

10

Key Words: immediate dental implant placement, CAD/CAM-fabricated surgical guides, dental extraction techniques, provisional implant restorations, crown contours

Introduction

The successful placement of an immediate implant and its provisional restoration requires the confluence of many clinical variables and treatment steps. It is critical to understand which of these factors can be controlled and which cannot. Done successfully, an immediate implant and provisional provides a valuable treatment option for patients, who appreciate the reduced treatment time and the enhanced esthetic outcomes.^{1,2} Our challenge is to provide this service without compromising the long-term result. This article summarizes the 10 key steps in delivering this service.

KEY STEPS in Immediate Implant Placement

Delivering a Screw-Retained Provisional

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Figure 1a: Preoperative clinical presentation of nonrestorable tooth #8.



Figure 1b: CBCT tangential image of immediate implant site with simulation of implant and generic abutment placement.

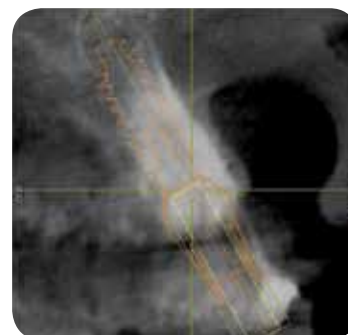


Figure 1c: CBCT cross-sectional view demonstrating the implant and abutment simulations. By using a cotton roll placed in the labial vestibule during the scan process, this image helps to determine the thickness of the labial plate and the overlying soft tissues.

Step 1: Arrive at a Proper Diagnosis

The use of a preoperative cone beam computed tomography (CBCT) scan for immediate implant placement is becoming the norm. The use of CBCT does not ensure a successful outcome; rather, it helps to prevent long-term failures.^{3,4} This scan will help determine if sufficient thickness of the labial plate is present, and the location of the incisive foramen. Placement of the implant with a deficient labial plate or into the incisive foramen will most likely result in fixture failure (**Figs 1a & 1b**).

Enhanced visualization of the gingival tissue thickness and labial plate dimensions can be easily achieved by placing a cotton roll in the vestibule adjacent to the proposed surgery site. The cotton roll creates space and prevents shadowing from the soft tissue of the lip (**Fig 1c**).

From the CBCT image it is also possible to plan the placement of the implant and the approximate abutment size.

2

Step 2: Fabricate the Diagnosis Wax-Up, Matrix, and Eggshell

Fabricate a diagnostic wax-up (**Fig 2a**). Pay attention not only to the esthetics of the provisional restoration, but also to those of the lingual and incisal contours and lengths. For the first three months, this restoration will need to be out of any occlusal contact. Plan out the protrusive and lateral-protrusive movements.

A methyl methacrylate or Radica (Dentsply Prosthetics; York, PA) "eggshell" provisional is fabricated from a silicone putty. This matrix will be used later to help orient and index the eggshell over the temporary abutment (**Fig 2b**). Sandblast the inside of the eggshell.



Figure 2a: Diagnostic wax-up.



Figure 2b: Silicone matrix with eggshell provisional restoration.

Done successfully, an immediate implant and provisional provides a valuable treatment option for patients.

3

Step 3: Preserve the Labial Plate During Extraction

The term *atraumatic extraction* is a misnomer. All extractions are traumatic to the bone and periodontal ligament (PDL). Minimizing outward expansion of the thin labial plate conceptually should decrease postoperative bone resorption. Start by gently tapping a thin surgical blade (Beaver-Visitec; Waltham, MA) into the PDL space with a mallet in the interproximal and palatal areas only. A 6900 Beaver blade is used to begin the PDL separation (**Fig 3a**). Removal of the root is best achieved by applying only forces that are either rotational or coronal in direction. Apply rotation forces in a counter clock-wise direction using narrow beak forceps (Karl Schumacher; Southampton, PA). Extraction appliances (e.g., Benex [Meisinger; Centennial, CO]; or Sopian [Sopian Research; Fort Worth, TX]) direct force coronally and are used when there is not enough remaining tooth structure for forceps. The Sopian system uses a large serrated post that is threaded in the canal system of the tooth (**Fig 3b**). The fulcrum tray and pry bar allow for a coronally directed force vector and subsequent removal of the intact root (**Figs 3c & 3d**).

Placement of a slowly resorbing particulate bone graft between the implant and the socket is suggested. Depending upon the tissue biotype, a subepithelial connective tissue graft may also be required.



Figure 3b: Insertion of threaded extraction post.



Figure 3c: The fulcrum tray and pry bar. An apically directed force is applied to the pry bar, resulting in the threaded extraction post and root being pulled in almost a purely coronal direction. This force minimizes the trauma to the thin labial plate.



Figure 3a: Tapping of a blade into the PDL space with a surgical mallet. The blade acts as a periosteal and facilitates rotational movement of the root within the alveolus when forceps are used.



Figure 3d: Extracted root.

Step 4: Use a Surgical Guide and Locate the Implant Precisely

The implant is ideally located slightly toward the palatal aspect of the socket, allowing for screw access palatal to the incisal edge of the provisional restoration. Establishing the correct osteotomy direction is often difficult as the pilot burs will tend to migrate to the apex of the socket. Side-cutting Lindemann burs (Salvin Dental Specialties; Charlotte, NC) can help to establish the correct osteotomy pathway. In this case, a higher level of control was gained by using a CAD/CAM-fabricated guide (SiCAT, Sirona Dental; Charlotte, NC). Using this type of guide, it is possible to correlate the bone geometries with the prosthetic simulation. These guides precisely orient the osteotomy drills using a series of sleeves matched to the diameter of the drill (Figs 4a-4c).

The coronal aspect of the socket is usually scalloped with the height of the interproximal bone 2 to 3 mm more coronal than the labial aspect. If the implant is placed too deeply, the provisional restoration's subcrestal contours will be difficult to shape, may impinge upon the bone within the socket, and lead to long-term bone loss. If the implant is not placed deeply enough, the lack of vertical height will result in contours that have an extreme horizontal component, and it will be difficult to create an esthetically acceptable result.

4



Figure 4b: Guide with the interchangeable sleeves. The sleeves are matched to the diameter of the osteotomy burs.



Figure 4a: Fabricated surgical guide. This guide transfers the information from the CBCT implant placement simulation to the mouth.



Figure 4c: Guide with implant driver and implant. This guide facilitates precise positioning of the implant according to the computer simulation.

5

Step 5: Fabricate the Temporary Abutment Cylinder

Try in an indexed screw-retained abutment cylinder. Mark the ideal length and lingual contour on the abutment. Unscrew the abutment and place it on an implant analog. Adjust with a high-speed bur as necessary, but do not do this in the mouth. Retry the abutment in the mouth to verify the correct position. If satisfied, remove the abutment from the mouth and sandblast the retentive portion of the abutment with aluminum oxide, leaving the apical portion smooth and highly polished (Fig 5). Hand torque the abutment into place and take a radiograph to verify the abutment has completely seated. Make sure the abutment is not impinging on the interproximal bone.



Figure 5: Sandblasted temporary abutment cylinder.

Remember that the interproximal surfaces will most likely be subcrestal and these contours should be slightly concave.

6

Step 6: Trim the Matrix and Adapt the Eggshell

Trim the buccal aspect of the matrix in a horizontal direction, removing the labial gingival and middle thirds. The remaining matrix will support and orient the eggshell on its palatal and incisal aspects. Cut an oval-shaped access hole in the palatal aspect of the eggshell (**Fig 6a**). Take the wooden dowel portion of a cotton-tip applicator and break it in half. Lubricate the dowel and insert it into the screw access chamber of the abutment (**Fig 6b**). Make any adjustments necessary to ensure that the access hole does not bind on the dowel. On the palatal aspect of the matrix, cut a 3-mm wide channel that runs from the palatal edge of the matrix to the incisal edge of tooth. Reposition the eggshell within the matrix. Position the matrix with the eggshell over the dowel and gently seat it on the gingival tissues. Verify the fit (**Fig 6c**).

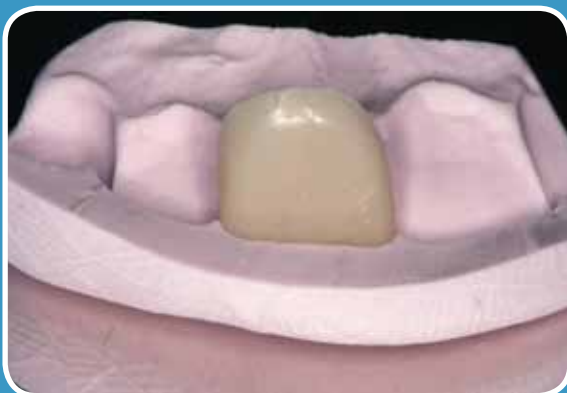


Figure 6a: Trimmed silicone matrix with eggshell provisional. The labial aspect of the matrix is removed, leaving the incisal and palatal aspects of the matrix to stabilize the eggshell provisional.



Figure 6b: Insertion of a lubricated wooden dowel into oval-shaped access hole of the egg-shaped provisional restoration.



Figure 6c: Lingual aspect of silicone matrix with palatal channel. The silicone matrix is trimmed on the palatal aspect to allow the direct visualization of the access hole and dowel.

7

Step 7: Bond the Abutment Cylinder to the Eggshell

Remove the abutment from the mouth and coat the retentive portion with an adhesive (OptiBond XTR, Kerr; Orange, CA), being careful to not get any resin on the apical polished end (Fig 7a). Likewise, coat the inside of the eggshell with the resin and light cure (Fig 7b). Reposition the eggshell within the matrix. Replace the cylinder with hand torque only. Insert the lubricated wooden dowel. Add a moderate amount of a flowable composite (Revolution Formula 2, Kerr) to the labial aspect of the inside of the eggshell and also to the labial aspect of the abutment cylinder (Fig 7c). Position the matrix and eggshell into the mouth and verify that the eggshell is seated fully into the matrix (Fig 7d). Light cure the labial aspect for 20 seconds, tacking the eggshell to the cylinder. Remove the dowel and gently remove the matrix by lifting the incisal edge first. Check the positioning of the provisional and light cure for another 20 seconds. With a pencil, mark the location of the gingival margin on the labial and palatal aspects.



Figure 7b: Application of adhesive to inside of the eggshell provisional.



Figure 7c: Placement of small amount of flowable resin to the labial aspect of the temporary abutment cylinder.



Figure 7a: Application of adhesive to the temporary abutment cylinder.



Figure 7d: Positioning of the silicone matrix with eggshell. The matrix aligns the eggshell provisional over the abutment cylinder. The flowable composite is light cured through the eggshell, bonding it to the temporary abutment cylinder.

8

Step 8: Fill in the Subgingival Contours

Unscrew the abutment from the implant and place an unflaired healing abutment while fabricating the provisional. The eggshell will be attached to the abutment cylinder in just one spot (**Fig 8a**).

Place the abutment on an implant analog and re-insert the lubricated dowel. Visualize the coronal emergence profile and subcrestal profile of the tooth being replaced. Add flowable composite in 1- to 2-mm increments. Remember that the interproximal surfaces will most likely be subcrestal and these contours should be slightly concave. If these surfaces are angular, they could impinge on the bone and prevent complete seating of the abutment. Apical to the interproximal tooth contacts, the surface contour should be concave, providing for a volume of soft tissue that will later comprise the papillae (**Fig 8b**).

The labial contour should follow that of the contralateral tooth. Just apical to the free gingival margin, the contour should be slightly convex without blanching of the tissue. This area then smoothly tapers toward the implant-abutment interface with a concave contour (**Fig 8c**).



Figure 8a: Initial bonding of the eggshell to the temporary abutment cylinder.



Figure 8b: Interproximal subgingival contour of the provisional restoration. The subgingival interproximal contour is concave and not flat. The proper shape will keep the provisional from binding on the bone and promote the maintenance of the gingival papillary tissues.



Figure 8c: Labial contour of the provisional restoration. The subgingival labial contour is convex apical to the free gingival margin and concave coronal above it.

Step 9: Check the Fit and Occlusion

Remove the healing abutment. Insert the crown abutment and check the interproximal contacts. If the contacts are too tight, complete seating of the crown will not occur. A greater concern with too-tight contacts is when the screw is tightened and the crown becomes "wedged" between the adjacent teeth, forcing the implant out of the osteotomy. Confirm the fit with a radiograph (**Fig 9**).

The percentage of bone contact to the implant surface in immediately placed implants will actually decrease over the first eight weeks of healing and then gradually increase thereafter.⁵ Protection of the restoration from any occlusal loading during this period is very important. Check the centric, protrusive, lateral-protrusive and cross-over occlusal positions.

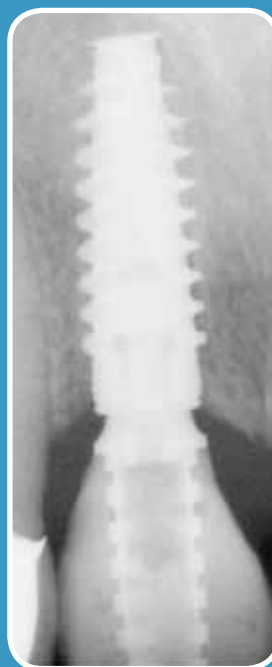


Figure 9: Radiographic confirmation of proper seating of the provisional restoration.

9

10

Step 10: Polish and Seat

Remove the provisional restoration and highly polish or add a glaze if desired. Insert the provisional and apply only a hand-torque force to secure the restoration (**Fig 10**). Place a sponge in the access hole and cover with resin adhesive and a flowable composite. Confirm the occlusion again. The occlusion should be checked frequently for the first three months, as supraeruption of the occlusal antagonist can occur.

This provisional restoration will function as a template for the final restoration. Adjustments to the provisional contours and contacts that will affect the gingival shape can be worked out in this early phase of treatment. Fabrication of the final restoration will be more predictable and the long-term result more stable.



Figure 10: Finished immediate provisional implant restoration at time of insertion.

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