, are therefore of increasing significance. The thickness of peri-implant mucosal tissues affects abutment materials selection, all of which must be in balance to achieve a predictable and sustainable esthetic outcome.[10–15]

Several clinical obstacles may complicate fabrication of an implant-supported provisional restoration following tooth removal. The peri-implant mucosal tissues often immediately collapse after tooth extraction, socket debridement, and implant placement, complicating the task of capturing the

subgingival contours and preextraction state of the tooth cervix relative to eccentric spatial implant positioning. Any bone graft material also must be adequately contained by the provisional restoration or custom healing abutment.[16–22]

Blood contaminants caught within the body of the provisional restorative material (acrylic resin, bis-acryl, or composite) can later oxidize, causing discoloration and weakening of the parent material. A device that controlled bleeding within the extraction socket would be beneficial and advantageous during this process. Current methods such as the Nealon technique, in which a liquid-powder method is used to paint the material into the socket around a provisional implant abutment component, or injection of a mixed material may be insufficient to accurately duplicate the subgingival profile of the mucosal tissues.[23] Use of an existing (autogenous) extracted tooth to create an immediate provisional restoration on an immediate postextraction implant also has been suggested.[24,25] Steigmann and Wang reported esthetic outcomes in regard to retaining the interdental tissues as well as patient satisfaction using the extracted tooth as a provisional restoration.[26]

Generally, an immediate implant provisional restoration (IIPR) should be screw retained to avoid problems associated with inadequate cement removal—so-called iatrogenic peri-implantitis.[27] From a biologic perspective, screw-retained versus cement-retained provisional restorations have a distinct advantage in that they only possess one subgingival connection: the implant-abutment interface. In contrast, cement-retained restorations have two, with the additional subgingival connection being the crown-abutment interface.

An IIPR should embody several key essential design elements to allow for simple, easy, quick, predictable, and repeatable fabrication: *(1)* The subgingival contours and shape of the cervical root area of the removed tooth should be replicated in their preextraction state. *(2)* The subgingival shape should be captured in the IIPR independent of the implant position. Current knowledge suggests that implant placement should be at least 3 to 4 mm in depth from the midfacial free gingival margin and 2 mm palatally from the facial osseous crest,[7] ie, placement should be spatially eccentric, by default or error. *(3)* Placement of a bone graft material into the gap to the level of the free gingival margin, followed by containment, protection, and maintenance, with the IIPR functioning as a prosthetic socket-seal device,[24,25] is critical for the esthetic outcome.

To meet these goals, a prefabricated polymethyl methacrylate (PMMA) shell device was developed to replicate the shape and dimensions of the extracted root at the cervical area and properly support the subgingival mucosal tissues. Both analog (physical) and digital (stereolithography, STL) file forms were developed. The analog version can be joined to any existing screw-retained provisional implant component (eg, PreFormance Temporary Cylinder, Biomet 3i), thereby capturing the subgingival profile of the mucosal tissues independent of the implant positioning. As Trimpou has stated[24]: "Simulation of the exact dimension of the lost tooth, especially on the cervical part of the new provisional restoration, is expected to preserve all relevant information and allows the design of a natural looking emergence profile."

The following case report illustrates the use of this device and method for fabricating an immediate provisional restoration of an implant placed immediately after tooth extraction in the esthetic zone.

Case report

A 26-year-old woman with a dental history of trauma to the maxillary right central incisor presented with evidence of internal resorption (Fig 1a). The midfacial gingival margin was slightly higher than that of the contralateral tooth due to prior incisal edge fracture with compensatory tooth eruption (Fig 1b). Periodontal probing enabled assessment of the periodontal phenotype; although all the adjacent tooth sites were thin, the tissue surrounding the central incisor was characterized as thick.[28] An irreversible hydrocolloid (alginate) impression (Jeltrate, Dentsply) was made of the incisor, and a provisional crown was fabricated from autopolymerizing acrylic resin (Super-T, American Consolidated).

Fig 1a *The patient presented with an internal resorption lesion of the maxillary right central incisor; note the Class IV distal incisal edge fracture repaired with a composite resin restoration.*

Fig 1b *The gingival zenith of the hopeless tooth needed correction in the definitive restoration.*

Fig 1c *After tooth extraction, socket debridement, and implant placement, the mucosal tissues immediately collapsed.*

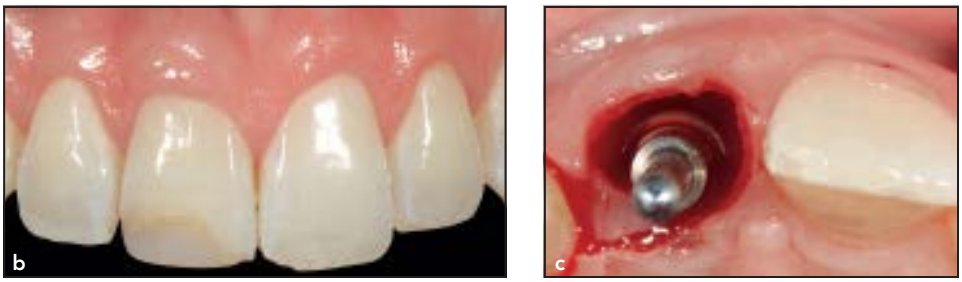

Fig 2 *A medium-sized shell was used for the maxillary right central incisor. Three views are shown:* (a) *facial,* (b) *facio-occlusal, and* (c) *occlusal.*

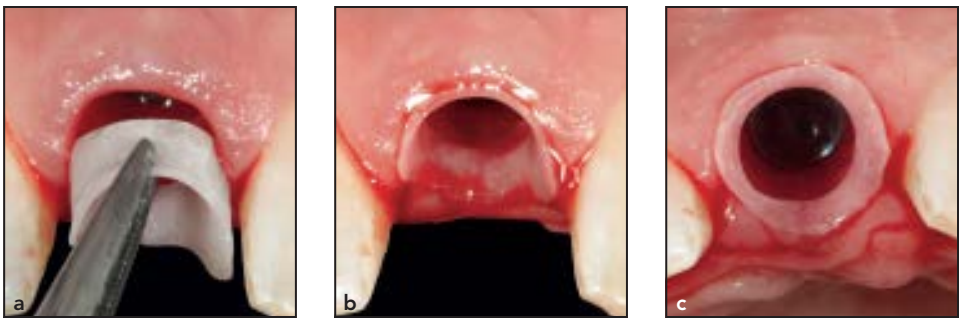

Fig 3 (a) *The fit of the shell was verified in the extraction socket and seated to the level of the free gingival margin prior to luting to the provisional implant cylinder.* (b) *The mesial aspect of the shell is by design slightly more incisal, indicative of the mesial papilla.* (c) *The shell supports the mucosal tissues, replicating the preextraction state of the tooth root cervix as well as controlling the volume of blood in the socket.*

An intrasulcular incision was made with a 15c scalpel blade to separate the supracrestal gingival fibers from the root surface prior to atraumatic tooth extraction. After socket debridement, a 4-mm-diameter implant (3i T3, Biomet 3i) was placed with a palatal bias (Fig 1c). At this point, the peri-implant mucosal tissues had already notably collapsed.

An analog maxillary right central incisor prefabricated shell was selected; each shell is tooth-specific (Fig 2). The fit was verified within the socket (Figs 3a to 3c), making sure that the shell properly supported the mucosal tissues before the provisional screw-retained polyetheretherkeytone (PEEK) implant component (PreFormance Temporary Cylinder, Biomet 3i) was seated (Fig 4a) and luted with acrylic resin (Fig 4b). Placement of the implant into the extraction socket helps to

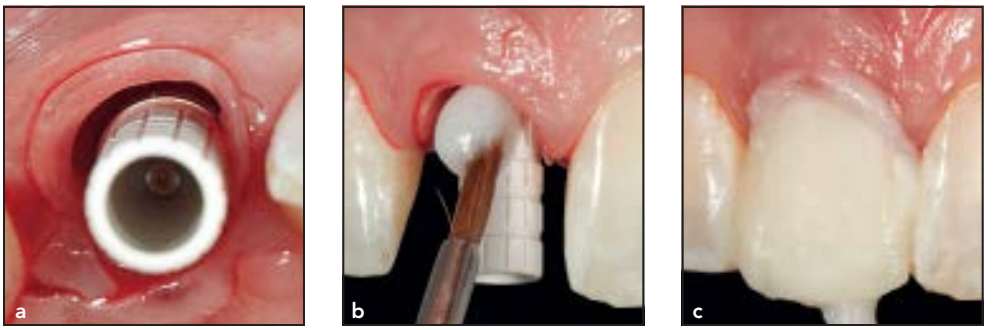

Fig 4 (a) *PreFormance Temporary Cylinder was seated and* (b) *acrylic resin was added using the Nealon technique to secure the two independent components.* (c) *The prefabricated provisional crown was adapted over the shell using autopolymerizing acrylic resin to create a full provisional restoration.*

Fig 5 *The provisional restoration was removed from the mouth and placed onto a laboratory replica to enable removal of the excess acrylic, along with trimming, finishing, polishing, and cleaning, prior to reinsertion in the patient's mouth.*

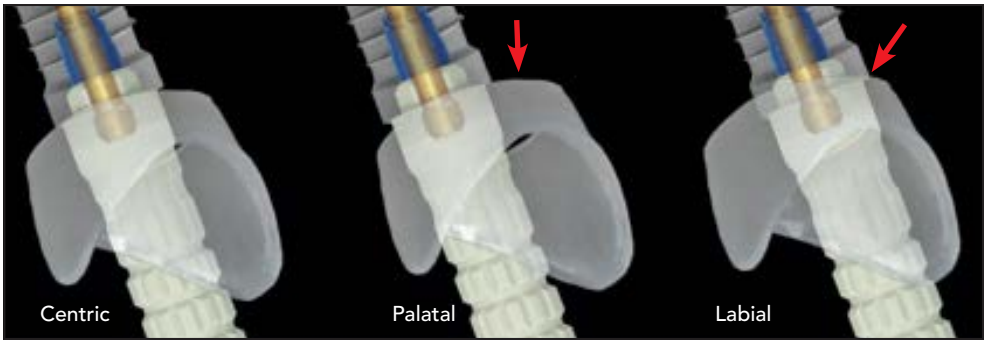

Fig 6 *When using a prefabricated device, the subgingival contours of the provisional restoration have the correct shape irrespective of the implant position. With palatal positioning of the implant, the shell creates a proper full facial contour. A flat contour may result if the implant location is excessive to the labial aspect.*

control bleeding, and the shell assists in this process. The provisional crown was relieved internally and readapted over the provisional implant cylinder to create a full-contoured provisional crown (Fig 4c). After polymerization of the acrylic resin, the screw-retained provisional restoration was removed and connected to a laboratory analog prior to trimming the excess acrylic. The advantage of using a prefabricated device is that it simplifies the challenging and time-consuming work of creating subgingival contours that duplicate the preextraction state, just as the use of prefabricated sheetrock in wall construction has replaced the archaic and time-consuming process of hand-plastering, making present-day fabrication easier, faster, and less variable. The restorative clinician can now focus on refining the contours of the IIPR (Fig 5). Use of a prefabricated shell ensures that the provisional crown contours will be correct irrespective of the implant position[29] (ie, convex if the implant is placed toward the palatal aspect and concave if it is placed toward the labial), since the IIPR is engaged to the provisional implant cylinder independent of the implant position (Fig 6). After the occlusion of the IIPR has been reduced and its surface has been finished, polished, and cleaned, bone graft material can be placed.

The IIPR was removed from the implant, and a flat-contoured healing abutment was seated. This allowed clear access to the gap between the labial bone plate and the implant surface. Bone graft material was then placed and packed

Fig 7 *The provisional restoration was removed, and a tall, flat-profile healing abutment was seated to allow access for placement of bone graft material into the gap between the facial plate and the implant surface. A sterile amalgam carrier and plugger were used to place and condense the bone graft material. The graft material was placed to the height of the free gingival margin, and then the healing abutment was carefully removed to allow reseating of the provisional crown.*

Fig 8 *The provisional restoration was reinserted, acting as a prosthetic socket-sealing device to contain, protect, and maintain the bone allograft material during the 5-month healing period. Using a periodontal scaler, excess bone allograft material was removed to the level of the free gingival margin.*

Fig 9 *Five months later, the gingival margin was still slightly lower than that of the adjacent tooth, but the tissue was healthy.*

Fig 10 *At the first provisional restoration disconnection, the increased width and shape of the implant ridge were evident, compared to those of the adjacent tooth. Bone grafting along with use of a provisional restoration that compensated for eccentric implant positioning and supported the pre-extraction state of the mucosal tissues were critical elements for achieving sustainable esthetics of the ridge shape and peri-implant mucosal tissues.*

with a sterile amalgam carrier and plugger to the level of the midfacial free gingival margin (Fig 7).[30] The particles may not be biologically reactive and can be incorporated into the mucosal tissues, potentially increasing their thickness.[31] The graft material acts as a scaffold to counteract bone modeling/remodeling, maintaining the shape and contour of the facial ridge, and minimizing collapse. The healing abutment was then carefully removed, leaving the bone graft particles undisturbed, and the provisional restoration was cleaned and replaced.[32] It then served as a prosthetic socket seal (Fig 8). The preextraction state of the cervical region of the tooth was duplicated, and with the addition of the bone graft material, the ridge profile can theoretically be increased.

Postoperative follow-up was performed 1 week after surgery, and the site was allowed to heal for an additional 19 weeks, during which the patient elected to have her remaining dentition whitened. Five months after implant placement (Fig 9), the IIPR was disconnected for the first time. The excellent ridge and peri-implant mucosal tissue contours can be seen in Fig 10.

During impression making, the mucosal tissues tend to spontaneously collapse after removal of the provisional restoration or custom healing abutment. Several authors have published techniques to counteract this problem, one of which is to make a custom impression coping of the provisional restoration contours.[33] However, when

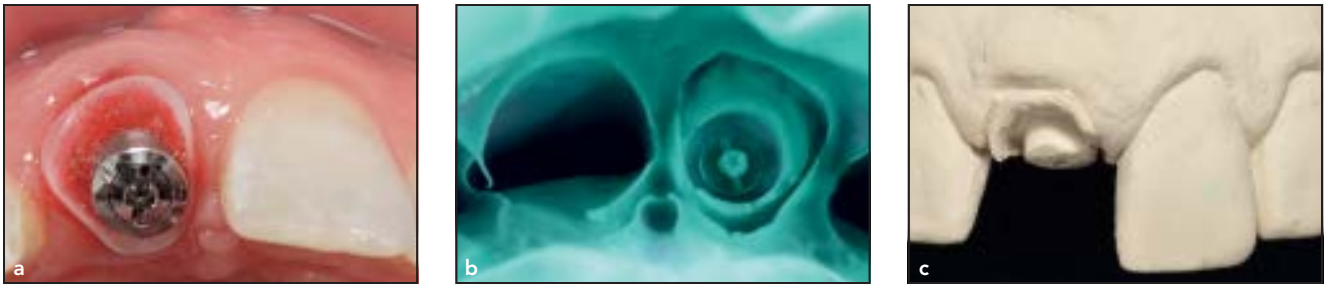

Fig 11 (a) *A prefabricated shell can also be used in conjunction with a BellaTek Encode (digitally coded) healing abutment to be scanned intraorally or recorded with a* (b) *tissue-level impression.* (c) *The shell and abutment must be at least 1 mm above the free gingival margin to be read accurately on the stone cast.*

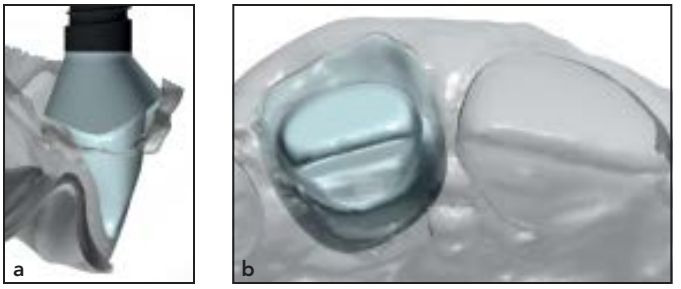

Fig 12 *The digital file of the shell being replaced, in this instance the central incisor, can be combined with the scanned location of the implant head.* (a) *The CAD/CAM design is seamless and less time consuming than traditional planning techniques since the file can be selected automatically with the predetermined shape and merged.* (b) *The occlusal outline form of the CAD/CAM abutment is provided by the scanned shell, which should protrude from the free gingival margin by at least 1 mm. The technician can merge the tooth-specific file to the implant connection spatial location.*

using a prefabricated shell, another tooth-specific component can be luted to a digitally coded healing abutment (BellaTek Encode Healing Abutment, Biomet 3i), using pattern resin (Pattern Resin LS, GC America) to precisely retain the position and shape of the mucosal tissues (Fig 11a). It is important that the shell and abutment extend at least 1 mm above the margin of the mucosa so it can be properly visualized (Fig 11b). A tissue-level impression can then be made, a stone cast poured (Fig 11c) and scanned, and a computer-aided design/computer-assisted manufacture custom abutment designed (Figs 12a and 12b). In the present case, an equivalent shell was luted to an implant-level impression coping (Fig 13) and a definitive impression was made with a medium/light-body one-step technique using a polyvinyl siloxane material (Flexitime Xtreme, Heraeus). A working cast was fabricated in the laboratory with gypsum stone. Again, a comparable prefabricated shell for the maxillary right central incisor made in pattern resin can be used in the wax-up process of a custom-fabricated abutment (Fig 14a). Further labial contour was created in the laboratory to move the mid-facial gingival zenith slightly more apical[34] to match that of the maxillary left central incisor (Fig 14b).

The definitive restoration was a cement-retained metal-ceramic crown[35] with a custom-fabricated metal-alloy abutment (Figs 15a and 15b). The custom abutment was gold plated and cleaned prior to connection to the implant. A duplicate die (Luxatemp Ultra, DMG America) indirect cementing technique[36] was used to provisionally cement the definitive crown and avoid any risk of leaving excess cement that could irritate the tissue.

The definitive restoration integrated well with the pink and white esthetics of the surrounding dentition (Fig 16) and periodontium (Fig 17). At the 1-year posttreatment recall, the facial contour of the maxillary right central incisor compared favorably with the silhouette of the contralateral natural tooth (Fig 18).

Fig 13 *An identical shell component can be used for the implant-level impression-making procedure. The device prevents collapse of the mucosal tissues during this process and can be luted to the implant impression coping with pattern resin to secure its position.*

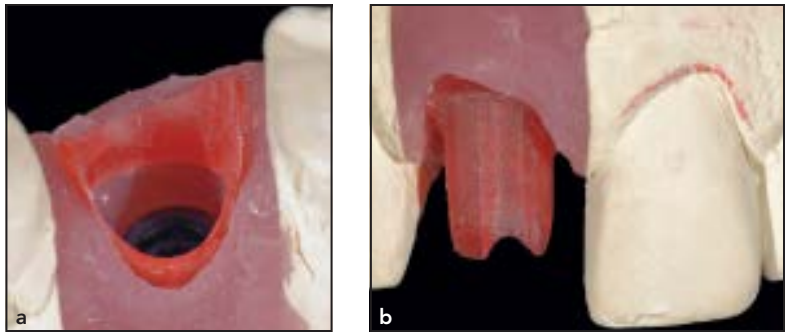

Fig 14 *The shell is duplicated in pattern resin in the fabrication of the final custom abutment.* (a) *The shell conforms to the mucosal shape without adjustment.* (b) *Additional contour was added with pattern resin to the abutment during fabrication to stretch the soft tissues to a gingival zenith position matching that of the contralateral central incisor.*

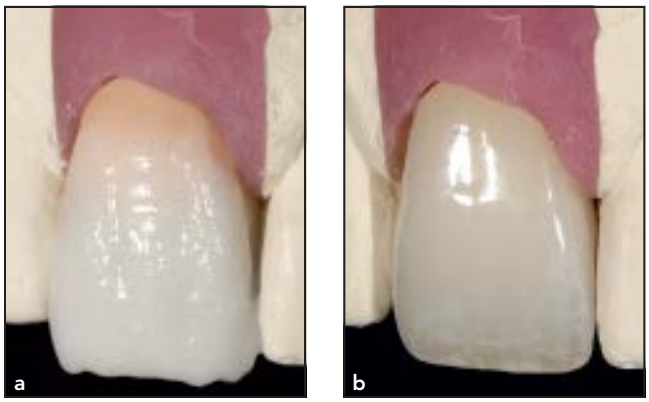

Fig 15 *A metal-ceramic full crown restoration was made on the metal alloy custom abutment.* (a) *The ceramic powders were layered, fired, and shaped; surface texture and luster were created; and* (b) *the definitive restoration was glazed and polished.*

Fig 16 *The definitive metal-ceramic crown was provisionally cemented onto the custom alloy abutment intraorally. Integration of white and pink esthetics has been achieved.*

Fig 17 *The facial view confirms the concept of predictable, sustainable esthetics from provisional restoration fabrication to definitive abutment design in an easy, simple, predictable, and repeatable workflow.*

Fig 18 *At 1 year, the intraoral labio-occlusal view shows the contours of the treated site in comparison with the contralateral natural tooth.*

Conclusions

Use of a prefabricated shell that conforms to the subgingival contours of the mucosal tissues is of clinical relevance and importance for hard and soft tissue preservation. It compensates for several clinical challenges in the esthetic zone presented by anterior tooth extraction, immediate implant placement, and IIPR fabrication. Such shells can compensate for immediate peri-implant soft tissue collapse and eccentric implant spatial placement. They can restore the preextraction state of the tooth cervical region and act as a prosthetic socket-sealing device for bone graft containment. The clinical case presented exemplifies the ease of use, simplicity, repeatability, consistency, and predictability for guided tissue preservation and sustainable esthetics when using shells, from provisional restoration fabrication and implant-level impression making through definitive abutment construction, whether digital or analog.

Disclosure

All authors with the exception of Dr Tan-Chu have a financial relationship with Biomet 3i resulting from speaking engagements, consulting, and other retained services.

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