

Development of Gingival Esthetics in the Terminal Dentition Patient Prior to Dental Implant Placement Using a Full-arch Transitional Fixed Prosthesis: A Case Report

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Despite significant advances in dental therapeutics, there are patients for whom no reasonable treatment is available that will reliably restore or maintain their existing dentition. The causes of future edentulism include advanced caries, failing root canal therapy, inadequate numbers of teeth to support a fixed prosthesis, untreatable periodontal disease, or a history of failed previous rehabilitations. For these patients, dental implants may provide a more predictable future than retention of their remaining teeth. It is proposed that transitional fixed prostheses designed specifically for a patient with terminal dentition offer the advantage of maintenance and development of proper gingival esthetics with improved function. Prior to implant placement, the gingival frame is established, enhancing the overall appearance of the final, full-arch implant rehabilitation. The specific prosthodontic and surgical techniques required for successful treatment of these patients are presented. (INT J ORAL MAXILLOFAC IMPLANTS 2001;16:583-589)

Key words: dental implantation, dental implants, gingival morphology, implant-supported dental prosthesis, ovate pontic, transitional prostheses

Although there have been significant advances in periodontics and prosthodontics, some patients present with dentitions that cannot be successfully rehabilitated. The causes of future edentulism include advanced caries, failing root canal therapy, inadequate numbers of teeth to support a fixed prosthesis, untreatable periodontal disease, or a history of numerous failed rehabilitations.

Previously, conventional removable dentures were the only available treatment. With osseointegrated dental implants, an alternative exists for pre-

dictable restoration with a fixed prosthesis. The state of the art of implant dentistry and expectations of patients for implant restorations to duplicate the appearance of their natural dentition continue to challenge the implant treatment team. Successful implant therapy can no longer be judged by whether or not the implant simply osseointegrates. Precise duplication of the color, contour, and vitality of natural dentition alone may not be adequate if an optimal gingival profile and underlying supporting osseous structures are absent.

The surgical and prosthodontic techniques required to develop enhanced gingival esthetics in the edentulous patient have been previously reported.¹ However, a patient with terminal dentition offers a unique opportunity to maintain or further improve gingival profiles prior to implant placement. An integral part of proposed treatment includes the concept of immediately loaded implants, which appears to be successful as reported by several clinicians.¹⁻⁷

Following tooth extraction, there is usually loss of bone horizontally and vertically. Without support from adjacent teeth, the interproximal osseous crest

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Figs 1a and 1b The remaining maxillary dentition could not be treated with conventional osseous resection therapy. The long-term treatment option included a fixed prosthesis supported solely by dental implants. The panoramic radiograph shows bone loss and anatomic restriction related to the inferior location of the antrum for placement of implants distal to the first premolar positions.

will flatten to mimic the facial aspect of the residual ridge. Retention of sufficient teeth to support a transitional fixed prosthesis with ovate pontics can be used to maintain facial prominence and interdental papillae surrounding the extracted teeth. Once the gingival frame has been successfully established, a surgical technique to place the implants can be implemented that conserves tissue and minimizes disruption of blood supply. Next, the remaining abutment teeth can be removed and the provisional prosthesis converted to one that is solely implant-supported.

The use of ovate pontics to support facial and interproximal tissues, thus resulting in a more natural appearance, is not a new concept. Many clinicians⁸⁻¹³ have reported on this prosthetic technique to enhance desired gingival contours of the edentulous ridge. Spear¹² described the concept and protocol for maintaining papillary height and form following anterior tooth removal. The consensus of these reports validates the opinion that optimal esthetics using ovate pontics can be achieved without a deleterious effect upon the surrounding hard and soft tissues.

The terminal dentition patient requires interdisciplinary collaboration in examinations, evaluation, and treatment planning. In addition to the normal information gathering, diagnostic casts mounted with facebow, interocclusal records, and analysis of digital photographs of the teeth relative to certain esthetic parameters are also included.

MATERIALS AND METHODS

The patient chosen to demonstrate this technique was a 42-year-old female in good general health with advanced periodontal disease of the maxillary arch

(Figs 1a and 1b). The remaining maxillary dentition was determined by the patient's periodontist to be either hopeless or severely compromised if conventional osseous resection therapy were instituted. Therefore, the most predictable treatment option for achieving the patient's goals was maxillary dental implants placed to support a fixed prosthesis.

The presence of the natural dentition provides the implant team the opportunity to maintain or enhance the gingival facial and interproximal contours prior to implant placement. A provisional prosthesis with ovate pontics can be placed immediately after tooth extraction, thereby supporting the soft tissue surrounding the extraction socket.¹⁴ Initial treatment planning required determination of the extraction sites that were most favorable for dental implants. Relevant considerations included optimal biomechanical stability of the prosthesis, bone quantity, and anatomic restrictions. Finally, the minimal number of abutment teeth required to support an interim acrylic resin fixed provisional prosthesis during the typical 4 months of healing following tooth removal was chosen.

In this patient, anatomic restrictions of the antrum bilaterally precluded implants being placed distal to the first premolar positions without bone augmentation of the sinus. The prospective implant sites were the first premolar, canines, and central incisors. Although the remaining dentition was severely compromised, the lateral incisors and second molar teeth were judged to be adequate to support a provisional prosthesis during the postextraction healing phase.

Fabrication of the transitional fixed prosthesis began with removal of the teeth scheduled for initial extraction from the diagnostic casts and formation of pontics that extended at least 3 mm into the future extraction sockets. The interim abutment teeth were



Figs 2a to 2c A transitional fixed prosthesis was prepared by removing the teeth scheduled for initial extraction from the cast and forming ovate pontics that extended at least 3 mm into the created sockets. An acrylic resin provisional restoration was first duplicated from the diagnostic wax-up and veneered with resin composite. Note that the subgingival portion of the pontic must be sufficiently broad to support the facial and interproximal tissues.



Figs 3a and 3b The interim abutments were prepared prior to tooth removal. The provisional fixed prosthesis was relined with acrylic resin and cemented with a temporary luting agent. Note the blanching of the facial and interproximal tissues that initially results from the ovate pontic form and narrow gingival embrasures.



Figs 4a to 4c Following 4 months of healing, the implants were placed. The remaining natural tooth abutments provided stable support for the surgical guide. The guide was fabricated from duplication of the provisional prosthesis in clear acrylic resin.

prepared on the cast, and an acrylic resin, monochromatic provisional restoration was duplicated from the diagnostic wax-up, reduced on the facial and incisal, treated with Rocotec (ESPE America, Norristown, PA) to improve bonding,¹⁵⁻¹⁷ and then veneered with Sinfony composite resin (ESPE America). The resin composite veneer gives the prosthodontist and dental technician precise control of the color, translucency, and surface characterization. It is important that the subgingival portion of the pontic be sufficiently broad to support the facial and interproximal tissues (Figs 2a to 2c).

The interim abutments were prepared in the mouth prior to tooth removal. Atraumatic extrac-

tion of the remaining dentition assures the greatest opportunity for osseous fill. At least 1 mm of the apical extent of the extraction socket was removed with a #8 surgical round bur to remove the potential risk of remaining anaerobic bacteria and facilitate healing. The provisional fixed prosthesis was relined with acrylic resin and cemented with a temporary luting agent (Figs 3a and 3b).

Following 4 months of healing, the implants were placed. The use of ovate pontics can result in advantageous facial and interproximal gingival contours (Figs 4a to 4c). Precise location of the implant within the confines of the crown abutment is crucial. Therefore, a surgical guide should be used to



Fig 5 A 5-mm tissue punch, which corresponded to the coronal diameter of the ITI implant, was used to outline the margins of each implant. The restorative platform transported gingival tissue facially as the implant was seated.

facilitate correct placement. The guide was fabricated by duplication of the existing provisional prosthesis in clear acrylic resin. The procedure involves a cast of the interim prosthesis in situ and a cast of the prepared tooth abutments without the prosthesis. A polyvinylsiloxane impression was made of the provisional restoration cast. The natural tooth abutments were blocked out with baseplate wax, and the cast was coated with a separating medium. Clear acrylic resin was poured into the impression, placed on the cast of the abutment teeth, and cured at 30 psi for 20 minutes. Parallel holes of 2.5 mm in diameter were placed into the guide at the center of the prospective implant sites. Engaging the abutment teeth ensures stability of the surgical guide.

Surgical Procedure

Once the gingival contours were established, a flapless surgical technique was employed to place the implants, since an open-flap technique is likely to cause disruption in the periosteum and its blood supply to the underlying bone and may result in a loss of optimal gingival form. A 5-mm tissue punch (Punch Implant Uncovering, Ace Surgical Supply, Brockton, MA), which corresponded to the coronal diameter of the ITI implant (Institut Straumann AG, Waldenburg, Switzerland), was used to outline the margins of each implant. Each tissue incision was placed slightly palatally to the final position of the implant. The restorative platform transports gingival tissue facially as the implant is seated (Fig 5). The overlying gingival tissue and periosteum were completely removed and the bone flattened. The surgical guide was employed for precise placement of the pilot holes. Correct placement of the implant microgap in both the vertical and horizontal dimensions is crucial to the maintenance of crestal bone (Figs 6a to 6c).

Determination of the appropriate implant length was made by placing the depth gauge into the osteotomy site and measuring the distance from the gingival margin at the facial aspect to the apex. A periodontal probe was used to calculate the gingival height overlying the alveolar crest. Subtraction of these numbers provided the length of implant that would place the microgap at least 2 mm coronal to the bone.

Once the implants had been placed, solid 4.0-mm abutments were connected to the implants and tightened. Angulation concerns that would interfere with placement of the provisional prosthesis were corrected by modification of the solid abutments intraorally with an appropriate bur under copious water spray, as previously described.¹

The provisional prosthesis was modified to incorporate the implant abutments into the former pontics, and the remaining teeth were extracted and converted into ovate pontics. Correction of the emergence profiles of the abutments is typically needed to optimize the transition from the implant restorative platform and the acrylic resin margins. It is important that the converted implant abutment crowns continue the contours of the pontics to maintain soft tissue support.

Special attention was given to the development of a definite cemento-enamel junction analogous to natural dentition. Narrow interproximal embrasures will maintain and enhance the facial and proximal gingival profiles. The provisional restoration was cemented onto the solid abutments with IRM (Dentsply International, Milford, DE) and the excess cement thoroughly removed.

Following osseointegration of the implants, the provisional restoration was removed and the solid abutments were tightened to the recommended torque of 35 N/cm². The absence of implant movement and sensation by the patient was a general indication of successful osseointegration.

Final preparation of the solid abutments—and if necessary the coronal portion of the implant—to achieve esthetic intrasulcular crown margin placement was completed with carbide finishing burs (#H375R-023, #7408-023, #ETUF 6.014, Brasseler USA, Savannah, GA). Impressions for casts, face-bow transfer, and centric relation records were made. A cast of the provisional prosthesis in place served as a template for the framework design and porcelain application. The appearance of the soft tissue profile, following seating of the final porcelain-fused-to-metal fixed prosthesis, mirrors the facial and interproximal contours typically found surrounding healthy, natural dentition (Figs 7a to 7e).



Figs 6a to 6c Subtraction of the gingival height above the osseous crest from the number displayed on the depth gauge will yield the length of the implant that will place the microgap at least 2 mm coronal to the bone. The optimal distance between adjacent implant restorative platforms is 3 mm.



Figs 7a to 7e Final preparation of the solid abutments and, if necessary, the coronal portion of the implant, to achieve esthetic, intrasulcular crown margin placement was completed with carbide finishing burs. The gingival contours simulate both facially and interproximally those found in the natural dentition state.



The conventional techniques for metal try-in and intraoral indexing with verification of soldered framework accuracy were completed. It is imperative that a soft tissue cast be fabricated to transfer the contour of the soft tissues for proper porcelain application. Special attention was directed toward the contours of the cemento-enamel junction and gingival embrasures of the definitive prosthesis (Figs 8a and 8b). The gingival embrasure dimensions must be biologically acceptable; however, the volume and distance from the contact point to the interseptal bone must also facilitate the maintenance of interdental papillae.

It is important to note that a distinct interdental papilla can be formed predictably between ovate pontics, even though the distance from the interproximal contact point is greater than 5 mm. The ovate pontic technique facilitates soft tissue contouring, despite the lack of optimal underlying

osseous support (Figs 9a and 9b). If an open-flap technique were employed instead of the tissue-punch technique described above, loss of the interdental papillae might be expected because of the disruption of blood supply following approximation of the surgical wound. Another advantage is significant reduction of treatment time related to reflection and closure of the tissue flap.

DISCUSSION

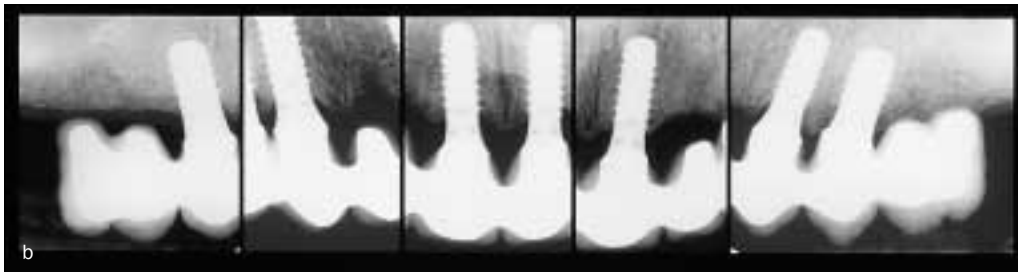
The concept of preventing the formation of an alveolar ridge defect is not new. Siebert¹³ recommended that teeth that are failing because of advanced periodontal disease, endodontic problems, or fractured roots should be extracted as soon as a definitive diagnosis and treatment plan has been decided. Phillips and Kois¹⁸ recognized that a successful



Figs 8a and 8b The definitive fixed prosthesis. The implant restorative platform has been placed accurately within the confines of the abutment crown contours, which allows the laboratory technician to provide proper facial and interproximal gingival support.



Figs 9a and 9b Seating of the definitive maxillary fixed prosthesis. The gingival contours facially and interproximally simulate those surrounding natural dentition. The radiographs show the relationship of the implant restorative platform to the osseous crest and to adjacent implant microgaps. Note the distance of the crestal bone apical to the contact point between the central incisors. Development of the papillae with ovate pontics prior to implant placement with minimally invasive surgical techniques brought about this result successfully.



prosthetic result requires a soft tissue profile in harmony with a normal dentition. Also emphasized in their article was the need for a team approach with the surgeon, restoring dentist, and dental technician to ensure proper implant positioning within an ideal hard and soft tissue topography. The authors further noted that following tooth loss, facial tissue recedes apically, with flattening of the interdental papillae, without proper support from a provisional prosthesis.

Clinicians have demonstrated success with placement of dental implants immediately following tooth removal. In this patient, the advanced osseous vertical defects caused by the periodontal disease, possible localized sepsis, and the difficulty in achieving optimal primary stability of the implant in

the absence of circumferential supporting bone precluded this approach.

The research of Cochran, Hermann, and others¹⁹⁻²¹ demonstrated the soft tissue attachments found surrounding natural dentition and that bone loss occurs as a result of creating a microgap between implants and their restorative components, consistent with the creation of a biologic width. Also, the optimal distance between adjacent implant restorative platforms is 3 mm. This reduces the bone-resorptive influence of the implant microgap, as recently reported by Tarnow and associates.²²

The protocol for evaluation and prediction of the final gingival contours surrounding single or short-span implant-supported fixed prostheses has been expounded.^{11,12,14,18,22-32} However, a challenge

remains to replace missing gingival contours when several adjacent teeth—or all teeth—have been lost. It would appear that the seemingly predictable success of immediately loaded implants via a provisional fixed prosthesis offers several advantages for the edentulous patient, including increased masticatory function, minimized effects of uncontrolled transmucosal loading through cross-arch stabilization, improvement of psychologic well-being, overall reduction in treatment time, and the opportunity to develop root prominences and esthetic gingival contours, including formation of interdental papillae.

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