

Basic Implant Surgical Procedures

Preparation for implant surgery requires a thorough review of the patient's chart, including medical and dental histories, operatory notes, radiographs, anticipated implant sizes and locations, surgical guides, surgical sequencing and strategy, possible complications, patient management, anesthesia, operating time, instrumentation, postoperative management, and restorative plan. Antibiotics are often given prophylactically before surgery (2 g amoxicillin 1 hour preoperatively or, in patients unable to take oral medications, cefazolin 1 g or ampicillin 2 g intramuscularly or intravenously 1 hour before the dental procedure are effective. Alternative medications include 600 mg of clindamycin orally or intravenously) but are usually not required in the postoperative period..

In many cases, the implants can be placed using local anesthetic block or infiltration techniques. However, in more complex and lengthy procedures, some type of sedation or general anesthesia may be preferred. Local anesthetics containing vasoconstrictors are usually used for hemostasis. Additional long-acting anesthetics for postoperative pain control may be warranted. It is imperative to have good access to the operative site via effective retraction of cheeks and the tongue. A mouth prop is invaluable.

Pre-rinsing with chlorhexidine gluconate for 1 to 2 minutes immediately before the procedure will aid in reducing the bacterial load present around the surgical site.

Patients with good plaque control and appropriate occlusal forces have demonstrated that root form, endosseous dental implants show little change in bone height around the implant over years of function. After initial bone remodeling in the first year (1 to 1.5 mm of resorption described as normal remodeling around an externally hexed implant), the bone level around healthy functioning implants remains stable for many years afterward. The average annual crestal bone loss after the first year in function is expected to be 0.1 mm or less (predictable tooth replacement).

Implant must be placed in healthy bone with good primary stability to achieve osseointegration. Compact bone offers a much greater surface area for bone-to-implant contact than cancellous bone. Areas of the jaw exhibiting thin layers of

cortical bone and large cancellous spaces, such as the posterior maxilla, have lower success rates than areas of dense bone. The best results are achieved when the bone-to-implant contact is intimate at the time of implant placement.

One-Stage versus Two-Stage Implant Placement Surgery

Currently, most threaded endosseous implants can be placed using either a one-stage (nonsubmerged) or a two-stage (submerged) protocol. In the one-stage approach, the implant or the abutment emerges through the mucoperiosteum/gingival tissue at the time of implant placement, whereas in the two-stage approach, the top of the implant and cover screw are completely covered with the flap closure. Implants are allowed to heal, without loading or micromovement, for a period to allow for osseointegration. In two-stage implant surgery, the implant must be surgically exposed following a healing period. Some implants, referred to as tissue level; specifically designed with the coronal portion of the implant positioned above the crest of bone and extending through the gingival tissues at the time of placement in a one-stage protocol. Other implant systems, referred to as —bone level; designed to be placed at the level of bone and require a healing abutment to be attached to the implant at the time of placement to be used in a one-stage approach.

A one-stage surgical approach simplifies the procedure because a second-stage exposure surgery is not necessary. The two-stage, submerged approach is advantageous for situations that require simultaneous bone augmentation procedures at the time of implant placement because membranes can be submerged, which will minimize postoperative exposure. Mucogingival tissues can be augmented if desired at the second-stage surgery in a two-stage protocol or as part of the one-stage protocol.

Implant Site Exposure

Exposure of the implant site can be accomplished in several ways, including flapless surgery or with tissue elevation (flap) that may include sulcular, midcrestal, and vertical releasing incisions. Flapless surgery may be indicated when there is adequate keratinized tissue over an ideal ridge form. This creates the least soft tissue trauma and may provide the best postoperative esthetics in patients with excellent presurgical anatomy and papilla shape. In flapless surgery, the

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implant and the healing or provisional restoration are placed in a single stage.

When a flap is required, the incision should be designed to allow convenient retraction of soft tissue for unimpeded access for implant placement. This is usually necessary when better access and visualization of the underlying bone is necessary and when additional procedures such as bone or soft tissue grafting are done at the time of implant placement.

- Midcrestal incision: The incision should be made through the keratinized tissue, being sure to place the blade up against the mesial-distal surfaces of the teeth adjacent to the edentulous space. In areas with a narrow zone of keratinized tissue, the incision can be made slightly to the palatal or buccal aspect to allow for keratinized tissue transfer to the buccal or facial aspect and better soft tissue closure. If sulcular incisions are necessary, great care is taken to follow the contour of the sulcus so as not to damage the soft tissue architecture.
- Vertical releasing incision: Using a sharp no. 15 blade, a curvilinear, beveled (~45 degrees), papilla sparing incision should be made to reduce or eliminate incision scarring. It must be ensured that the vertical releasing incision is extended apically enough to allow complete release of the flap.

Implant Placement

Flap Reflection

- Reflection at the papilla is initiated with a periosteal elevator, using gentle, well-directed, controlled pressure. The periosteal elevator's edge can be used in a light (painting) strokes to cleanly release the subperiosteal fibers (flap is developed from the papilla up along the vertical release).
- The dissection is then directed along the sulcular tissue to the point where it meets the crestal portion of the incision. The index finger of the opposing hand supporting the facial aspect of the ridge allows greater control and protection of the flap during reflection.
- The reflection is continued by the elevation sulcularly to the distal extent of the incision.
- Once the buccal flap is reflected, the palatal or lingual flap can be reflected

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enough to visualize the width of the ridge. Any soft tissue tags should be carefully removed.

- When the buccal flap has been reflected completely, a retractor can be positioned against the bone inside the flap. This allows good visualization of the operative site while protecting the integrity of the flap. It is extremely important to avoid trauma to the flap with the tip of the retractors.

Preparing the Osteotomy

The surgeon must confirm that the drill is spinning in the forward mode when using the drilling micromotor (speed set as recommended by the manufacturer of the implant system).

- All drills should be copiously irrigated internally, externally, or both.
- The depth indicator markings on the precision and pilot drills should be reviewed.
- The entry point and its ideal angulation should be determined with the **precision drill** (surgical guide facilitate orientation).
- Drilling with the precision drill is done at full speed to a depth of 1 to 2 mm short of the depth of the intended implant (e.g., 8 mm deep for a 10-mm implant).
- The area is irrigated, and the 2-mm **pilot drill** is used at full speed to the intended depth (e.g., 10 mm deep for a 10-mm implant).
- The area is rinsed, and **guide pin** corresponding to the size of planned implant is placed to evaluate osteotomy position, spacing, angulation and line-up against the opposing dentition.
- The tip of the narrowest **twist drill** is placed into the pilot hole, and the drill is run at full speed in a gentle pumping motion. It may be necessary to remove the drill and clean the accumulated bone off the drill. The drill is again run at full speed and taken to the final depth of the intended implant. The site is sequentially prepared in this manner.
- The osteotomy is rinsed, and the appropriate guide pin is placed to **reevaluate** position and alignment.
- The tip of **final twist drill** is placed into the opening of the osteotomy. Great care

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is taken to achieve perfect position and angulation, as this is the drill that finalizes the osteotomy→ run at full speed in a gentle pumping motion to the final depth of the intended implant.

- The osteotomy is then **inspected** with a thin instrument for possible bone perforation (e.g., sinus communication or buccal wall perforation).
- Immediately after completing the osteotomy, the **speed** of the motor is **changed** to the desired and/or recommended torque, measured in newton centimeters (Ncm—typically around 30 Ncm) for the insertion of the implant. If the implant is put in at the original setting of 800 to 1500 rpm, the osteotomy could easily be damaged, the implant seated too deep, or primary stability lost.

Inserting Implant

- The implant is opened and placed on the driver that has been inserted into the handpiece. The handpiece must be held such that the tip of the implant is pointing up (lessen the likelihood of the implant falling off the driver).
- The tip of the implant is inserted into the osteotomy, and driven into place by keeping light pressure in an apical direction until the implant is almost completely seated or until the motor torques out (approximately 1 to 2 mm short of complete seating).
- Using the hand torque wrench, the surgeon continues to seat the implant, using the torque lever of the wrench to quantify the amount of torque present. If the torque exceeds the lever, the implant is hand torqued to its final position by using the handle of the torque wrench.
- The seating of the implant is finalized by verifying that the platform is even with the mesial and distal heights of bone.
- The area is irrigated thoroughly.
- An implant with a torque value of 35 Ncm or greater is considered to have good primary stability, and single-stage healing is possible. If so, an appropriate-sized healing abutment is placed. If a two-stage process is required, then an appropriate-sized cover screw is placed.

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- The abutment should protrude 1 to 2 mm through the tissue. The intended tissue emergence of the planned restoration helps determine whether the healing abutment is tapered or parallel.
- The healing abutment is placed onto the insertion wrench, again by holding the screw pointing up. The abutment is screwed into the implant and tightened with finger pressure, making sure that no tissue is caught under the abutment.

Suturing Flap

- The flap is sutured using some type of resorbable suture (chromic gut or Vicryl) or nonresorbable suture (proline).
- The anterior papilla is secured first. The buccal aspect of the papilla is entered with the suture needle, which is passed through the embrasure to engage the palatal tissue. The needle is then positioned lower on the palatal tissue and penetrated and brought through the embrasure to the buccal and the papilla engaged apically to the first entry point.
- The vertical release is then sutured, followed by the mesial and distal sides of the abutment. These are simple interrupted sutures tied in the same fashion as the first suture described.

Postoperative Management

A radiograph should be taken postoperatively to evaluate the position of the implant in relation to adjacent structures such as the sinus and the inferior alveolar canal and relative to teeth and other implants and to verify the complete seating of the cover screw or healing abutment.

Patients should be given mild to moderate strength analgesics. Patients may also be instructed to use 0.12% chlorhexidine gluconate rinses for 2 weeks after surgery to help keep bacterial populations at a minimum during healing. The patient is evaluated weekly until soft tissue wound healing is complete (approximately 2 to 3 weeks). If the patient wears a tissue-borne denture over the area of implant placement, the denture can be relined with a soft liner after 1 week. Interim partial dentures or orthodontic retainers with an attached pontic may be worn immediately but must be contoured to avoid soft tissue loading over the implant site.

Uncovering

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The healing time or the length of time necessary to achieve osseointegration varies from site to site and from patient to patient. Insertion torque values, quality of bone, bone grafts, patient health, location, number of implants, and soft tissue health all have an impact on healing time. Typical healing times are 4 to 6 months. In single-stage surgery, no surgical uncovering is necessary.

In a two-stage system, the implant must be surgically uncovered and a healing abutment placed. The goals of surgical uncovering are to attach the healing abutment to the implant, preserve keratinized tissue, and modify the form or thickness of tissue. A soft tissue healing period after uncovering must be allowed before restoration of the implant can take place, typically 2 to 4 weeks.

The simplest method of surgical uncovering is the **tissue punch**. This method of uncovering utilizes a soft tissue punch equal to or slightly larger than the diameter of the implant placed. The implant is palpated through the tissue to determine its location. The **tissue punch** is placed directly over the implant circumference and twisted through the soft tissue thickness, taking care not to damage the bone at the level of the implant platform. The punch is then removed, along with a precisely determined piece of tissue that was lying directly above the implant, exposing the implant cover screw. The cover screw is then removed, and an appropriate sized and appropriate-shaped healing abutment is placed. The advantage to this technique is that it is less traumatic, no periosteum needs to be reflected, and only a short soft tissue healing time is required. This technique does, however, require an adequate zone of keratinized tissue so that the implant can be accurately located. Disadvantages to this technique include sacrifice of a portion of the keratinized tissue, inability to visualize the bone surrounding the implant, and the inability to directly visualize the precise abutment–implant interface.

If the implants cannot be accurately located, if the clinician needs to visualize underlying bone, or if a slight keratinized tissue transfer is indicated, then a crestal incision with the creation of a slight soft tissue flap is required to uncover the implants. If an adequate zone of keratinized tissue is present, the soft tissue flap can be contoured with a scalpel, scissors, or a punch to conform to the shape of the healing abutment. This allows for a nicely shaped and contoured soft tissue cuff around the healing abutment and eventually the final implant restoration. Obvious advantages to this technique include easy access, minimal invasiveness, and ability

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to directly visualize the bone surrounding the implant and to precisely fit the healing abutment to the implant platform. The disadvantage to reflecting a flap during uncovering is the possibility of bone loss due to stripping the periosteum from bone during the uncovering. Advanced techniques for cases with an inadequate zone of attached tissue include tissue transfer procedures, tissue grafting, and split-thickness apically repositioned flaps.

Implant Stability

Initial implant stability is one of the most important predictors of long-term implant success. This depends on the depth and density of bone, implant size, and precision of the surgical technique. A good sense of implant stability can be obtained during the seating process and by verifying adequate torque resistance capability of the seated implant.

Radiofrequency analysis has been used to measure and verify implant stability. This technology involves attaching a transducer to an implant and applying a steady-state resonance frequency to the implant. The advantage of this technology is that it is not dependent on measuring implant movement in just one direction but rather by evaluating the complete bone-implant interface.

Complications

Implant placement surgery can be performed with great accuracy and with little complication if the case has been diagnosed, planned, and surgically performed well. However, as with any surgical or clinical procedures, complications are possible and include the following:

- Complications that can occur with any surgical procedure, including pain, bleeding, swelling, or infection.
- A positioning error resulting in implants placed at a compromised angulation or position. The implant may be placed too close to an adjacent tooth root or too far to the mesial, distal, or buccal aspect, thus compromising bony support. The implant can be placed too far into bone, making prosthetic access difficult. If the implant is not placed deep enough into bone, leaving threads of the implant body above the osseous crest, there will be compromised bony support, soft tissue health, hygiene, and esthetics.

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- Surgical technique complications such as a tear of the soft tissue flap, poor closure of the incision, or excessive soft tissue trauma from retraction may result in tissue dehiscence, infection, and eventual loss of the implant. Poor attention to detail in preparation of the osteotomy such as overdrilling the diameter of the osteotomy could result in poor prognosis for integration.
- Invasion of critical anatomic structures can create more serious complications. If the implant invades or impinges on the canal of the IAN, this may result in paresthesia (altered sensation that the patient does not find painful, e.g., numbness, tingling), or dysesthesia (altered sensation that the patient finds painful or uncomfortable). If the implant invades the maxillary sinus or the nasal cavity, this may result in an infection. Bone structure compromise can present as overthinning of the buccal or facial plate or dehiscence or fenestration of overlying tissue. Bone perforation can occur at the inferior border of the mandible because of inaccurate drilling depth or on the lingual aspect of the posterior mandible because of the lingual undercut from poor positioning or angulation of the implant drills.
- Mechanical complications can present as an implant platform fracture because of excessive insertion torque. If the osteotomy is improperly prepared in dense bone, it is possible to get the implant —stuck in bone, short of complete seating, making it extremely difficult to retrieve the implant.
- Incision line opening can occur from inadequate suturing or not having tension-free closure.
- Esthetic complications can occur from poor implant positioning or angulation, making proper prosthetic restoration unrealistic.

Implant Components

❖ Implant Body or Fixture

The implant body, or fixture, is the implant component placed within bone during the first stage of surgery. Most contemporary implant fixtures are referred to as root form implants, taking the form of a cylinder or a tapered cylinder, and are made of titanium or titanium alloy. Most current implant fixtures have an external threaded design. A wide variety of external thread designs and different surface

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textures and coatings that attempt to maximize implant stability and the process of osseointegration. Most implant fixtures incorporate an antirotational design feature (located internally or externally to the implant platform) at the interface of the adjoining prosthetic components.

❖ Cover or Healing Screw

After placement of the implant fixture in a two-stage surgical approach, prior to suturing, the implant fixture is sealed at its platform with a low profile, intra-implant cover screw. It is important that the surgeon be sure that the cover screw is fully seated on the implant platform prior to suturing the flap to prevent bone from growing between the screw and the implant. In the second-stage the cover screw is removed and replaced with a healing abutment.

❖ Healing or Interim Abutment

Dome-shaped intra-implant screws that provide permucosal access to the implant platform. Healing abutments are placed at the completion of the implant placement surgery in a one-stage surgical approach or after uncovering in a two-stage surgical approach. Healing abutments are made of titanium or titanium alloy. The abutments can be parallel walled or tapered and range in height from 2 to 10 mm.. The healing abutment should project 1 to 2 mm superior to the height of the gingival tissue. A tapered healing abutment is used to help shape soft tissue to a more appropriate emergence for the planned restoration (e.g., a crown). A parallel-walled abutment would be used where the tapered emergence is not necessary (e.g., a retentive bar for an overdenture).

❖ Impression Coping

Impression copings facilitate transfer of the intraoral location of the implant to the same position on the laboratory cast. Impression copings can be either screwed into the implant body or screwed or snapped onto an implant abutment.

Typically, the impression transfer can be either closed-tray transfer or open-tray transfer. The closed-tray technique captures the index of the impression coping, and after the impression is removed from the mouth, the impression coping is unscrewed from the implant and placed along with an implant analog back into the impression. An open-tray transfer uses a specific impression coping that is

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designed to emerge through the impression tray. When the impression is ready to be removed from the mouth, the impression coping is unscrewed and pulled out in the impression. The open-tray method is considered the more accurate transfer method and is indicated when large-span frameworks or bar structures are planned or when the implants are too divergent to easily remove the impression tray in the closed-tray technique. A heavier-bodied polyvinyl siloxane or polyether impression material is recommended. Radiograph is taken to confirm that the impression coping is accurately seated on the implant platform. On completion of the transfer impression, an implant analog is screwed onto the impression coping to allow the fabrication of a laboratory cast.

❖ Implant Analog or Replica

It replicate exactly the top of the implant fixture (fixture analog) or abutment (abutment analog) in the laboratory cast. Both are screwed directly into the impression coping. The impression coping or analog component is then placed back into the impression (closed-tray transfer) or is maintained in the impression (open-tray transfer), and the impression is ready to be poured. It is tremendously beneficial to create a soft tissue mouldage in the impression prior to pouring.

The **soft tissue mouldage** is an elastomeric product that simulates the soft tissue portion on the dental cast. This allows the laboratory technician to have an accurate and flexible representation of soft tissue.

❖ Implant Abutment

The abutment is the portion of the implant that supports or retains a prosthesis or implant superstructure. A superstructure is defined as a metal or zirconia framework that attaches to either the implant platform or the implant abutment(s) and provides retention for a removable prosthesis (e.g., a cast or milled bar retaining an overdenture with attachments) or the framework for a fixed prosthesis. Abutments are described by the method in which the prosthesis or superstructure is retained to the abutment. Abutments can be divided into three main categories: (1) screw-retained abutment uses a screw to retain the prosthesis or superstructure, whereas a (2) cement-retained abutment uses cement to retain the prosthesis or superstructure. A (3) prefabricated attachment abutment (e.g., locator or O-ring attachments) helps retain a removable prosthesis.

❖ Prosthesis Retaining Screw

Prosthesis retaining screws are intended to attach prosthetic abutments, screw-retained crowns, or frameworks to the implant fixture or implant abutment. The screws are generally made of titanium, titanium alloy, or gold alloy and are sized specific to the type, size, and design of the implant or abutment system. The screws typically have a hex or square design to accept a specific size and shape of wrench or driver. Most prosthesis screws are tightened to specific tolerance by a torque wrench or handpiece. The torque value is measured in newton centimeters and typically ranges from 10 to 40 Ncm.

Defining implant outcomes

Some implant outcomes are reported as the presence or absence of the implant at the time of the last examination, regardless of whether the implant was functional, suffered from bone loss, or had other problems. This type of assessment is a measure of **implant survival** and should not be confused with implant success.

Implant success (evaluate the condition and function). Criteria for implant success have not been used consistently. Classically success defined as an implant with no pain, no mobility, no radiolucent peri-implant areas, and less than 0.2 mm of bone loss annually after the first year of loading. Implants that are osseointegrated but not functional are referred to as **sleepers** and should not be considered successful.

Aesthetic Results and Patient Satisfaction

The goal of treatment is to achieve natural-appearing, optimally functioning, implant-supported tooth replacements. Proper tooth dimensions and contours, and ideal soft tissue support are key factors for successful aesthetic outcomes. For some patients, such as those with severe alveolar deficiency, an ideal aesthetic outcome may be impossible because reconstructive surgical procedures are complex, require extensive time, and remain unpredictable. For others, a less-than ideal aesthetic outcome may be acceptable.

Aesthetic problems and dissatisfaction happen when results do not match a patient's expectations. The risk of failure is greater among those with high aesthetic demands and risk factors such as a high smile line, thin periodontal soft tissues, or compromised bone support.