Over the last several decades, dentistry has focused on more conservative treatment modalities and preventive techniques. This has been possible not only because of improved techniques and materials, but also because of the understanding that tooth preparation, regardless of how conservative it may be, is an irreversible procedure.

A missing tooth in the anterior region is not only a physical loss, but also may be an emotional experience for the patient as well. To remove healthy tooth structure of adjacent teeth to replace a congenitally missing tooth or a tooth lost to decay, trauma, root fracture, failed root canal treatment, or pathology is, for some patients and dentists, a very aggressive treatment option. Infection in any of these situations creates an environment in the hard and soft tissues that makes regeneration procedures more difficult, thereby complicating the ability to create a natural appearance in the definitive restoration.

While a conventional three-unit fixed partial denture is a predictable technique to replace a missing tooth, the invasive nature of the treatment can lead to other complications throughout the life of the restoration. Complications may include mechanical overload of the abutment teeth with weakening or fracture, risk of endodontic treatment, periodontal problems, decay, and cement failure. If any of these complications occurs on one of the abutment teeth, the entire prosthesis will fail. Splinting teeth can overload the supporting structures because teeth function individually, and oral hygiene techniques become more cumbersome.
HISTORY OF SINGLE-TOOTH RESTORATIONS

For more than 50 years, dentistry has sought a more conservative approach to replacing a single missing tooth with a conventional fixed prosthesis, which involves the cutting of sound tooth structure. Treatment possibilities have evolved from bonding a natural extracted tooth or composite resin restoration to the adjacent teeth, to the Rochette bridge, to the Maryland bridge, and currently to the single-implant–supported crown. It is debatable which technique is the most conservative, and in many instances the patient’s preference dictates the restoration of choice. The clinician must also evaluate the advantages and disadvantages of such techniques in order to provide the patient with the best clinical result since not all patients should be treated with the same restoration type or design.

While the Rochette bridge replaced the missing tooth without any tooth preparation, it was, at best, considered a temporary solution, and its framework was designed with a gold substructure and hence resulted in a thick metal framework. Such restorations were designed with macromechanical retentions (Figs 1a to 1c) to lock the composite into the gold and through the bonded lingual surface. This technique met the patient’s conservative requirements of replacing the missing tooth, even though it required the patient’s compliance not to overload the prosthesis during masticatory function and necessitated a modified flossing technique because of the splinted prosthesis (Fig 1d).

Proven over the years through the achievement of acceptable clinical results, such resin-bonded prostheses continued to improve, and their evolution led to the development of the Maryland bridge. For this technique, the tooth required a conservative preparation in the enamel only with a gingival rest to create a definite seat. The preparation design included an interproximal wraparound to help prevent lingual displacement and to increase stability on a bondable surface area (enamel) with a solid, nonperforated, metal substructure that could be as thin as 0.2 mm. Use of a non-noble metal alloy significantly increases the mechanical retention of the etched framework and more easily prevents degradation of the luting resin in the oral cavity. Care must be exercised so the framework does not involve the incisal third of the abutment teeth, since this could block translucency and result in a graying effect (Figs 2a to 2h).

While use of a resin-bonded retainer involves a very conservative technique and preparation of the enamel is minimal, the mechanical retentive properties of the prosthesis, by design, have a wraparound effect of 180 degrees. Still, care must be exercised to prevent occlusal overload during function.

Presently, the single-implant–supported crown is a predictable method of tooth replacement, and it has several improvements over resin-bonded prostheses: preparation of adjacent teeth is not needed; the tooth replacement will function individually; a conventional oral hygiene technique can be used; preservation and stimulation of existing bone and soft tissues occur, including recreation of the interproximal papillae; and stability and function are improved because of the implant supporting the crown.

While osseointegration around implants is a well-documented phenomenon, the implant designs will continue to undergo structural modifications to fulfill the prosthetic requirements one faces as the practice of dentistry evolves. Such changes include the transitions from the standard-diameter implant to wider-diameter implants; from the external-hexagon, antirotational device to the internal morse taper connections; and from the two-stage surgical approach to the now more frequently used one-stage techniques that include immediate loading. These are just a few of the factors that complicate the analysis of implant designs with respect to failure or success. The area often considered the most critical is the implant-abutment interface, and because of evolving designs, this is where dentistry may see some significant changes to obtain the best possible fit and improved tissue response.
Rochette Bridge

Fig 1a Lingual view of the waxup for the Rochette bridge.

Fig 1b Cast framework on the stone model.

Fig 1c Framework showing mechanical undercuts to lock the bonded prosthesis.

Fig 1d Buccal view of the bonded Rochette bridge. (Prosthetics and laboratory work by Alexander H. Chan, DDS.)

Maryland Bridge

Figs 2a and 2b The maxillary right central incisor and supporting bone have been lost as a result of trauma. The rotation of the left central incisor and the vertical bone loss required a multidisciplinary treatment approach.

Fig 2c A connective tissue graft was placed to correct the soft tissue defect, and orthodontics corrected the rotation of the left central incisor. (Orthodontics by Sergio Rubinstein, DDS; surgery by Sergio Rubinstein and Patrick J. Pierre, DDS; 1981.)

Fig 2d Lingual view of the Maryland bridge. The incisal extension required slight trimming to avoid blocking translucency.

Figs 2e and 2f Views of the Maryland bridge replacing the maxillary right central incisor.

Figs 2g and 2h Views of the patient’s smile.
IMPLANT PROSTHODONTICS

Since the endosseous implant was introduced in the United States, the prosthetic indications have grown from the mandibular, fixed, bone-anchored prosthesis to the single-tooth replacement.9–16 While many clinicians still resist the application of endosseous implants, preferring the more traditional restorations, one could argue the relative morbidity of preparing the adjacent teeth for fixed partial dentures compared with the two-stage, one-stage, or immediate-loading implant surgical and prosthetic protocol. Clearly not only can implant prosthodontics offer excellent cosmetic outcomes, but it also allows for bone preservation and stimulation, and the restoration most closely resembles an actual tooth during function.

DIAGNOSIS

When a patient needs replacement of a missing tooth (Figs 3a to 3c), the clinician must perform a series of clinical and radiographic evaluations (Fig 3d) to visualize and offer the available treatment options. The patient must be made aware of these options, which generally include some form of removable partial denture, resin-bonded retainers, fixed partial prosthesis, or an implant-supported restoration. If a single-tooth implant restoration is considered, the clinician must first determine whether an adequate recipient bed, or site, for the implant exists. Once this has been determined clinically and radiographically, the function, esthetics, and contours of the final prosthesis, as well as peri-implant health, should be considered. Treatment should proceed only if all prerequisites are fulfilled. It is important that the site to be treated be evaluated along with the complete dentition to formulate a comprehensive treatment plan.

CLINICAL EXAMINATION

Definitive tooth replacement must follow active disease control and some type of provisionalization of the missing tooth (Fig 3e). Several clinical concerns need to be addressed: measurement of proximal space and adjacent teeth, the occlusal relationships, anterior and canine guidance, and esthetic demands. The esthetic demands include the lip profile, alveolar height and buccolingual dimensions, and the quality of the overlying gingiva.9

There must also be enough mesiodistal clearance for the implant in order to avoid risk to adjacent structures such as the nasopalatine or mandibular nerve, nasal cavity, neighboring teeth, or the maxillary sinus. In most cases, the implant and prosthetic components will require a minimum of 6 to 8 mm of mesiodistal clearance depending on the location in the dental arch.15–18 A congenitally missing tooth will most likely have a normal osseous ridge, both in height and width, whereas alveolar atrophy always follows the extraction of teeth. Its severity depends on several factors, including (1) quantity and quality of bone, (2) existing or previous pathology, (3) length of time following tooth loss, and (4) trauma incurred during the extraction and the loading of the tissues. The collapse of the facial plate and alveolar height subsequent to tooth loss19 can impact the position and angulation of an implant. The ideal implant placement and how alternative positions affect prosthetic design and morphology has been described at length; however, this will vary from case to case and depending on the implant system selected.

Occlusal relationships will influence the design of the crown. A minimum of 7 to 8 mm is required from the coronal aspect of the implant to the opposing occlusion.15,16 When determining the occlusal clearance for an implant, it is important to remember that implants are often intentionally placed below the crest of the ridge about 2 to 4 mm apical to the cementoenamel junction of adjacent teeth to provide a sufficient emergence profile for the crown.20 Incisal relationships that subject teeth to heavy occlusal loads must be carefully evaluated, because an esthetic result must be achieved while the teeth and implant are protected from undesirable forces.21,22 While parafunctional
A Multidisciplinary Approach to Single-Tooth Replacement

Restoration of Lateral Incisors

Figs 3a to 3c  Pretreatment views of Maryland bridges. The lateral incisor prostheses are improperly contoured because of the malpositioned maxillary central incisors and canines.

Fig 3d  Initial radiograph showing inadequate space to place implants in the position of the congenitally missing lateral incisors.

Fig 3e  Orthodontic treatment in progress with provisional prostheses bonded only to the mesial of the canines while the root position of the central incisors is being adjusted. Once the centrals are in the correct position, the provisionals are bonded to them while the position of the canines is adjusted. Treatment can then proceed to implant surgery. (Orthodontics by Howard Spector, DDS.)

Fig 3f  Incisal view of premachined, 15-degree angulated abutments. Note that the implants have been placed slightly palatal to the incisal edge so the abument screws can be placed in the cingulum area. (Surgery by Douglas V. Gorin, DDS.)

Fig 3g  Acrylic resin, implant-supported, provisional restorations 4 months after insertion. Soft tissue contouring and tooth bleaching have been accomplished at this stage.

Fig 3h  Final crowns in solid stone model with soft tissue duplication.

Fig 3i  Horizontal lingual screws allow for improved lingual contours and ease of retrievability.

Fig 3j  Final implant-supported crowns on the maxillary left and right lateral incisors. (Prosthetics by Sergio Rubinstein, DDS; laboratory work by Masayuki Hoshi, RDT.)
activities are not a contraindication for implants, they do influence treatment planning. It is paramount to have a passive fit between the implant, component(s), and crown.

Because esthetic demands have an enormous impact on the treatment planning of implant-supported prostheses, a high lip position that exposes the gingiva will affect the requirements of implant placement, soft tissue management (Figs 4a to 4d), and design of the final prosthesis. Loss of crestal bone requires a longer clinical crown usually with larger gingival embrasure spaces. A narrow implant diameter placed into a site with minimal alveolar bone loss can lead to unesthetic results with improper contours, such as a bulky implant-prosthetic connection with a cantilever effect.
SOFT TISSUE CONSIDERATIONS

It is well-documented that soft tissue architecture is influenced by the underlying bony architecture. It is further documented that tooth loss results in a loss of alveolar bone height and loss of soft tissue architecture in both the facial and apical directions. When a tooth must be extracted, changes in bone loss and soft tissue architecture can be controlled by using orthodontic supereruption prior to extraction. This technique can provide solutions to very difficult situations (Fig 5a). On average, anterior tooth loss will result in a 3-mm apical migration of the soft tissue. Supereruption of 3 mm prior to extraction will compensate for this loss. When a defect in soft tissue architecture already exists, it can be predictably corrected by adding the amount of the defect in millimeters to the “3-mm rule.” For instance, a 3-mm defect would require 6 mm of supereruption (Figs 5b to 5d). After supereruption is complete, the clinician should wait 3 months before proceeding with extraction and implant placement. This allows for complete maturation of both the bone and the soft tissue. Once the tooth is extracted and the implant is placed, an ovate pontic is used to provide scaffolding for the soft tissue during the healing process (Figs 5e to 5l). The implant is uncovered, and an immediate provisional restoration engaging the implant is placed to allow for tissue maturation (Figs 5m to 5p). The final prosthetic restoration is fabricated and delivered after the hard and soft tissues have healed (Fig 5q).
Soft Tissue Management with Supereruption (continued)

Fig 5e  Radiograph taken immediately after implant placement.

Figs 5f to 5h  Fabrication of a fixed provisional Maryland bridge.

Figs 5i and 5j  The provisional Maryland bridge is placed immediately following implant placement.

Figs 5k and 5l  Clinical and radiographic views after 4 months of healing.
**Fig 5m** Appearance of the soft tissue immediately upon removal of the fixed provisional.

**Fig 5n** Tissue appearance immediately after implant uncovering and placement of the second provisional.

**Figs 5o and 5p** Tissue appearance 4 weeks after implant uncovering.

**Fig 5q** Final restoration. (Figs 5a to 5q: Orthodontics, restorative dentistry, and laboratory work by Alan J. Nidetz, DDS; surgery by David Barack, DDS.)
Radiographic Stents

Figs 6a and 6b  Radiographic and surgical stent with barium sulfate to delineate buccal contours. Gutta-percha markers are placed on the occlusal surface to suggest the ideal implant inclination.

Radiographic Examination

Radiographs will provide information regarding the bone available for implant placement and the position of vital structures, as previously described, in order to help prevent disappointing postoperative results. Determining the need for specific radiographs depends to some degree on the patient’s clinical presentation as well as the dental team’s philosophy.

Periapical radiographs will provide a fairly accurate assessment of interdental clearance (see Fig 3d); however, maxillary anterior radiographs are subject to frequent elongation as a result of film angulation. Panoramic radiographs are also subject to significant distortion both horizontally and vertically.\(^\text{37,38}\) As much as radiographic markers, such as metal balls of known dimensions, can help to calibrate the films for improved accuracy, the lack of dimensional reliability combined with the two-dimensional quality of traditional radiographs underscores the value of digital reformatted computerized tomography. These diagnostic films provide a three-dimensional cross-sectional view through the maxilla or mandible with a 1.1:1 or 1:1 magnification ratio.\(^\text{38-40}\) Linear tomograms can be useful for isolated areas while minimizing radiation and expense to the patient.\(^\text{41,42}\) This type of tomogram will clearly demonstrate the quality of cortical and trabecular bone as well as the boundaries of the facial or linguopalatal plate, the maxillary sinus, nasal cavity, and mandibular nerve.

Radiographic stents with radiopaque markers such as gutta-percha or barium sulfate can be helpful (Figs 6a and 6b). These will produce a cross-sectional image indicating the desired inclination of the implant with its possible corresponding contours. This position can then be evaluated in terms of available bone to determine whether the desired position is surgically realistic. Clearly, the osseous architecture will not always allow for ideal implant position. The information provided by cross-sectional images will enable the clinician to anticipate any limitations and determine how to correct defects surgically or identify acceptable alternative implant positions. With careful planning, the surgeon and restorative dentist can eliminate what otherwise might be an unpleasant surprise and then communicate to the patient possible prosthetic designs as a function of the ultimate implant position.

Once all the diagnostic data have been obtained, the surgeon and restorative dentist must anticipate the design of the final restoration to achieve an optimum functional and esthetic clinical result. The final position of the implant depends not only on the hard and soft tissue topography, but also on the implant diameter, the desired emergence profile, and the contours of the neighboring teeth. The simplest restorative design to date places the abutment screw through the cingulum in anterior teeth and through the central groove in posterior teeth. To achieve this result, the surgeon must position the
implant slightly palatal to the incisal edge for anterior teeth and close to the central groove for posterior teeth. If the surgeon and restorative dentist determine that a facial angulation is required, then some form of substructure, such as a premachined angled abutment (see Fig 3f) or custom abutment, will be necessary to maintain an esthetic result.

**STENT CONSTRUCTION**

Once the initial clinical and radiographic findings have been established, a clear acrylic resin or plastic stent with radiographic markers should be fabricated. Such a stent should demonstrate the ideal prosthetic position and indicate the preferred implant placement as well as acceptable alternatives that will facilitate an optimum final prosthesis.

Clinicians may be tempted to place implants for single-tooth replacements without a stent, believing that the neighboring teeth will serve as a reference for implant inclination and position. However, once the flap has been raised, the surgeon will focus on the osseous architecture to determine optimum implant support. The stent can serve to prevent prosthetic failures resulting from overangulation, especially to the facial. Generally, the stent used for preoperative radiographs can also be used during surgery to guide implant placement and to help in uncovering the implant after the primary healing period.

Stents used for single-tooth replacement are simple in design and easy to fabricate. A stent that replicates the buccal profile with the palatal portion cut out will prevent screw access to the facial and will aid in centering the implant mesiodistally. Some clinicians prefer stents that restrict the implant placement to a specific position (using a 2- to 3-mm hole in the stent), as this will clearly indicate the desired position for the primary drill. Once the surgeon increases the bur size, this stent is no longer usable. It is possible for the surgeon to slightly redirect bur angulation (especially in softer bone), but it does not allow for alternative positions or angulations that may be clinically acceptable. Alternatively, the stent should be entirely open in its lingual aspect to facilitate the surgeon with additional options.

When stents are created, the radiographic stent can be designed first, and if necessary it can be modified to correspond to the computerized tomogram. Such computerized tomogram-assisted stents will help to place the implant not only in its planned buccolingual and mesiodistal positions, but also at the desired depth.

**PROVISIONALIZATION**

The patient will want to wear some form of provisional tooth replacement during the primary healing period, especially in an esthetic area. Primary healing can range from 2 to 8 months depending on the clinical situation. The type of provisional selected can be a removable appliance; a resin-bonded fixed provisional, if adjacent teeth allow for bonding; or a passive acrylic resin provisional using the implant, with the restoration being out of occlusion. The advantages of the resin-bonded provisional are that it is cosmetic, noninvasive, and fixed; it maintains occlusion and adjacent teeth positions; and it allows for tissue contouring and papillae preservation.

It is important that the appliance does not transmit any load to the healing implant site and thus increase the risk of failure. The provisional restoration must maintain a passive fit and provide for soft tissue support.

**SURGICAL PLACEMENT OF IMPLANTS**

While placing the implant, the surgeon will focus on avoiding injury to vital structures or adjacent teeth, maximizing bony support for the implant, engaging cortical bone for implant stability (for certain systems), and placing the implant in the ideal prosthetic position. These considerations must be factored into planning the direction of the implant placement, the chosen length and di-
ameter of implant to be used, the depth of implant placement (including whether the implant must be countersunk, for some systems), the height relative to the osseous crest and adjacent teeth, and whether or not bone grafting is to be implemented.

A position that is centered between the neighboring teeth, with note to the anatomic structures, usually best fulfills these considerations. The buccolingual orientation depends on the presence of intact bone and the ability to engage the palatal or buccal plate, while keeping in mind the desired prosthetic position of the implant. If there is a conflict between the most stable position of the implant and the desired prosthetic position, then the surgeon must refer to the range of alternative acceptable positions. Some surgeons will intentionally engage the floor of the maxillary sinus or nasal cavity, but care must be taken not to perforate these vital structures because the predictability of osseointegration will be diminished. The vertical position of the implant will depend on the desired emergence profile of the final crown. It has been recommended that the implant be placed 3 to 4 mm apical to the neighboring cementoenamel junction. If minimal resorption of the osseous crest has occurred, the crest may require some resection to create the required space for countersinking the implant to the suggested depth. Any resection should be postponed until the implant is uncovered to prevent excessive resorption of the crest and subsequent exposure of the implant surface. A wider implant diameter or narrower diameter of the tooth to be replaced can reduce the amount of countersinking needed to account for proper emergence profile.

The indications for osseous grafting include augmentation of the ridge for implant stability or esthetic concerns. Bone grafting may be performed, in some instances, 3 to 6 months before implant placement. In selective cases, osseous grafting can be performed at the time of implant placement. If minor bone modification is needed, the osteotome can help stretch the existing bone. While ridge augmentation procedures have been employed for several years, the predictability of crestal augmentation in the coronal direction is questionable.

OSTEODISTRACTION AND BONE GRAFTING

According to Samchukov et al, “Most significant new ideas, concepts, or products go through a four-stage evolution in their infancy. They are initially rejected by almost all potential users who claim that it cannot be done or it is too much trouble. Shortly thereafter, it is accepted by a few; the vast majority, however, contend that it is just not there yet or maybe later. After a period of time, most people adopt the new technique, and begin to question why their colleagues are not using it. Finally, after years of clinical and experimental documentation, it becomes the standard of care—the technique by which all others are compared.”

Osteodistraction has many clinical applications and facilitates different treatment modalities in a more conservative and predictable manner. As distractors become smaller and more efficient, distraction osteogenesis is becoming a viable technique to build up bone in a vertical direction. However, guided tissue regeneration techniques have improved the predictability for increasing the ridge thickness, especially in smaller areas. Sinus lift procedures are currently being performed with a high degree of predictability and are enabling treatment options that once were not imaginable. It is important to remember that smoking has been shown to increase the rate of dental implant failure.

Presently, the choice of osseous grafting materials includes autologous bone, freeze-dried bone allograft, demineralized freeze-dried bone allograft, resorbable bone substitutes, and nonresorbable bone alloplast. Allografts can be placed into fresh extraction sites and then covered with membranes for guided tissue regeneration to preserve ridge height prior to the implant placement. Researchers do not agree on the ideal grafting material to be used around en-
Bone Grafting

Fig 7a The patient was unhappy with the Maryland bridge because of the need to floss laterally with a threader. The patient was not interested in correcting the malposition of the canine with orthodontics.

Fig 7b The maxillary lateral incisor was congenitally missing. Note the loss of the buccal plate, complicating ideal implant placement. A bone graft was required.

Fig 7c Final implant-supported crown.

Fig 7d Lingual view of the final crown with a horizontal screw, which improves the lingual contour and ease of retrievability. (Prosthetics by Sergio Rubinstein, DDS; laboratory work by Masayuki Hoshi, RDT.)

dosseous implants. Many clinicians prefer de-mineralized freeze-dried bone allografts in the treatment of infrabony periodontal defects. However, this grafting material appears to be subject to rapid resorption when used in sites not rich in mesenchymal cells; therefore, the use of rich plasma cells mixed with autogenous bone is increasing in popularity. In time researchers will be able to evaluate its long-term stability. While bone growth into grafted sites has been reported, a fibrous connective tissue around grafted hydroxyapatite has also been documented. If grafted sites are infected, there may be a chance for the infection to disseminate. Autogenous bone is widely used, but volume may be limited by available donor sites. A variety of materials have been used with implant placement, but they appear to be most predictable when used with membranes for guided tissue regeneration.
TOOTH EXTRACTION WITH IMMEDIATE IMPLANT PLACEMENT

Implants can be placed into fresh extraction sites when adequate bone exists to immobilize the implant; this generally requires that about 40% of the implant be embedded in firm bone tissue. Some benefits are improved preservation of alveolar bone and decreased treatment time. Implants should not be placed into sites where there is inadequate bone to stabilize the implant; to do so will risk micromovement of the implant and interfere with the tissue’s ability to integrate around the implant. Implants should also not be placed into sites with a remaining infection associated with a diseased tooth. This would interfere with tissue healing, risking dissemination of the infection as well as implant failure.

For placement of an implant into a fresh extraction site, the implant site should be prepared beyond the apex of the extraction site and quite often along an axis not parallel to the long axis of the extracted tooth (Figs 8a to 8f). The coronal aspect of the implant will be either partially or completely exposed without direct contact to the socket walls. Therefore, the cells of the bone tissue must travel a significant distance to reach the implant surface and mature into a supporting tissue. This is in contrast to the surgical principles described in which a tight bone fit was considered critical for osseointegration to occur. To encourage bone fill of the remaining socket space, steps must be taken to prevent the gingival flap from contributing to the healing of this potential space.

One way to reduce the distance the bone cells must travel is to place an implant that resembles the anatomy of the extraction site, either conical or cylindrical in shape. The implant will thus fill more of the socket or be slightly larger to engage healthy bone for its stability.

A bone graft will act as scaffolding for the bone-forming cells to travel and reach the implant surface. Graft materials also support the flap and may act as a barrier to the soft tissue. Expanded polytetrafluoroethylene membranes used for guided tissue regeneration also support the overlying flap and thereby preserve the space to be occupied by bone.

One- and Two-Stage Surgery

In selective cases, second-stage surgery is not needed when a taller healing cap is placed, thus preventing the soft tissue from covering the implant. Such cases will depend on ease of the surgical technique, occlusion, oral hygiene, and the patient’s ability to follow postoperative instructions.

For other cases second-stage surgery is required. The time allotted for the primary healing period depends on the site of implant placement, the quality of bone, whether bone grafting has been performed, or whether the implant has been placed into a fresh extraction site. Generally, this ranges from 2 months to 8 months. At the time of implant uncovering osseointegration must be verified by radiographic and clinical means.

Implant Uncovery

The desired esthetic result will influence soft tissue management during all surgical phases as well as during implant uncovering (see Figs 3g to 3j). Posterior implants are frequently uncovered by use of linear incisions or a circular tissue punch. Anterior procedures should focus on the preservation of keratinized tissue, color match of the gingiva, and the ultimate height of the soft tissue facial and interproximal to the implant. The need for a wide zone of keratinized tissue around implants has been argued for some time. While many agree that minimal to no attached tissue is necessary to maintain peri-implant health, esthetics demands a healthy, wide zone of gingival tissue around natural teeth and implants. If an inadequate zone of tissue exists prior to implant placement, soft tissue grafting can be performed prior to placement of the implant. However, either pedicle flaps or connective tissue grafts are preferred because these procedures tend to provide the best color match of grafts to the recipient tissues.
Immediate Implant Placement

Fig 8a  Healing cap over the implant. The tooth was lost as a result of vertical fracture, and a fixed provisional was not used. Note the loss of the papillae.

Fig 8b  Tissue healing around the implant. (Surgery by Kenneth H. Peskin, DDS.)

Fig 8c  Radiograph showing impression post-implant transition. Note the bone loss around the neck of the implant subsequent to a previous infection.

Fig 8d  Angled, screw-retained abutment with perforation to accept a lingual screw.

Fig 8e  Buccal view of the final crown.

Fig 8f  Lingual view of the final crown with the lingual screw parallel to the axis of the implant. (Prosthetics by Sergio Rubinstein, DDS; laboratory work by Masayuki Hoshi, RDT.)

Follow-up care should include suture removal if a flap was raised, plaque control, and evaluation of healing prior to initiation of prosthetic procedures. Oral hygiene with a soft brushing technique begins when the healing cap is exposed into the oral cavity and will continue throughout treatment until after the implant-supported crown is in place. Oral rinses for plaque control have been shown to pro-
mote healing in the early postoperative period; indefinite use of chlorhexidine is typically prescribed as part of the oral hygiene regimen for implants. A 3-month maintenance program has been shown to effectively maintain peri-implant health. The surgeon’s responsibility for the health of the implant does not end with second-stage surgery, but joins with the patient’s and the restorative dentist’s efforts for a long-term successful result.

**PROSTHODONTIC ALTERNATIVES**

For many clinicians, fabrication of an implant-supported crown as either a screw-retained or cemented restoration is a personal preference. Each technique has its advantages and disadvantages. The screw-retained restoration allows more simple retrieval if any modifications, repairs, or alterations to the existing tooth contours or adjacent teeth are needed. While traditionally the screw will be in a vertical direction along the axis of the implant, a horizontal or transversal placement of the screw in the lingual surface of an anterior restoration will allow for better lingual anatomy on its lingual surface along with the improved esthetics (see Fig 7d).

Another option is to have the abutment screw retained on the implant with the final restoration temporarily cemented to the abutment to allow for some retrievability. However, in some cases retrievability of a temporarily cemented crown can be a challenge. An additional problem can occur when the crown is permanently cemented and there is uncertainty of whether the cement has been removed entirely. Two of the most favorable advantages of the cementable crown are its similarity to conventional prosthodontics and the elimination of the screw through the crown, hence better contours and esthetics (Figs 9a to 9d).

Designs of implant restorations have evolved to accommodate the width of the different teeth they can replace, not only wider anterior teeth but also posterior teeth (Figs 10a to 10f). With the existing variations of teeth and the mesiodistal space between teeth in direct correlation to the available supporting bone, it is necessary to have implants of different diameters to solve the challenges faced in implant dentistry.
CONCLUSION

The ultimate goal of the single-tooth implant restoration is to restore the lost tooth with both optimum function and esthetics. The definitive restoration should ideally resemble the original tooth in contour and shade while both restoring and preserving the bone and soft tissues. Long-term health will only be possible if treatment is followed by a proper maintenance program.

ACKNOWLEDGMENTS

We would like to thank Dr Tatiana Quintiliano for her tireless effort in helping us prepare this article for publication.

REFERENCES


