Transferring the Emergence Profile of Single-Tooth Implant Restorations

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Successful osseointegration and function have traditionally been the main goals of implant therapy.[1,2] However, successful osseointegration does not automatically lead to an optimal esthetic result, and inadequate treatment planning may severely compromise the esthetic result regardless of biologic and functional integration.[3] Exact replication of the natural dentition, maintenance of a harmonious soft and hard tissue architecture,[4,5] and imperceptible integration of the final implant prosthesis are among the challenges of modern implant dentistry.[6]

Provisional implant-supported restorations play a key role in achieving those goals, and many techniques have been described to maximize the appearance of the tissues around implants through alteration of the provisional restoration.[7–16] The ideal emergence profile and morphology of the peri-implant soft tissues should be determined during the preprosthetic laboratory phase and then modified chairside. A proper impression technique is key for an accurate transfer of the peri-implant tissue contour from the patient's mouth to the definitive cast.[7] This article describes three techniques to transfer the peri-implant soft tissues in different clinical scenarios that are common in daily practice: *(1)* transfer of the original emergence profile established with a provisional restoration to the final restoration; *(2)* transfer of a modified emergence profile established through subsequent modification of a provisional restoration to the definitive restoration; and *(3)* transfer of the natural emergence profile to the final restoration for immediate implant placement.

TRANSFER OF THE ORIGINAL EMERGENCE PROFILE TO THE FINAL RESTORATION

Accurate transfer of the peri-implant soft tissue condition to the definitive cast is difficult with standard impression copings even if a natural and harmonious emergence profile can be established without alteration of the provisional restoration. The step-by-step procedures for fabrication of a customized impression coping are illustrated with an exemplary case of a 28-year-old male patient who was referred for prosthetic restoration of a single implant in the area of the maxillary right central incisor. The soft tissue around the 5-mm healing abutment appeared healthy except for a recession on the labial aspect and a scar on the

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Transfer of Original Emergence Profile to Final Restoration

Fig 1 Preoperative labial view. The patient was referred with an implant in the area of the right central incisor with a 5-mm-high healing abutment and a removable partial denture (surgeon: Dr J. Arruti, San Sebastián, Spain).

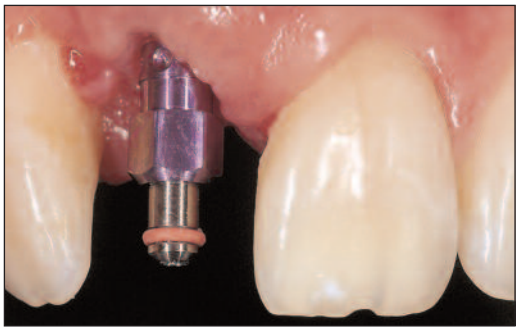

Fig 2 An implant carrier was inserted to evaluate the position of the implant and to examine the available soft tissue.

Fig 3 Labial view of the provisional restoration.

Fig 4 Intraoral situation 3 months following provisionalization reveals favorable tissue changes.

mesial line angle. A removable partial denture (RPD) served as the provisional restoration (Fig 1). An implant carrier was attached to the implant as a diagnostic tool to evaluate the implant position with respect to the free gingival margin and implant angulation (Fig 2). The labial soft tissue was less than 1 mm in height and revealed unfavorable scars.

Provisionalization

A provisional restoration (Fig 3) was made according to a diagnostic full-contour waxup, and a circular emergence profile was carved on the cast around the implant analog to provide an ideal tooth contour. A transfer coping served as a provisional abutment, and composite resin was added to fill the space between the carved stone and the coping. The abutment was prepared according to the silicone matrices of the waxup, and a provisional acrylic resin crown was fabricated. The crown was cemented to the provisional abutment on the implant. The pressure applied to the surrounding soft tissue caused some initial blanching, which may result in a dynamic tissue remodeling process and "creeping papilla formation."[4,8] The situation was evaluated after a healing period of 3 months, particularly assessing the location of the gingival margins, papillary heights as compared to the adjacent teeth, and the emergence profile established in the laboratory (Fig 4). Figure 5 shows the provisional abutment in relation to the established tissue contour and improved tissue height.

Fig 5 Labial view of the provisional abutment made from a 3.25-mm implant carrier and modified with composite resin at the gingival third.

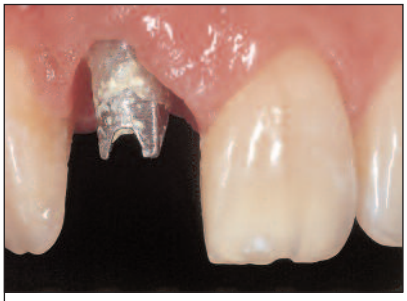

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Fig 6 The customized impression coping was fabricated on the initial cast. Composite resin fills the space between the machined impression coping and the carved emergence profile.

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Fig 7a The customized impression coping fits the emergence profile and resembles the provisional restoration in the gingival area. The coping supports both mesial and distal papillae and prevents soft tissue collapse.

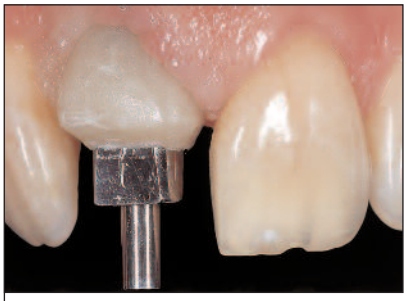

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Fig 7b A standard impression coping is modified to replicate the cervical contour of the provisional restoration.

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Fig 8a Labial view of the initial cast on which the provisional restoration and the impression coping were fabricated.

8a

Fig 8b Labial view of the definitive cast reveals favorable soft tissue changes, particularly on the distal aspect.

8b

Customized Impression Coping

Conventional impression copings cannot support the marginal soft tissue sculpted by the provisional restoration. Therefore, a customized impression coping was fabricated.[9] The submarginal contour remained untouched and allowed the use of the original cast on which the provisional restoration was fabricated. A standard impression coping was attached to the analog, and the space between the impression coping and the carved submarginal emergence profile was filled with light-curing composite resin as outlined by the silicone matrix (Fig 6). Support of the interproximal papillae at the same height as the provisional restoration is fundamental to prevent collapse of the soft tissues over the implant (Figs 7a and 7b).

The provisional restoration was removed, and the customized impression coping was placed. Periapical radiographs were taken to verify fit and implant-bone relationship. An open-tray impression technique was applied with a polyvinyl siloxane (PVS) impression material. After setting, the impression coping was unscrewed through the access hole in the impression tray, and the impression was removed with the coping. An implant analog was attached and the definitive cast was poured, creating an exact soft tissue replica of the intraoral situa-

Transfer of Original Emergence Profile to Final Restoration *(continued)*

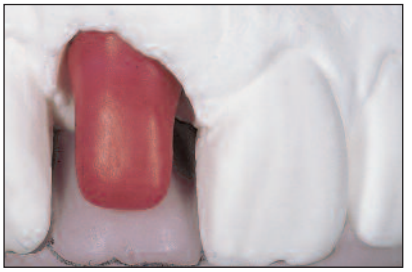

Fig 9 A silicone matrix of the full-contour waxup is used as a reference during waxing of the coping and ensures desired dimensions and adequate porcelain support.

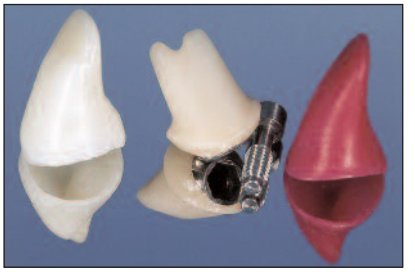

Fig 10 A CAD/CAM densely sintered aluminum oxide ceramic coping (Procera AllCeram, Nobel Biocare) was fabricated with a double-scanning technique of the ceramic abutment and the waxed-up coping.

Fig 11 The all-ceramic crown during layering of the veneering feldspathic ceramic.

Fig 12 Crown contour, line angles, and surface texture are marked on the adjacent tooth and on the crown for final adjustments.

tion. Figures 8a and 8b illustrate the changes in tissue topography after 3 months of healing.

Definitive Restoration

The shallow labial soft tissue necessitated a tooth-colored abutment to avoid discoloration of the tissue at the implant-restoration interface. A standard UCLA-type abutment (Nobel Biocare, Göteborg, Sweden) was veneered with feldspathic ceramic, and a CAD/CAM designed, high-purity, densely sintered aluminum oxide ceramic crown (Procera AllCeram, Nobel Biocare) was fabricated on top of the abutment.

A double-scanning technique was used for fabrication of the high-strength ceramic coping: the abutment was scanned first, followed by scanning of the waxed-up coping (Figs 9 and 10). Crown margins were defined 1 mm subgingivally on the labial aspect of the abutment and 1 mm supragingivally on the palatal aspect. The alumina ceramic coping was veneered with feldspathic ceramic (Fig 11), and natural surface texture of the restoration was achieved with round-, tapered-, and flame-shaped diamond burs (Fig 12). A thin coat of glaze was applied, and a final polish was performed with a diamond paste.

Figure 13 shows the definitive abutment and crown. After try-in, the abutment was secured at 35 N/cm with an electric torque driver (Nobel Biocare). The ceramic crown was luted with a self-cur-

Fig 13 Final all-ceramic crown and definitive abutment resemble the emergence profile established with the provisional restoration.

Fig 14 Postoperative situation 1 week following insertion of the implant-supported all-ceramic crown for the maxillary right central incisor.

ing composite resin cement (Panavia 21, Kuraray, Osaka, Japan).[17] The esthetic situation and favorable soft tissue response was verified 1 week postoperatively (Fig 14).

TRANSFER OF A MODIFIED EMERGENCE PROFILE TO THE DEFINITIVE RESTORATION

Alterations of the provisional restoration may become necessary for support that will gradually increase and to form a natural soft tissue contour. A technique to transfer a modified emergence profile is demonstrated in the clinical example of a 47-year-old male patient who presented with a removable partial denture to replace a missing maxillary left central incisor (Fig 15). The amount of vertical and horizontal bone loss at the edentulous site was obvious in the occlusal view (Fig 16).

The definitive treatment plan included an implant-supported restoration with simultaneous soft tissue augmentation. A palatal incision was made, the implant was placed (4.3 13-mm Replace HA, Nobel Biocare), and a 3-mm healing abutment was connected to gain coronal tissue height and to prevent collapse of the ridge. A connective tissue graft was placed to increase labial tissue volume and was sutured over the healing abutment (Fig 17). The existing removable partial denture was modified to avoid contact with the augmented site.

Stage-two surgery was performed after a 6-month healing period, and a 5-mm healing abutment was placed (Fig 18). One week later, a preliminary impression was taken, and a full-contour waxup was made. A line was carved into the stone at the cervical third of the waxup creating an angle from the implant head to the prospective emergence profile (Fig 19), which is carved out of the solid stone cast (Fig 20). The original implant carrier was transferred into a provisional abutment with light-curing composite added to replicate the previously

Transfer of Modified Emergence Profile to Final Restoration

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Fig 15 Preoperative condition in a patient seeking implant treatment in the area of the maxillary left central incisor, which had been replaced with a removable partial denture.

Fig 16 The occlusal view demonstrates the amount of hard and soft tissue deficiencies.

Fig 17 Occlusal view 6 months after implant placement. A 3-mm healing abutment and a connective tissue graft were inserted simultaneously at the time of implant placement to increase soft tissue height and labial bulk.

Fig 18 At second-stage surgery, a 5-mm healing abutment was placed.

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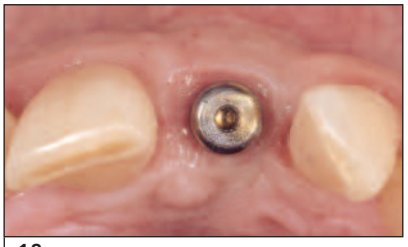

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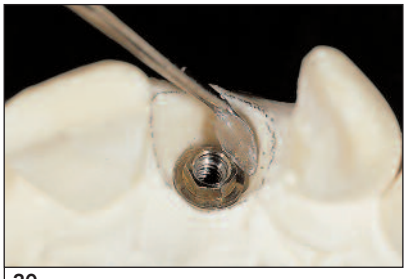

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Fig 19 A diagnostic waxup and silicone matrices were made as references for fabrication of the provisional abutment and crown.

Fig 20 The cervical third is shaped to create an emergence angle from the implant head to the gingival margin and carved in the solid stone cast.

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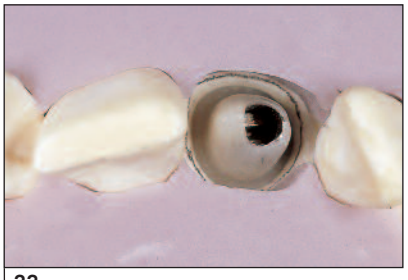

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Fig 21 A provisional abutment is fabricated with an implant carrier and composite resin.

Fig 22 The abutment is prepared with the silicone matrix as a reference. The preparation finish line is 1 mm subgingival on the labial aspect and 1 mm supragingival on the palatal aspect.

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Fig 23 Completed provisional abutment and restoration.

Fig 24 The provisional crown is cemented to the abutment with temporary cement.

Fig 25 Over a period of 3 months, acrylic resin was added to the cervical aspect of the provisional restoration to modify the emergence profile, to close open spaces, and to stimulate interproximal tissue growth.

Fig 26 Intraoral situation 3 months after placement of the provisional crown.

created emergence profile (Fig 21). The abutment was prepared (Fig 22), and the preparation verified with a silicone matrix. The implant-supported provisional restoration was completed (Fig 23) and seated on the provisional abutment with temporary cement (Temp-Bond NE, Kerr, Romulus, MI) (Fig 24).

Prosthesis-Guided Soft Tissue Management

Ten days after the provisional restoration was placed, the gingival margin receded apically, and a black space developed between the central incisors. The provisional restoration was temporarily removed to allow primary tissue reshaping and formation of the interproximal papillae. Gradual addition of acrylic resin to the cervical areas of the restoration achieved a natural soft tissue contour (Fig 25). Soft tissue stability was assessed (Fig 26) and followed for 2 months to ensure a predictable and stable esthetic outcome.

Final Impression and Definitive Restoration

Since the provisional restoration was modified chairside, the original cast did not replicate the established soft tissue situation and, therefore, could not be used for fabrication of a customized impression coping as presented in the first case. The provisional restoration had to be used to transfer the emergence profile to a custom impression coping with a chairside impression as described by Hinds.[13]

After removal of the provisional restoration and abutment, a standard healing abutment was placed to prevent soft tissue collapse over the implant head. An implant laboratory analog was then attached to the provisional abutment, and the provisional crown was placed on top of the abutment. A small plastic cup was filled with polyether impression material (Impregum, 3M Espe, St Paul, MN), and the provisional restoration and analog were buried until the interproximal contact areas were submerged (Fig 27). After final setting, the impression material was slightly cut back (Fig 28), and the crown and the abutment were reposi-

Transfer of Modified Emergence Profile to Final Restoration *(continued)*

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Fig 27 The provisional abutment and crown are connected to an implant analog and embedded in impression material to duplicate the cervical aspect of the restoration.

Fig 28 Close-up view of the trimmed mold.

Fig 29 A standard impression coping is screwed to the implant analog fixed in the impression material. Flowable composite resin is injected into the space between the coping and the impression material.

Fig 30 After light curing, the customized impression coping is removed and can be used to accurately transfer the emergence profile topography of the provisional crown.

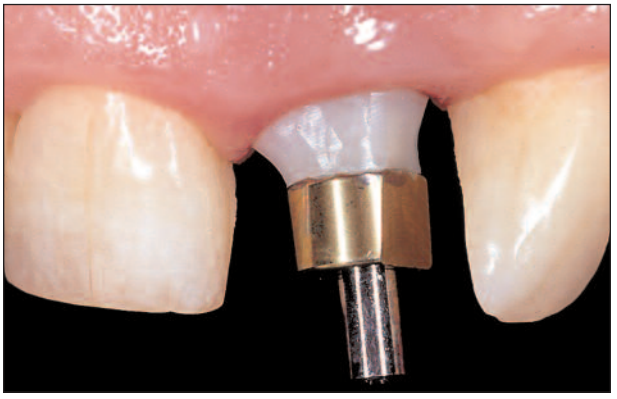

Fig 31a Labial view of the customized impression coping in place.

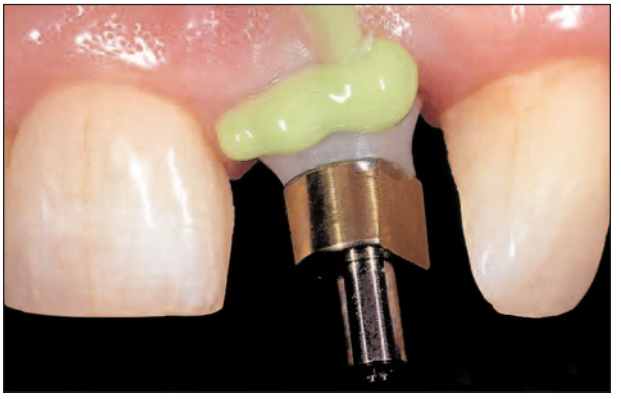

Fig 31b Final impression with a customized implant analog. Low-viscosity impression material is applied around the coping for maximum detail.

tioned in the patient's mouth. In the laboratory, the corresponding impression coping was screwed to the implant analog embedded in the polyether cervical contour mold. A flowable composite was injected around the coping to obtain an exact replica of the cervical contour of the provisional restoration (Fig 29), then light cured and removed from the mold (Fig 30). The final impression was taken after the tissues recovered (about 15 days later) using the custom-made impression coping and a PVS impression material (Figs 31a and 31b). Accurate fit and positioning of the coping were verified with a periapical radiograph.

Figure 32 shows the peri-implant tissue morphology transferred to the definitive cast. A UCLA-type abutment (Nobel Biocare) was fabricated with the lost-wax technique and cast with high-noble alloy. After finishing and polishing of the metal and subsequent application of porcelain opaques, the porcelain shoulder was placed be-

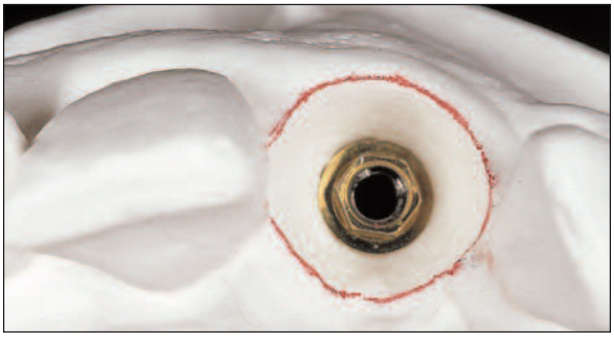

Fig 32 Peri-implant soft tissue morphology transferred to the definitive stone cast.

Fig 33 Feldspathic veneering ceramic is fired to a customized abutment to prevent tissue discoloration.

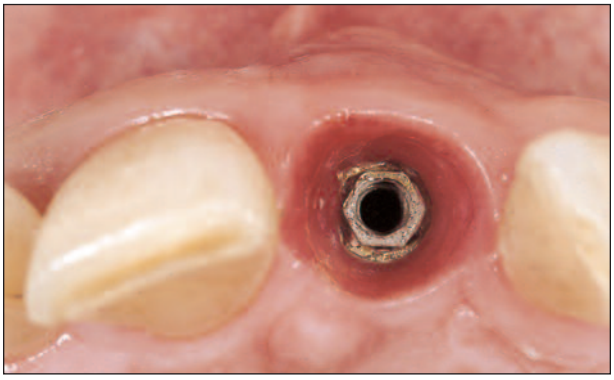

Fig 34a Occlusal view of the peri-implant soft tissue.

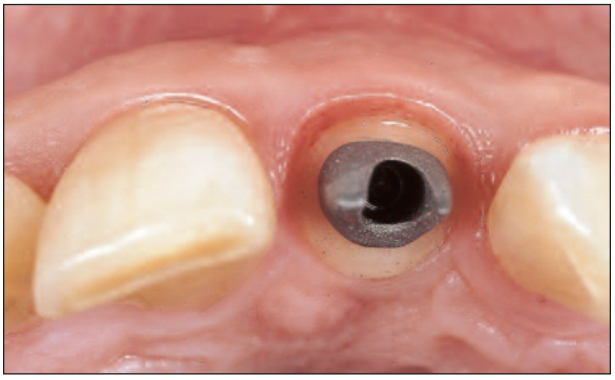

Fig 34b Occlusal view of the peri-implant soft tissue after insertion of the definitive implant abutment.

Fig 35 Completed all-ceramic crown on the definitive cast.

Fig 36 Postoperative labial view of the implant-supported all-ceramic crown for the maxillary left central incisor.

Fig 37 Preoperative labial view of a failing PFM restoration on the maxillary right central incisor.

Fig 38 Extracted tooth reveals severe carious lesion and fractured endodontic post.

tween the abutment and the transferred cervical contour to prevent discolorations by the underlying metal (Fig 33). The provisional restoration was removed (Fig 34), and the customized definitive abutment was placed (Figs 34a and 34b). An all-ceramic crown (Procera AllCeram) was fabricated with the exact emergence profile established during the provisional phase (Fig 35). The postoperative situation is demonstrated in Fig 36.

IMMEDIATE IMPLANT PLACEMENT AND TRANSFER OF THE NATURAL EMERGENCE PROFILE TO THE FINAL RESTORATION

A maxillary right central incisor had been restored with a severely compromised porcelain-fused-to-metal (PFM) crown in a 46-year-old female patient with a high smile line (Fig 37). Clinical and radiologic examination suggested extraction of the tooth because of recurrent caries and extensive hard tissue loss beyond the crestal bone. The patient opted for an implant-supported restoration to avoid preparation of the adjacent teeth. Since the clinical and radiographic evaluations did not reveal any acute infection, immediate implant placement and simultaneous provisionalization were selected as part of the final treatment plan. Preoperative examination included measurement of the distance between the interproximal contact point and the crestal bone as well as the distance between the free gingival margin and the crestal bone on the labial, palatal, mesial, and distal aspects of the right central incisor.

An initial diagnostic impression was obtained to fabricate a provisional crown to be relined chairside on a provisional abutment. The right central incisor was extracted with a periotome in an atraumatic manner, and the integrity of the labial and lingual bone plates was assessed (Fig 38). Based on the diameter and size of the extraction socket, a 5 x 13-mm tapered implant (Replace, Nobel Biocare) was inserted without damaging the buccal plate (Fig 39). The implant head was placed 3 mm below the gingival margin, angulated to the incisal edge, and situated 4 to 5 mm beyond the apex. A provisional straight abutment was prepared chairside according to position and dimensions of the prospective restoration. The previously fabricated provisional crown was relined on the provisional abutment for optimal fit.

After finishing and polishing, the abutment was inserted, and the provisional crown was cemented with temporary cement (Fig 40). The restoration was adjusted occlusally to prevent contact in centric and eccentric occlusion. The patient was instructed to maintain adequate oral hygiene and was evaluated once a week during the first month and then once a month for 6 months.

Six months after implant placement, the clinical situation was examined (Fig 41), and periapical radiographs were taken to verify implant-bone integration. A final impression was made with the provisional restoration as a custom impression coping. A

Immediate Implant Placemant and Transfer of Natural Emergence

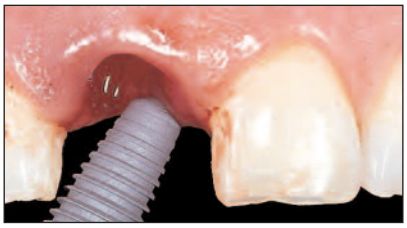

Fig 39 A tapered implant was immediately placed into the extraction socket without elevation of a flap.

Fig 40 The provisional restoration was inserted immediately after implant placement to maintain soft tissue support. Care was taken to eliminate any occlusal contacts.

Fig 41 Labial view of the clinical situation 6 months after insertion of the implant and the provisional crown.

Fig 42 A pickup impression is used to accurately record the current condition and to transfer the emergence profile established at the time of implant placement.

Fig 43 The provisional restoration was carefully removed from the provisional abutment.

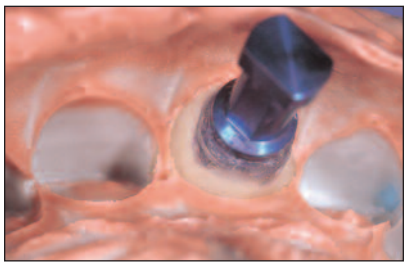

Fig 44 An implant analog was connected to the abutment and the provisional crown and inserted into the pickup impression.

Fig 45 Occlusal view of the definitive cast and the transferred soft tissue contour.

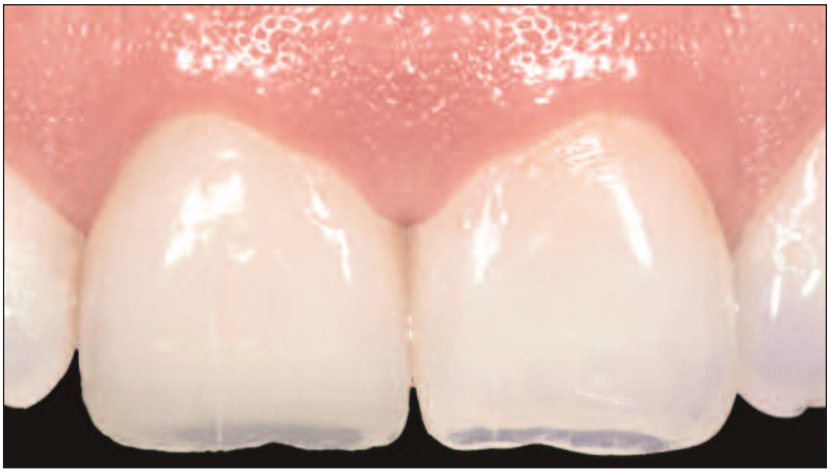

Fig 46 Postoperative labial view of the all-ceramic, implant-supported crown for the maxillary right central incisor.

single-impression double-mix technique was applied with a low-viscosity PVS material injected around the provisional restoration and adjacent teeth (Fig 42) and the heavy-body material in the impression tray. After setting, the provisional restoration was removed (Fig 43), and the provisional abutment was unscrewed. The crown was placed on the abutment and connected to an implant analog and then inserted into the final impression (Fig 44). A thin layer of wax was placed around the cervical aspect of the crown to avoid damage of the restoration with the die stone. The definitive

cast was poured, and the provisional restoration was placed in the patient's mouth immediately after setting of the stone. Figure 45 demonstrates the shape of the emergence profile on the cast. A definitive abutment was fabricated using ceramic for the gingival third, and a Procera AllCeram crown was fabricated and adhesively luted to the abutment. The postoperative situation (Fig 46) reveals optimal soft tissue integration and morphology, emphasizing the importance of adequate tissue support in all stages of implant treatment.

DISCUSSION

A natural, harmonious gingival morphology is an integral part of esthetic tooth- and implant-supported prosthetic restorations. The surrounding soft tissues ("pink esthetics") are the natural frame of any restoration and are, therefore, just as important for the final esthetic and functional outcome as the restoration itself ("white esthetics").[4] A natural soft tissue contour can be extremely challenging to achieve in implant prosthodontics, where soft and hard tissue defects are often present. Even when an optimal tissue contour is established with an adequately shaped provisional restoration, accurate transfer of this shape to the final restoration may be difficult, especially with standard implant impression copings. The cylindrical geometry of standard impression copings fails to transfer accurately the three-dimensional shape of the natural emergence profile of incisor teeth.[9,11,13,16] Multiple techniques have been described to overcome these problems with customized impression copings.[7–16]

This article has described techniques for accurate transfer of optimal emergence profiles for anterior single-tooth implant restorations in three common clinical scenarios. In general, customized impression copings can be categorized into two main groups: *(1)* the provisional restoration is modified clinically to guide tissue and papilla formation and *(2)* the provisional restoration provides an optimal tissue contour without subsequent modification. If the soft tissue reveals a satisfactory morphology without modifications, the same cast used for fabrication of the provisional restoration may be used to customize the impression coping for the final impression, eliminating the need for multiple steps and appointments.

Transfer of an emergence profile established through chairside modifications of the provisional restoration may require extra steps. The restoration is embedded in impression material to record its cervical shape. It is key to support the papillae at least 1 or 0.5 mm coronal to their peaks. An open-tray technique is recommended and may require a custom tray depending on the position and angulation of the implant.

The pickup impression technique described in the third case offers various advantages: it is simple, easy to perform, and less time consuming (only one appointment needed). It may also be the most accurate method, with maximum information but without the need for additional components, a full-contour waxup, or open-tray impression techniques.

Selection of a technique for transferring a natural emergence profile is based on personal experience, abilities, preferences, and the clinical situation rather than on scientific evidence. Therefore, randomized clinical trials are needed to assess predictability and stability of the esthetic and functional results and to provide scientific rationale for technique selection.

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