The Shanelec SMILE Technique: Immediate Microsurgical Implant and Provisional Restoration Placement in Anterior Esthetic Sites

Leonard S. Tibbetts, J. David Cross, and Bryan S. Pearson

Contents

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L. S. Tibbetts (✉)
Private Practice, Arlington, TX, USA

J. D. Cross
Private Practice, Springfield, IL, USA

B. S. Pearson
Department of Periodontics, Louisiana State University, HSC School of Dentistry, New Orleans, LA, USA

Private Practice, Lafayette, LA, USA

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Abstract

Replacement of a tooth in the anterior esthetic zone with a lifelike implant restoration can be a significant challenge. In this chapter, a microsurgical procedure for tooth extraction, implant placement, bone grafting, a connective tissue graft, and fabrication of a tissue supporting provisional crown is detailed. The SMILE Technique, developed by Dr. Dennis Shanelec, is an exacting, predictable procedure that has been used in over 1700 cases in multiple practices with a 98.58% overall success rate. The only exclusion criterion, other than ASA type IV patients, was uncontrolled diabetes and uncontrolled periodontal diseases.

Keywords

SMILE technique · Implant microsurgery · Minimally invasive extraction · 10× magnification · Socket drilling · Properly fabricated immediate provisional crown · Advancing the flap

1 Introduction

Over 22 years ago, Dr. Dennis Shanelec pioneered and changed implant dentistry with The SMILE Technique (simplified microsurgical implant lifelike esthetics), otherwise defined as immediate microsurgical implant and provisional restoration placement in anterior esthetic sites. This microscope-based procedure for immediate implant and provisional restoration placement has established an extremely predictable technique for maintaining the highest natural esthetic standards in even the most challenging clinical cases.

The loss of a tooth in the anterior esthetic zone often results in enormous distress. Dental implant placement has evolved into a successful and predictable option for the edentulous and partially edentulous patient [1–6]. Periodontists have been at the forefront in the development of this important technique in the anterior esthetic zone.

The Periodontal Practice Development Network Study Club was founded in 1984 by a small group of periodontists to share knowledge and techniques developed to stay on the cutting edge of periodontics. Dr. Dennis A. Shanelec demonstrated that microsurgical periodontal plastic surgical procedures were less traumatic and more predictable than the then currently practiced periodontal plastic surgery procedures being done without magnification (macrosurgery). The surgical microscope and the microsurgical techniques developed by Dr. Shanelec allow the surgeon to develop enhanced motor skill by using a precise hand grip and a reduction in physiologic tremor. Microsurgical procedures are less invasive, have diminished morbidity, and result in rapid healing [5, 7, 8].

Esthetics is a key marketing area in dentistry. It is understandable that patients often have a significant fear of losing a front tooth and how it is to be replaced [9]. In the past, the gold standard for replacing a missing incisor or cuspid had been a fixed partial denture. This was usually preceded by the patient wearing a removable temporary partial denture, often referred to as a "flipper," which is descriptive of its

inherent limitations. Restoring the appearance of normal anatomy in the anterior esthetic zone following tooth loss is often compromised by the collapse of adjacent papillae, resorption of the buccal alveolar bone, and recession of the buccal marginal gingival. Another complication often seen with the use of a fixed partial denture for replacement of a missing tooth in the esthetic zone is that preparation of abutment teeth for use with a fixed partial denture often results in irreversible trauma to the pulp that necessitates root canal therapy.

In both medicine and dentistry, the use of microsurgery has resulted in the development of minimally invasive techniques that replaced procedures that produced more surgical trauma [7, 10–12]. By applying the principles of microsurgical techniques described in the literature, significant improvements in periodontal and implant surgical procedures are possible. As an example, the application of microsurgical principles to surgical tooth extraction can result in a significant reduction in trauma to the extraction site. The increased visual acuity made possible with the microscope allows the surgeon to increase motor movement precision and to see nuances in the direction of tooth movement during luxation. These subtle motions, which are not apparent with normal macrovision, can indicate a path of least resistance for the root during extraction. This can result in less trauma to the alveolar bone, the gingiva, and the papillae [11].

All of the phases of tooth extraction, implant osteotomy and placement, bone grafting, connective tissue grafting, and fabrication of the provisional restoration are performed using the microscope at a magnification of 10× or greater [5, 7, 13]. Because of the minimized tissue trauma resulting from microsurgical techniques for tooth extraction and implant osteotomy, patients report little or no discomfort following these procedures [7, 10, 12].

Implant osteotomy done using the microscope is a unique experience for the surgeon. Because of the enhanced illumination and visual acuity, the socket walls and apex appear large and clearly visible. In the anterior maxilla, the most favorable bone for implant placement lies to the palatal and apical aspects of the socket. The osteotomy must therefore be done at an angle to the socket wall using a lateral cutting bur. Twist drills are not designed for this purpose, as they track in the direction of least bone density and into the open socket. Without using lateral cutting burs before each incremental increase in twist drill size, the implant angulation and position will invariably move toward the buccal aspect of the extraction socket. The coaxial lighting and stereoscopic magnification provided by the microscope allows precise preparation and placement of the implant in a stable and esthetic position.

2 Immediate Implant Placement in the Maxillary Anterior Area

In most cases, implants have become the best option for restoring failed maxillary and/or mandibular anterior teeth. Several factors can influence the choice when deciding between immediate versus delayed implant placement [14]. Immediate implant placement with a provisional restoration has been shown to be a predictable

procedure [9, 15–17]. The advantages of using the surgical microscope for immediate implant placement and fabrication of the provisional crown are significant and include greater precision and less trauma in tooth removal, enhanced lighting and visualization, allowing more precise osteotomy and implant placement with minimal bleeding. Using the microscope to create a provisional crown that matches the original contours of the extracted tooth allows the provisional crown to provide the correct support for the surrounding soft tissue. Such support is essential for maintaining the stability of the gingival architecture during the healing and implant osseointegration [6, 9, 13, 15, 17].

The SMILE Technique has several advantages over macrosurgical implant placement including (1) precision of the surgical procedure and enhanced motor skills; (2) minimal surgical trauma, with reduced inflammation and little to no prolonged bleeding; (3) excellent illumination of the surgical field; (4) precision of implant site preparation; (5) exactness of provisional crown design and fabrication; and (6) precise primary apposition of the connective tissue graft wound edges with an emphasis on passive primary wound closure [5].

At the present time, more than 1700 SMILE technique cases have been successfully completed and documented by Dr. Shanelec and members of Dentorati, a microsurgical study club. Of those cases, there are 18 where the implant failed to osseointegrate, and 6 cases that were lost to follow-up after implants and provisional were placed. The success of the SMILE technique is attributed to careful application of the detailed microsurgical steps described below. The goal is immediate implant and provisional implant restoration in an extraction socket with excellent esthetics and predictable dental implant osseointegration. Success is attributed to thorough, precise completion of each of the microsurgical steps associated with the technique. A level of competence through experience as a microsurgeon is required to perform the SMILE Technique.

When the implant platform is ≥5 mm below the crest of the papilla, a properly fabricated immediate provisional crown can consistently maintain the mesial and distal papillae heights. Buccal recession of approximately 1 mm will occur, however, unless a concurrent subepithelial connective tissue graft of 1.5 mm thickness is performed. Preexisting inflammation around the failing tooth has not been found to be a contraindication to treatment. However, complete debridement of the socket with the microscope at 10× magnification is required, using the protocol developed by Dr. Shanelec. Following thorough debridement of the socket it is flooded with an antibiotic (super-saturated solution of Tetracycline or Clindamycin), or sodium hypochlorite solution in order to decontaminate the site before beginning the osteotomy. A fractured or an avulsed tooth should be treated at the earliest possible time. When possible, the fractured or avulsed tooth should be retained and mimicked when the implant provisional crown is fabricated. This permits papilla regeneration by the properly supported gingiva (Table 1; Figs. 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.8, 13.9, 13.10, 13.11, 13.12, 13.13, 13.14, and 13.15).

Table 1 Microscopic esthetic zone implant placement technique sequential flowchart [5]

Step	
1	All procedures performed under the microscope at magnifications 10× to 20×
2	Take a clear silicone impression of the failing tooth to light-cure composite for the provisional (Fig. 13.1a)
3	Create a flowable composite shell crown that replicates the anatomy of the failing tooth (Fig. 13.1b, c)
4	Atraumatic extraction, NO flaps (Fig. 13.3a–b, Video 1)
5	Complete microscopic socket debridement of the lateral and apical granulation tissue (Fig. 13.3a, b, Video 2)
6	Decontamination of the socket with an antibiotic or sodium hypochlorite solution for 30 s
7	Use lateral side cutting drills to align the osteotomy to the palatal wall of the socket (Fig. 13.4, Video 3)
8	The implant is placed with the implant apex positioned palatally and the implant platform approximately 2 mm toward the labial (Fig. 13.6a–b)
9	Position the implant platform approximately 5mm below the mesial and distal papillae
10	Position the palatal aspect of the platform at the palatal bony crest of the socket (Fig. 13.6a–b)
11	Use an appropriate diameter implant 12–14 mm long
12	Use a standard internal or external hex implant platform
13	Place the implant with at least 35 Ncm torque
14	Fill the buccal socket gap with osseous allograft, xenograft, or stem cell bone graft material to the level of the implant platform (Fig. 13.6c–d, Video 4)
15	Compress the surface graft material 1–2 mm to create a finely powdered bone graft seal (Fig. 13.6c, d)
16	Mold a collagen membrane free form or use Avitene (Microfibril, Collagen Hemostat, Davol, Inc., Warwick, RI, USA) over the bone autograft (Fig. 13.6e)
17	Hollow out the shell crown from step 3 (Fig. 13.1d)
18	Lute the shell crown to the opaqued abutment in the mouth (Fig. 13.7a, b)
19	Eliminate the flash and fill the subgingival contours with flowable composite
20	Create and check the emergence profile to support but not distort the buccal tissue and the papillae
21	Take an impression of the gingival half of the provisional attached to the implant analog (Fig. 13.10)
22	Highly polish and glaze the provisional (Fig. 13.7c)
23	Cure the provisional with a high intensity xenon light to eliminate free monomer
24	Harvest a connective tissue graft from the palate and place it into a buccal envelope (Fig. 13.8a, b, Videos 5 and 6)
25	Place the connective tissue graft into the tunnel
26	After freeing the papillae, advance the flap with 6-0 polypropylene suture as needed (Fig. 13.9)
27	Fill the screw space inside the implant with metronidazole gel
28	After installing the provisional crown with the proper torque (35 Ncm) place nonsterile Teflon tape above the screw head and seal the access with composite
29	Reduce the occlusion to remove all excursive movement contacts
30	Fabrication of a custom impression coping for the restorative dentist final impression of the implant restoration, with the exact same contours as the original temporary custom composite crown (Fig. 13.11a–e)
31	Perform postoperative evaluations every 4 weeks until the final restoration is done
32	Proceed to final restoration no sooner than 3 months of healing (Fig. 13.13a–b)
33	Postoperative evaluation of the ceramic crown both clinically and radiographically at 1 month post-placement and annually thereafter (Figs. 13.13c, d and 13.14a, b)

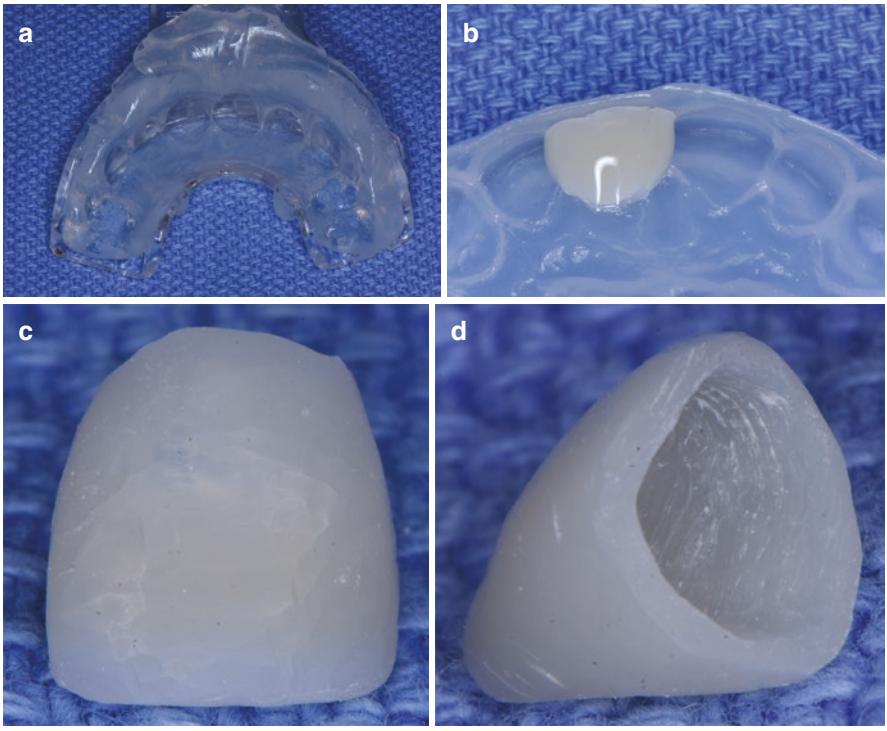

Fig. 13.1 (**a**) A clear silicone impression of the failing tooth is taken to assure duplication of the anatomy of the immediate provisional crown that is to be placed. (**b**) Impression of failing tooth is filled with flowable composite replicating the tooth anatomy and light cured. (**c**) A replicated shell crown duplicates the dento-gingival junction and the proximal contours of the extracted tooth. (**d**) Hollowed out shell crown to be joined to the opaqued impression coping attached to the implant analog

3 Case Presentation

The immediate microsurgical implant placement with implant supported provisional restorations following atraumatic extractions has been used since 2000 with a 98% success rate by clinicians competent in microsurgery.

4 Step 1: Implant Microsurgery

Cases are done using a working magnification of 10× or above for all phases of treatment. Little or no discomfort has been reported by patients following the combination of microsurgical tooth removal, precise implant placement in the socket, and seating an anatomically correct provisional restoration. The overall success rate

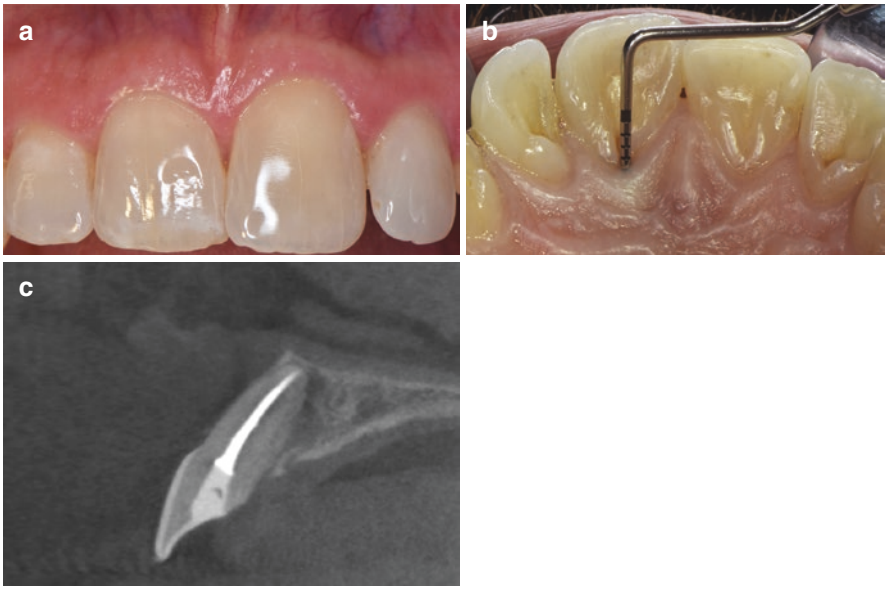

Fig. 13.2 (**a**) Failing left central incisor. (**b**) Palatal probing depth of 11 mm. (**c**) CAT scan exhibiting minimal buccal bone, with the only area of bone for implant placement apically and palatally

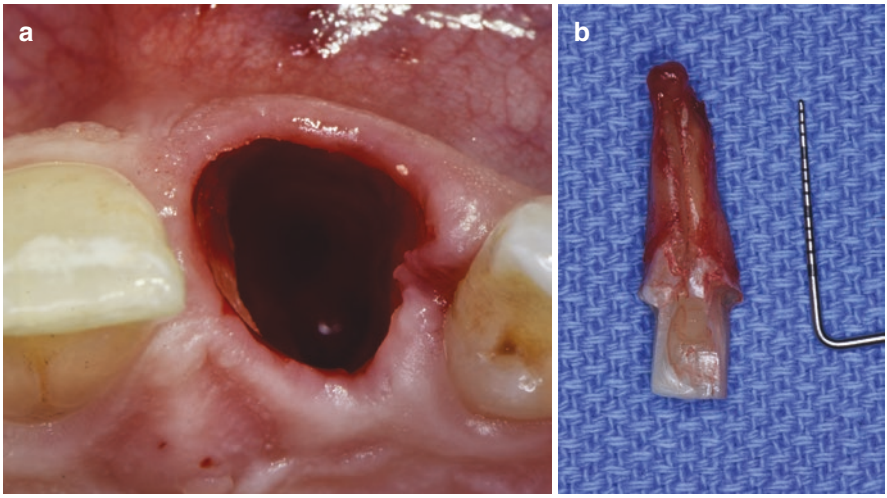

Fig. 13.3 (**a**) With enhanced visual acuity and improved surgical dexterity, the socket walls and apex appear large and clearly visible, with the gingiva and socket bone intact. (**b**) Extracted tooth with developmental root defect that contributed to probing depth

Fig. 13.4 Laterally cutting burrs for cutting into the palatal socket wall prior to using the twist drills

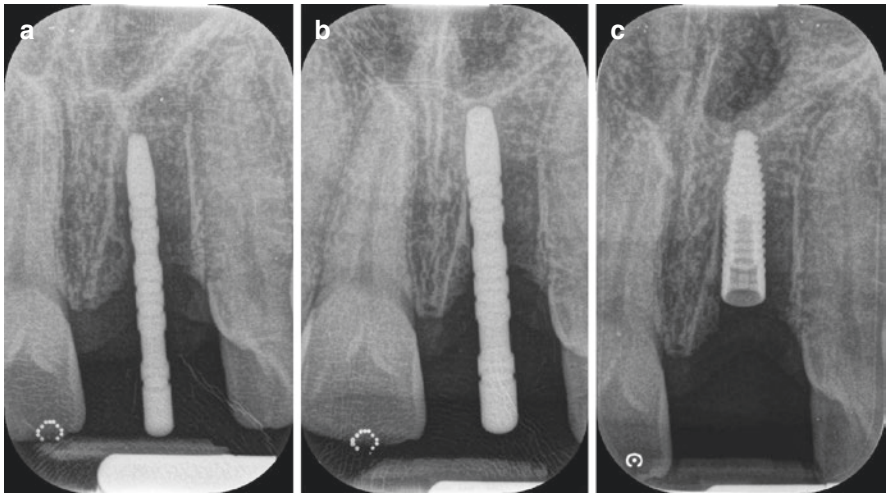

Fig. 13.5 (**a**) Palatal wall of extraction socket is drilled into with the enhanced vision to an appropriate depth, and then enlarged with twist drills. (**b**) Depth gauges are used to determine proper implant position. (**c**) Apex of tapered implant is positioned palatally, while the implant platform is positioned approximately 2mm toward the labial

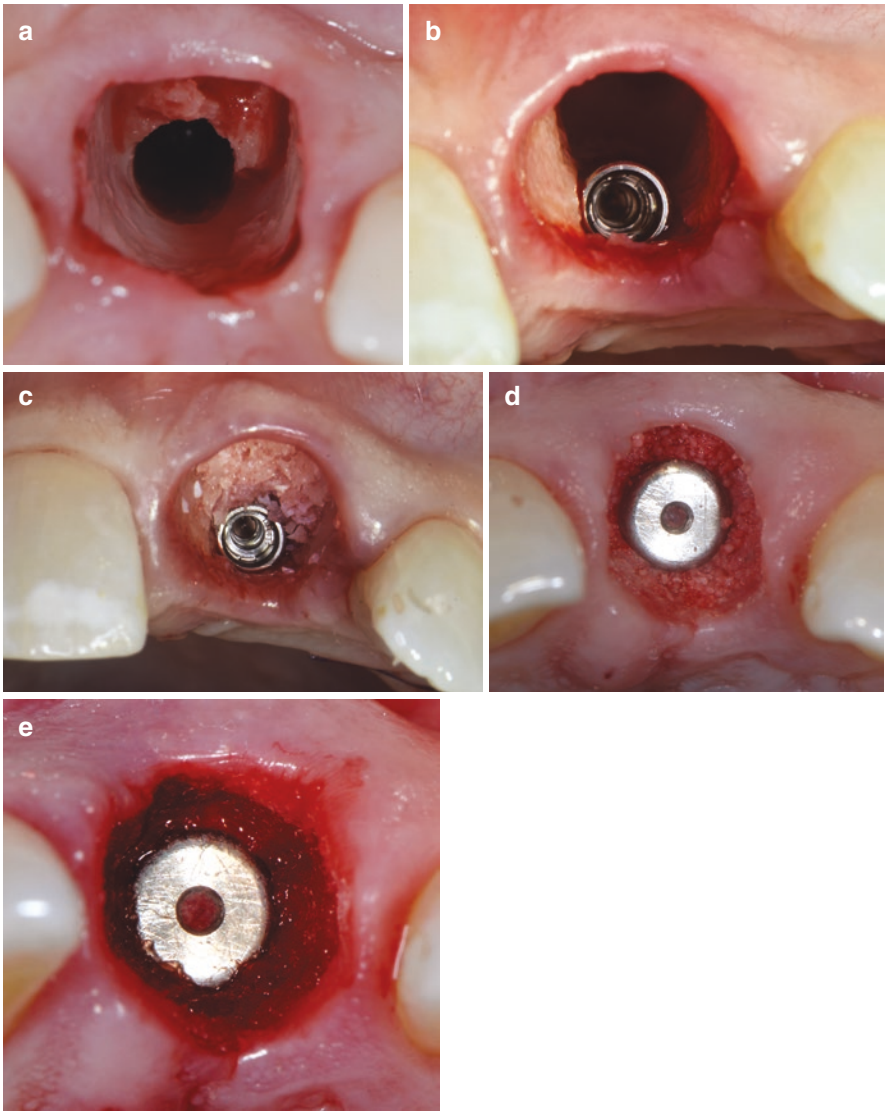

Fig. 13.6 (**a**) Osteotomy preparation for implant placement requires knowledge of both the anatomy of the maxilla and an appreciation of the cutting pattern of the drills. (**b**) Position palatal aspect of the implant platform at the palatal bony crest of the socket. (**c**) Fill the buccal socket gap with osseous allograft, xenograft, or stem cell bone graft to the level of the implant. (**d**) Compress the surface graft material 1–2 mm to create a fine powdered graft material seal. (**e**) An autograft bone graft filtered from the drilling bone dust is compressed to the platform level and covered with Avitene or a free form collagen membrane

Fig. 13.7 (**a**) Opaqued screw retained abutment attached to an implant analog. (**b**) The hollowed out shell crown is luted to the opaqued screw retained abutment with light cured composite. (**c**) Voids and rough edges are carefully eliminated. The emergence profile is created and examined so that it supports the gingiva without distortion and is polished and glazed. The free monomer is eliminated by light curing

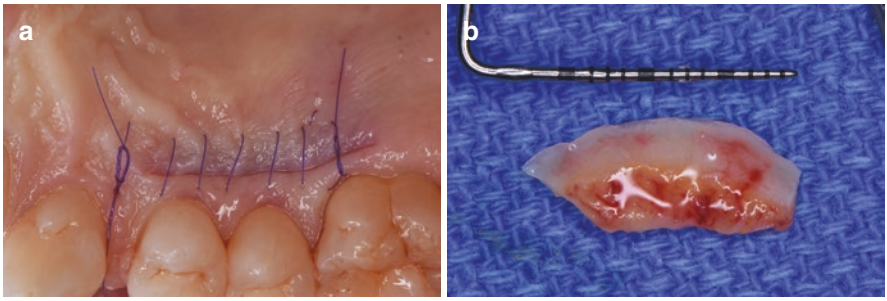

Fig. 13.8 (**a**) Sutured subepithelial connective tissue graft donor site. (**b**) A subepithelial connective tissue graft approximately 1.5 mm thick will be placed in a buccal envelope to prevent recession

Fig. 13.9 Primary passive wound closure of the connective tissue recipient site, after freeing the papillae

Fig. 13.10 Impression of the provisional crown used to fabricate the custom transfer coping

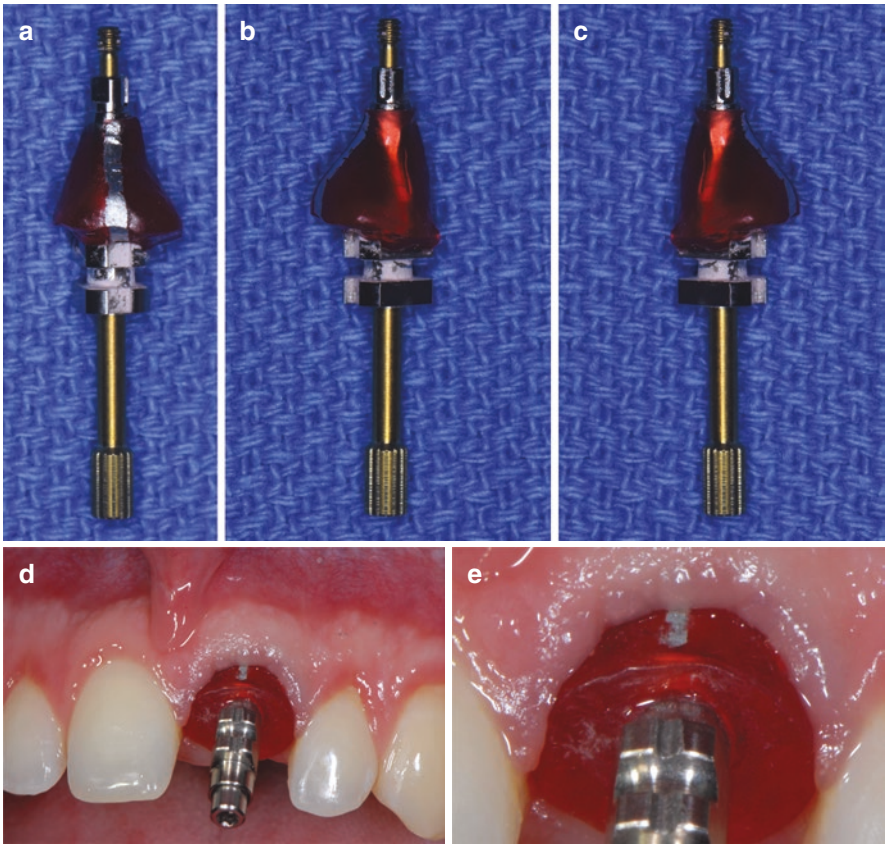

Fig. 13.11 (**a**) A custom transfer coping is made for the ceramist with a mark applied to the labial for orientation. It duplicates the natural height and contours of the gingival tissues and individually shaped to support the gingival tissue without distorting the buccal and interproximal tissues. (**b**) Distal proximal view of emergence profile. (**c**) Mesial proximal view of emergence profile. (**d**) Seated view of the custom fabricated transfer coping. (**e**) Enlarged view of transfer coping showing support of the gingiva

of the cases treated demonstrates that predictable and consistent results have been achieved with this technique for many years.

5 Steps 2, 3, 18, and 19: Preparation of Provisional Replication of the Failing Tooth

Before surgery, a clear silicone impression of the failing tooth is made to assure accurate capturing of the dento-gingival junction. A flowable light-cured composite duplication of the tooth is fabricated from the impression for the provisional fabrication, and it is trimmed to the exact location of the dento-gingival junction,

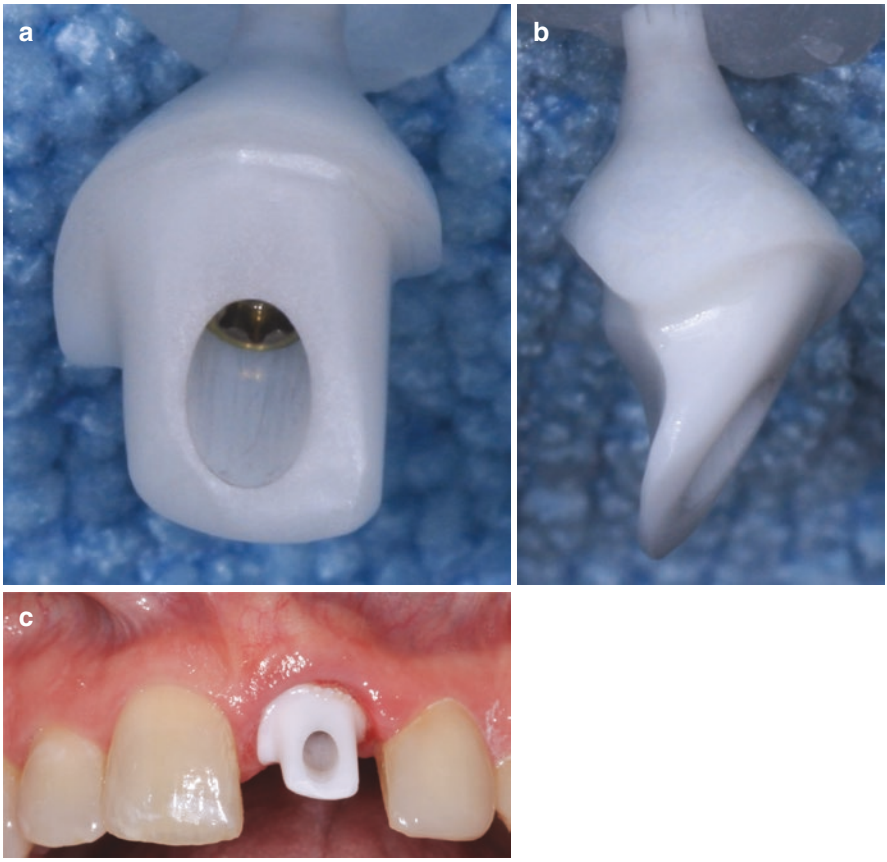

Fig. 13.12 (**a**) A zirconium abutment with the exact same contours as the impression transfer coping of the provisional emergence profile. (**b**) Mesial view of the zirconium abutment from the impression transfer coping of the provisional emergence profile. (**c**) Seated zirconium abutment with the preservation of the natural height and contour of the gingiva

establishing the emergence profile. The replicated shell crown is hollowed out to later be filled with a light-cured esthetic color-matched composite, which will be used for luting to a screw-retained temporary, opaqued titanium abutment.

6 Steps 4–6: Extraction with Minimal Trauma and Socket Debridement

With the application of enhanced visual acuity and improved surgical dexterity made possible by the microscope, gingival and osseous anatomy is preserved. Minimization of forces during the extraction protects the alveolar bone, particularly the buccal wall. Damage to the gingiva and papillae is prevented by prior atraumatic

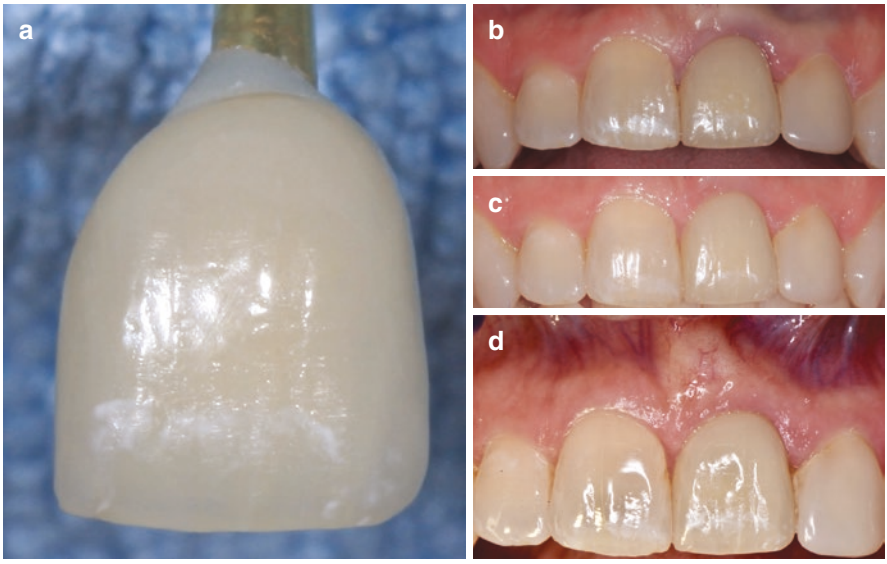

Fig. 13.13 (**a**) Final crown seated on the custom abutment. (**b**) Final restoration at the time of cementation. (**c**) Postoperative view at 24 months. (**d**) 24-month postoperative enlarged view

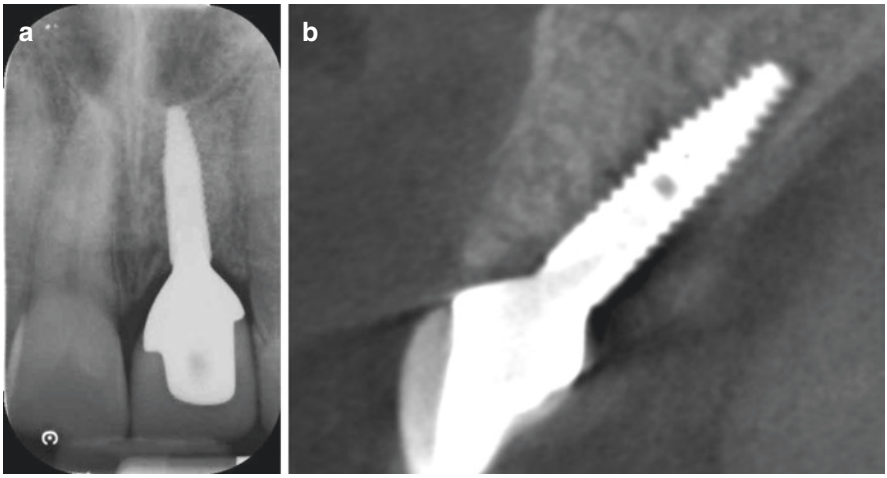

Fig. 13.14 (**a**) 24-month postoperative radiograph of implant. (**b**) 24-month CAT scan

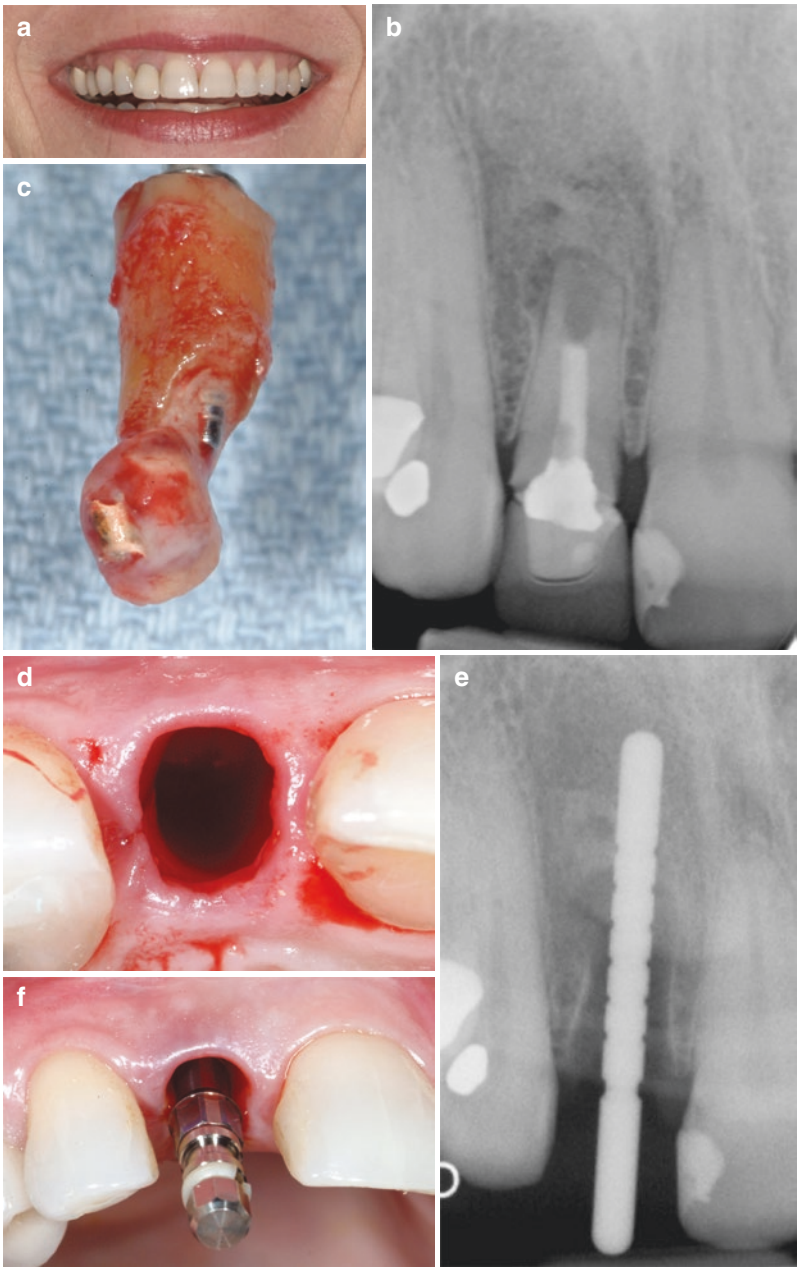

Fig. 13.15 (**a**) Preoperative view of failing maxillary right lateral incisor. (**b**) Radiograph of failing maxillary right lateral incisor. (**c**) Microsurgically assisted extracted lateral incisor. (**d**) Debrided, atraumatic extraction socket with little to no bleeding. (**e**) Depth gauge of palatally inclined implant preparation. (**f**) Implant apex positioned palatally to tip the implant platform slightly to the buccal. (**g**) Highly polished and glazed provisional crown. (**h**) Tapered implant with screw retained provisional crown prior to placement of Teflon tape and composite restoration sealing. (**i**) Final implant screw retained restoration on maxillary right lateral incisor

Fig. 13.15 (continued)

separation of papillae from the root of the tooth being extracted. Magnification allows surgeons to see subtle degrees in luxation direction that are not otherwise visualized. Following extraction, the sulcus is deepithelialized with a flame-shaped diamond, and microscopically the socket is thoroughly debrided of granulation tissue, irrigated and filled with one of several possible decontamination solutions for 30 s, such as super-saturated solutions of tetracycline, clindamycin, or a solution of sodium hypochlorite.

7 Step 7: Socket Drilling

The most favorable bone in the maxillary anterior is positioned both palatally and apically to the socket, requiring drilling in the extraction socket that is totally different than drilling in edentulous sites. Drilling must therefore be done at an angle to the socket wall using lateral cutting burrs or ultrasonics before each incremental increase in twist drill size. Twist drills are not designed to drill at an angle to the socket wall and tend to track in the direction of least dense bone. Attempting to use a twist drill for this step will generally result in directing the preparation toward the labial plate. With microscopic magnification and lighting, drilling on the lateral

socket wall can succeed in accomplishing a stable and esthetic placement for maxillary anterior implants.

8 Steps 8–13: Implant Placement

Implants can be placed with the implant apex positioned palatally and the implant platform bucally approximately 2 mm toward the labial. Implants placed into the extraction osteotomy sites have been torqued to as much as 76 Ncm, but generally are only torqued to 35 Ncm. The thread geometry of tapered implants is felt to improve implant stability without the danger of lateral bone compression. Of the implants placed using the SMILE Technique, over half have been 12 and 14 mm in length.

9 Steps 14–16: Osseous Grafting of the Buccal Socket Gap

Both allograft and xenograft have been used to fill the labial socket gap to the level of the implant platform. The surface graft material is compressed 1–2 mm to create a fine powdered allograft or xenograft seal. A layer of microfibrillar collagen is placed over the bone before the implant provisional crown is placed. In all the cases, connective tissue was harvested from the palate and placed into a split-thickness envelope recipient site prepared on the buccal aspect of the socket. This is done to preserve and restore the gingival height that would be lost as a result of injury or inflammation.

10 Steps 17–24: Implant Provisional Crown

The implant provisional crown must support the surrounding gingiva exactly like the extracted tooth to preserve natural esthetics [18]. This involves placing an opaqued titanium screw-retained temporary abutment, creating a hollowed composite shell crown from the clear silicone impression of the failing tooth. The shell crown is luted to the opaqued abutment in the mouth and the flash is eliminated using a micro-diamond bur. The subgingival profile for each patient is individually shaped at the time of surgery, with voids and rough edges eliminated and the provisional carefully contoured to support the gingival tissue. The emergence profile is created and examined so it supports the gingiva without distorting the buccal and interproximal tissues. The provisional crown is polished and glazed as a final step. To eliminate free monomer that may be present to irritate the soft tissue or bone, a light-cured composite is used. An impression of the gingival one-half of the provisional crown attached to an implant analog is made before the crown is attached to the implant. This is used to fabricate a custom impression transfer coping. The possibility of the provisional crown loosening is reduced by the precise attachment of the machined titanium provisional abutment. Of the 1700 successful cases less than 1% of the provisional crowns have had the screw loosen.

11 Steps 25 and 27: Advancing the Flap

After placing the subepithelial connective tissue graft into the buccal envelope, the papillae are freed with a microsurgical knife, and the flap is advanced with 6-0 polypropylene suture as needed.

12 Steps 26, 28, 29, 30, 31: Provisional Restoration Seating, Adjusting Occlusion, Postoperative Care

To avoid premature loading of the screw retained provisional crown the occlusion is removed, and lateral contacts with adjacent teeth are adjusted to assure minimal, symmetrical, light proximal contacts. The screw threads are coated with metronidazole gel, and the provisional crown is positioned with the proper torque. Nonsterile Teflon tape is placed above the screw head, and the access is sealed with composite. By doing so, patients leave the office with a non-loaded esthetic provisional tooth securely anchored to the implant. Postoperative evaluations are performed at 4-week intervals.

13 Step 32: Final Restoration

Patients are never without a natural looking tooth when an immediate provisional crown with an exact emergence profile is placed at the time of the implant placement. The provisional crown ensures that the gingiva is supported during implant osseointegration. The exact emergence profile of the provisional crown is transmitted to the ceramist by using the custom impression transfer coping created from the provisional crown [19–21]. From the model made from the impression, a computer scan is used to create the permanent zirconium ceramic abutment exactly matching both the provisional emergence profile and the original tooth shape. A final restoration is fabricated and placed after 12–24 weeks [5].

14 Step 33: Postoperative CAT Scan

Creating a tooth in a natural harmony with the adjacent teeth is possible by combining the skills of a team comprised of a competent microsurgeon, a restorative dentist, and a ceramist.

15 Clinical Results and Discussion

Using the SMILE Technique for cases done in private practice settings in California, Texas, Louisiana, New York, and Illinois, over 1700 cases have been completed involving the extraction of maxillary central incisors, lateral incisors, or cuspids.

The long-term success rate over a period of 1–18 years is 98.58%. No exclusion criteria were used for the cases other than ASA type IV patients, uncontrolled diabetes and uncontrolled periodontal diseases. Patient scheduling and restorative logistics usually determined the delivery of the final restoration at about 12–24 weeks following implant placement.

Treatment success criteria included: (1) the absence of infection, mobility, pain, inflammation, or bleeding upon probing; (2) the ability to withstand rotational torque of >35 Ncm at the time of permanent abutment placement; (3) a peri-implant tissue sulcus <1 mm apical to the implant platform; (4) radiographic evidence of bone to the top most implant thread; (5) restoration of the implant that remains in function; and (6) a satisfactory objective esthetic outcome for both the patient and the provider.

Once a level of competence is achieved in microsurgical procedures, implant microsurgery offers the opportunity for implant therapy that can preserve or enhance the esthetic results.

Rapid healing, minimal discomfort, superior esthetics, and improved patient acceptance are the benefits of this technique. As use of the surgical microscope increases, the advantages of its use in many phases of dentistry will become more obvious. Use of microscopy has the potential to clinically advance dentistry in many areas. While the technique described is multifaceted requiring multiple steps for successful completion, the clinical outcome is outstanding. Successful treatment requires microscope magnification, attention to detail, and a combination of thorough microsurgical and restorative skills.

16 Key Points

1. The SMILE Technique developed by Dr. Dennis Shanelec has been shown to be a predictable, successful implant procedure with a 98.58% success rate.
2. The SMILE Technique consists of 5 microsurgical procedures including a connective tissue graft, atraumatic tooth removal, precise implant placement, bone graft, and fabrication of a screw retained custom composite temporary crown, all performed using a surgical operating microscope.
3. Due the complexity of each individual procedure, a moderate to advanced level of microsurgical experience is required.
4. The proper incorporation of each of the steps is critical to the long-term success of the procedure.
5. A highly polished, properly contoured screw retained composite temporary restoration is required to achieve ideal esthetics through precise tissue support.

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